

MONITORING REPORT

PUBLICATION DATE 14.10.2020

VERSION v. 1.1

RELATED SUPPORT – TEMPLATE GUIDE Monitoring Report v. 1.1

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Key Project Information

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KEY PROJECT INFORMATION

GS ID (s) of Project (s)	GS7527
Title of the project (s) covered by monitoring report	İzmir Ödemiş Biogas Power Plant
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	07
Version number of the monitoring report	10
Completion date of the monitoring report	21/11/2024
Date of project design certification	30/12/2021
Date of Last Annual Report	22/12/2023
Monitoring period number	01
Duration of this monitoring period	The 1 st monitoring period from 01/01/2020 to 31/12/2022 (first and last days included)
Project Representative	Bio Solutions ARF Yenilenebilir Enerji Üretim Anonim Şirketi
Host Country	Ödemiş/İzmir – Turkey
Activity Requirements applied	☐ Community Services Activities ☒ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Methodology (ies) applied and version number	UNFCCC/CDM – Approved baseline and monitoring methodology AM0073 – “GHG emission reductions through multi-site manure collection and treatment in a central plant”, Version 1.0
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved		Units/ Products
SDG 13: Climate Action	Emission reductions	536,703		tCO ₂ e
SDG 8: Decent Work and Economic Growth	The number of males and females employed by the project	2020	31 employees	Number
		2021	27 employees	
		2022	29 employees	
	the Average monthly salary	1,950-6,680 TL		Turkish Liras
	Trainings	63 trainings		Numbers
SDG 7: Affordable and Clean Energy	Quantity of net electricity generation supplied by the project to the grid	49,083.512		MWh

Table 2 – Product Vintages

SDG 7 Affordable and Clean Energy		Amount Achieved
Start Dates	End Dates	Quantity of net electricity generation supplied by the project to the grid (MWh)
01/01/2020	31/12/2020	13,303.14
01/01/2021	31/12/2021	18,769.352
01/01/2022	31/12/2022	17,011.02

SDG 8 Decent Work and Economic Growth		Amount Achieved		
Start Dates	End Dates	The number of males and females employed by the project	Average monthly earnings of employees	Trainings
01/01/2020	31/12/2020	31 jobs created including 26 males and 5 females	3,065 TL/person, the salary for men	32 trainings

			and women was the same.	
01/01/2021	31/12/2021	27 jobs created including 23 males and 4 females	3,530 TL/person, the salary for men and women was the same.	20 trainings
01/01/2022	31/12/2022	29 jobs created including 23 males and 6 females	6,680 TL/person, the salary for men and women was the same.	11 trainings

SDG 13 Climate Action		Amount Achieved
Start Dates	End Dates	GHG emission reductions (tCO ₂ e)
01/01/2020	31/12/2020	169,956
01/01/2021	31/12/2021	188,914
01/01/2022	31/12/2022	177,833

SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

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The proposed project activity is a biogas-to-energy project that will generate renewable energy by capturing biogas from cattle manure -via anaerobic digestion- and utilising it to produce thermal and electric energy through cogeneration systems. The project is being implemented by ARF Yenilenebilir Enerji Üretim Anonim Şirketi in Ödemiş district, İzmir province, in Turkey.

The cattle manure generated at the site is a major environmental, economic and legal problem for its members, as well as for the local people living around the site. The proposed project activity whose main feedstock is cattle manure generated at farms of the Cooperative's members, provides an environmentally friendly solution to this manure management problem.

Manure generated by approximately over 36,327 cattle living at around 123 neighbouring farms is 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 planned project, biodegradation of organic wastes coming to the Biogas Plant in anaerobic environment is taking place. The biogas that is released during the biodegradation of organic wastes is used for electricity and heat production in biogas unit.

The project activity has total number of five biogas engines installed at the biogas power plant, with the net capacity of 0.600x1 MWe and 1.067x4 MWe. Accordingly, the biogas system installed has been designed with a total power of 4.868 MWe. 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.

The project has obtained the approval of Environmental Impact Assessment (EIA) issued by the Ministry of Environment and Urbanization in Turkey on May 11th, 2017 and the Electricity Generation License (EGL) issued by the Energy Market Regulatory Authority (EMRA) in Turkey on September 20th, 2018. The project has begun to generate electricity and fed directly into the Turkish national grid on October 26th, 2018, which is regarded as the project's implementation date.

In the baseline scenario, the common practice for the cattle farm owners to manage the manure generated at their farms is to have uncovered anaerobic lagoons/ponds. The project, whose primary feedstock will be cattle manure generated at farms in Ödemiş, provides an environmentally friendly solution to this manure management problem. The baseline scenario for the proposed project activity is grid connected electricity generation in the Turkey Power Grid, which is identical to the scenario existing prior to the start of implementation of the proposed project activity. The proposed project activity will displace electricity generation in the baseline.

A.2. Location of project

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The project is located Bozcayaka Mevkii, 104 Ada-3 No'lu Parsel, 105 Ada-4 No'lu Parsel, 110 Ada-2 No'lu Parsel, ÖDEMiŞ District, İZMiR Province, TURKEY

LATITUDE: "38.135748"

LONGITUDE: "27.975186"



Figure 1. The Geographic Location of the project



Figure 2. ARF Project site. Source: Google Earth



Figure 3. ARF Project Site

The precise location of the farms where the project activity takes place have been given below.

Table 2. Coordinates of Farms

Number	Name of the Farm	Latitude	Longitude	Distance to Biogas Plant (km)	Lagoon Depth (meters)	Retention Time (months)
1	ABDULLAH ÖZTÜRK ÇİFTLİĞİ	38.192212	28.033953	11.5	2	3-6
2	ADAŞ EMLAK	38.198937	27.970945	11.2	5	3-6
3	ADEM ÇAKIR - HASAN ÇAKIR	38.145672	28.143722	22.7	3	3-6
4	ADEM UĞUR ÇİFTLİĞİ	38.13568	27.940170	4.2	3	3-6
5	AHMET YAĞCI	38.110922	27.875407	11.5	3	3-6
6	AHMET HAMDİ SAYGIN	38.205727	27.925237	15	6	3-6
7	ALFEMO	38.217615	27.600299	38.7	4	3-6
8	ALİ BALCI	38.212054	27.637579	38.7	3	3-6

9	ALİ KURBANCI	38.207070	27.820190	23.5	3	3-6
10	ALPER ERKİN	38.112430	27.475660	31.1	3	3-6
11	ANIL ZEYBEK	38.137610	28.154850	22.7	3	3-6
12	ARİF UZBASAN ÇİFTLİĞİ	38.199890	27.949474	11.5	2	3-6
13	ARİF ÜLTECİEL ÇİFTLİĞİ	38.216642	27.980719	12.2	2	3-6
14	ARİF YURDAŞAN	38.205484	27.983389	11.5	1.5	3-6
15	ARMUTLU ÇİFTLİĞİ	38.180923	28.006859	12.2	2	3-6
16	ARNAVUT HÜZEYİN	38.152419	28.004086	4.7	2.5	3-6
17	AYKANLAR ÇİFTLİĞİ	38.243468	27.629526	38.7	2	3-6
18	AYTEKİN KARADAĞ	38.131494	28.072559	38.7	3	3-6
19	BALATACI MEHMET	38.212646	27.951611	12.2	2	3-6
20	BARIŞ BURGAZLIOĞLU	38.215617	27.930958	11.5	2	3-6
21	BEYTULLAH UÇAR ÇİFTLİĞİ	38.181458	27.993470	12.2	2	3-6
22	BÜLENT IRAK	38.10491	28.018200	6.9	6	3-6
23	CAFER HAKANOĞLU ÇİFTLİĞİ	38.22603	28.009960	13.7	2	3-6
24	CAN-HAKKI ZÜLAN ÇİFTLİĞİ	38.22328	27.990490	11.5	2.5	3-6
25	COŞKUN DEMİR	38.247754	27.966515	38.7	3	3-6
26	ÇELİKKALELİ	38.105000	28.018410	6.9	2	3-6
27	CELEP HÜSNÜ	38.219933	27.946693	11.5	3.5	3-6
28	CESUR ERDOĞAN	38.105346	28.020887	6.9	2,5	3-6
29	ÇİÇEKÇİ NAZMİ	38.170173	27.9504830	11.2	3	3-6
30	DEĞİRMENCİ ÇİFTLİĞİ	38.100579	28.204188	22.7	2	3-6
31	DENİZ OKUROĞLU ÇİFTLİĞİ	38.254277	28.015926	38.7	2	3-6
32	DOKTOR RIZA KARGIN ÇİFTLİĞİ	38.100059	27.701756	23.3	2	3-6
33	EKBER AYDEMİR	38.110980	27.61778	37.1	2	3-6
34	ELEKTRİKÇİ SAMİ ÇİFTLİĞİ	38.119050	28.014661	3.9	2.5	3-6
35	EMİN KARAOĞLAN	38.139500	28.015800	6.9	3.5	3-6
36	EMİN SARI ÇİFTLİĞİ	38.09027	27.740030	23.3	3	3-6

37	ERAY YILMAZ LAZ ÇİFTLİĞİ	38.097059	27.715883	23.3	3	3-6
38	ERCAN TEKELİ	38.147913	27.967247	2.3	2	3-6
39	ERGÜN ÇAKIR	38.216600	27.907160	17.2	2	3-6
40	ERKOÇ ÇİFTLİĞİ	38.119057	28.012034	6.9	4	3-6
41	ERSOY EDİZ	38.125576	28.051879	6.9	4	3-6
42	ESKİCİ ÇİFTLİĞİ	38.149457	27.956550	2.3	1.5	3-6
43	FAHRETTİN DADAL ÇİFTLİĞİ	38.215884	27.981321	11.5	2	3-6
44	FARUK ERDİŞ	38.153894	27.999358	4.7	2	3-6
45	FATİH-HASAN KIRLIER	38.220664	28.004995	11.5	2	3-6
46	GALERİCİ ASİL ÇİFTLİĞİ	38.220684	27.952918	11.5	3	3-6
47	GÖKHAN ÖZEN ÇİFTLİĞİ	38.112560	27.475760	31.6	5	3-6
48	GÜLCÜOĞLU ÇİFTLİĞİ	38.107700	27.471634	31.6	2	3-6
49	GÜRAL ULUSOY ÇİFTLİĞİ	38.200000	27.994396	12.2	4	3-6
50	HAKAN DÖNMEZ ÇİFTLİĞİ	38.246826	28.215926	38.7	2	3-6
51	HAKAN-İBRAHİM GÜREŞMEN	38.209772	27.979808	11.5	4.5	3-6
52	HALİT BÜYÜKKUTLU	38.112862	27.991532	4.7	5	3-6
53	HASAN PALASKA ÇİFTLİĞİ	38.221002	27.919436	17.2	2	3-6
54	HÜSEYİN-NAZMİ GÖKÇEN TARIM	38.128442	28.000132	4.7	2	3-6
55	HÜSEYİN DERELİ	38.134270	28.074830	9.6	2	3-6
56	HÜSEYİN KURT	38.119050	28.015461	3.9	1.5	3-6
57	HÜSEYİN MEYDAN ÇİFTLİĞİ	38.136810	27.939380	4.2	2	3-6
58	HÜSEYİN ÖZGÜROĞLU	38.192925	27.971489	11.5	2	3-6
59	HÜSNÜ BOYACIOĞLU ÇİFTLİĞİ	38.242830	27.950790	14.6	2	3-6
60	HÜSNÜ KULLUK	38.219933	27.946693	11.5	3	3-6
61	İBRAHİM SEVGİ ÇİFTLİĞİ	38.209502	28.023828	13.4	2	3-6

62	İRFAN AKÇA ÇİFTLİĞİ	38.201413	27.937765	11.5	3	3-6
63	İRFAN SOĞUKSU ÇİFTLİĞİ	38.203457	27.985105	11.5	3	3-6
64	İSMAİL HARMAN ÇİFTLİĞİ	38.134858	28.002416	4.7	3.5	3-6
65	KADİR ZEYBEK ÇİFTLİĞİ	38.249516	27.960004	38.7	2	3-6
66	KEPCECİ AYDIN DEVECİOĞLU ÇİFTLİĞİ	38.197362	28.044125	15.5	2	3-6
67	KORAY ERİŞ	38.092800	27.774300	23.3	2	3-6
68	KORKMAZ CAM ÇİFTLİĞİ	38.210063	27.910161	15	2	3-6
69	KÖROĞLU ÇİFTLİĞİ	38.114.698	28.009853	6.9	2	3-6
70	KÜRŞAT DİKİCİ ÇİFTLİĞİ	38.093.800	27.689300	23.3	2	3-6
71	LEVENT OKAN	38.223860	27.959590	12.2	2	3-6
72	MEHMET CINGİRT ÇİFTLİĞİ	38.232192	28.033972	16.2	3.5	3-6
73	MEHMET ÇAKIR ÇİFTLİĞİ	38.192920	27.993028	12.2	2	3-6
74	MEHMET ELMALI ÇİFTLİĞİ	38.242970	28.032960	16.2	2	3-6
75	MEHMET KARACA	38.210109	28.965648	11.5	3	3-6
76	MEHMET NİHAT KARACA ÇİFTLİĞİ	38.210195	28.965642	11.5	2	3-6
77	MEHMET ÖZER	38.182810	28.100690	18.7	3	3-6
78	MEHMET ÖZİLHAN	38.200548	28.004002	12.2	3	3-6
79	MERT MEHMET ATİK HAYVAN ÇİFTLİĞİ	38.177530	27.858890	18.6	2	3-6
80	MUHARREM-MÜNİR UYANDIRAN ÇİFTLİĞİ	38.175090	27.940055	11.2	3	3-6
81	MUSTAFA KAYA ÇİFTLİĞİ	38.202000	28.049390	15.5	4	3-6
82	MUSTAFA SERT İKİZLER GALERİ ÇİFTLİĞİ	38.212878	27.966874	11.5	4	3-6
83	MUSTAFA TÜYENE	38.218420	28.066250	17.7	3	3-6

84	MUSTAFA UYSAL KONYALI ÇİFTLİĞİ	38.112002	28.016317	6.9	3	3-6
85	MUZAFFER- MUSTAFA SOFTA ÇİFTLİĞİ	38.151605	27.963153	2.3	6	3-6
86	NALBANTÇI FERİDUN ÇİFTLİĞİ	38.116459	28.001601	4.7	3	3-6
87	NAYMAN TARIM	38.098570	27.757089	23.3	6	3-6
88	NECİP KUYUCU ÇİFTLİĞİ	38.195035	27.971447	11.2	3	3-6
89	NİYAZİ SAYAN ÇİFTLİĞİ	38.149757	27.999493	4.7	3	3-6
90	NURİ SEÇEROĞLU	38.115145	28.015383	6.9	5	3-6
91	OSMAN YAZAN DOYRANLI ÇİFTLİĞİ	38.165808	27.804561	21.4	3	3-6
92	ÖMER DEMİRCİ ÇİFTLİĞİ	38.18187	27.82353	21.4	3	3-6
93	ORHAN KEMAL AKKUŞ ÇİFTLİĞİ	38.210556	27.979704	11.5	2	3-6
94	ORHAN YÜNLÜOĞLU	38.244268	27.973936	38.7	2	3-6
95	ÖZHAN ÖZEN ÇİFTLİĞİ	38.16114	28.05183	10.5	2	3-6
96	PROKONS ÇİFTLİĞİ	38.148743	27.876568	20.6	2	3-6
97	RIFAT ERİŞ ÇİFTLİĞİ	38.221076	27.921631	17.2	1.5	3-6
98	RIFAT YERDELEN ÇİFTLİĞİ	38.188145	27.933963	15	2	3-6
99	SÜLEYMAN GACAR	38.217515	27.907768	17.2	3	3-6
100	RÜYA ÇİÇEKÇİLİK ÇİFTLİĞİ	38.21623	27.90707	4.2	3	3-6
101	SALİH ALKIŞ ÇİFTLİĞİ	38.17704	27.94300	13.4	3	3-6
102	SALİH UYAROĞLU BESİCİLİK	38.130150	28.073344	9.6	2	3-6
103	ŞAHİN BOZKAN ÇİFTLİĞİ	38.173278	28.013640	12.2	2	3-6
104	ŞENTÜRK ÇİFTLİĞİ	38.154256	27.887102	20.6	2.5	3-6
105	SALİM ÖZIRMAK	38.153926	28.001070	4.7	2.5	3-6
106	SERCAN PEŞİNCİ ÇİFTLİĞİ	38.133511	28.070520	9.6	2	3-6

107	SERKAN AKA ÇİFTLİĞİ	38.223769	27.947821	11.5	2	3-6
108	SERVİSCİ EMİN	38.222832	27.942994	11.5	2	3-6
109	ŞİRİN KASAP ÇİFTLİĞİ	38.251931	27.970040	38.7	3	3-6
110	TEYFİK KİRAZ	38.252025	28.211544	38.7	2	3-6
111	TİTAR TARIM	38.098.936	27.677.943	23.3	4	3-6
112	TURGAY KAPLANKARA	38.135492	28.075898	9.6	2	3-6
113	TURGAY UYAR	38.200509	27.977066	11.2	2	3-6
114	ULU KARTAL	38.135331	27.931843	11.5	2	3-6
115	ÜLKÜ GABAROĞLU	38.215991	27.917872	17.2	2,5	3-6
116	UĞUR NİZAMOĞLU ÇİFTLİĞİ	38.226224	27.946348	11.5	2	3-6
117	ÜZEYİR ÇAKIR ÇİFTLİĞİ	38.21399	27.65333	38.7	2	3-6
118	ÜZEYİR DUVARCI ÇİFTLİĞİ	38.26957	27.98459	17	2	3-6
119	YEDİ KARDEŞLER ÇİFTLİĞİ	38.099630	27.739732	23.3	2	3-6
120	YURDAER-TUNCER ÖZTÜRK	38.21191	28.02619	13.4	2	3-6
121	YÜKSEL ÇAKIROĞLU	38.212671	27.979266	15	1.5	3-6
122	ZAİMOĞLU ÇİFTLİĞİ	38.209391	27.918309	15	3	3-6
123	ERDAL ATASOY	38.26957	27.98459	11	3	3-6

A.3. Reference of applied methodology

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The approved methodology applied by this project is referenced as AM0073" Approved baseline and monitoring methodology – GHG emission reductions through multi-site manure collection and treatment in a central plant", Version 01¹".

Applied Tools:

¹https://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_8CTM5MFZLTD07SZK1A6D7AK3YPIG7S/EB44_repan04_AM0073_NM0239.pdf?t=NEF8cmtqcTk1fDAWoFtyxnHNDwGHp_UlqPs4

- Tool 06: "Project emissions from flaring", Version 04.0²;
- Tool 3: "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", Version 03.0³;
- Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", Version 03.0⁴;
- Tool 07 "Tool to calculate the emission factor for an electricity system", Version 07.0⁵;
- Tool 01: "Tool for the demonstration and assessment of additionality", Version 07.0.0⁶;
- Tool 27: "Methodological tool: Investment analysis", Version 12.0⁷;
- Tool 23: "Additionality of first-of-its-kind project activities", Version 03.0
- Tool 24: "Methodological tool: Common practice", Version 03.1

A.4. Crediting period of project

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Design Certification Date: 30/12/2021

Start date of crediting period: 01/01/2020

Project has been design certified on 30/12/2021. As per the GHG Emissions Reductions & Seq. Product Requirements V.2⁸ para 10.2.1 start date of the crediting period is the start date of the project operation or two years prior to the date of Project Design certification whichever is later. As in-line with the GHG Emissions Reductions & Seq. Product Requirements V.2⁸ first crediting start date is defined as 01/01/2020 to 31/12/2024 (first and last days included)

As the updated crediting period start date is more than 1 year but less than 2 years (Less than 1 year and 3 months) the below requirements have been checked according to Design Change Requirements V1.1 table 1.

- There has been no change on the project activity as described in the registered PD. All the equipments have been installed and made operational as described in the PD. Also, more conservative values have been taken; Emissions Reduction has been decreased by %75 compared to the registered PD in this monitoring report. During 1st monitoring period Total ER has been calculated as 3,732,939 tCO₂e in the registered PD where in this MR it has been calculated as 536,703 tCO₂e
- Substantive progress has been made to start the project activity as the project activity was already operational on the start date of crediting period; Due to covid spread the project has some delays in registering however, the change is to comply with the rule specified in GHG Emissions Reductions & Seq. Product Requirements V.2 para 10.2.1.

The 1st monitoring period is from 01/01/2020 to 31/12/2022(first and last days included), which belong to the first crediting period.

Expected lifetime of the project: 30 years.

² <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf>

³ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf>

⁴ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf>

⁵ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

⁶ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf>

⁷ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v12.pdf>

⁸ <https://globalgoals.goldstandard.org/501-pr-ghg-emissions-reductions-sequestration/>

SECTION B. IMPLEMENTATION OF PROJECT

B.1. Description of implemented project

>>

Within the scope of the project, the biogas plant established by using bovine (livestock and dairy cow) manure. Most of the waste to be processed in the plant will be supplied by livestock farms functioning under the organizational roof of the Ödemiş Cattle Breeders's Cooperative / Association. Animal manure will be transported by covered (closed) trucks and vacuum trucks in order not to pollute the environment, preventing pollution and odor. A transportation and expedition plan will be carried out in order to protect the environment and animal health in terms of hygiene.

Within the scope of the project, the biogas that will be released during the biodegradation of organic wastes is used for electricity and heat production in cogeneration unit. Continuously Stirred Tank Reactor (CSTR) type anaerobic digesters are used to capture methane rich biogas. Captured biogas is then utilized in cogeneration units. Waste heat from gas engine is utilized mainly for heating anaerobic fermenters. The generated electricity is not only supplied to the national grid but is also used as auxiliary/internal consumption required for the plant to function. Untreated animal manure is an important source of methane which is of the most potent Greenhouse Gases (GHGs). The project activity avoids methane emission through the methane capture and utilization processes. Furthermore, the project reduces CO₂ emissions from fossil fuel based electricity generation by supplying biogas based electricity to the national grid. Emission reductions are not claimed for heat generation and usage. The cogeneration system installed is designed with a total power of 4.868 MWe.

Table 3. Biogas Generator Technical Data

TECHNICAL DATA		
Manner of work		4 cycles
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	kgm ²	11.64
Rotation direction (from flywheel view)		Left
Radio interference level VDE 0875		N
Starter motor output	kW	13
Starter motor voltage	V	24

Manufacturer	GE Jenbacher
Model Type	JMS 320 GS-B.L JMS 312 GS-B.L

Table 4. Digesters' Technical Data

Unit	Qty	Inner Diameter	Inner Height	Upper Space	Bio Volume	Gross Volume	Conical Height	Roof Slope	Storage Period
DIGESTER	8	27 m	8 m	0.8 m	4,116.43 m ³	4,574.48 m ³	6.3 m	50°	19.3 day
POST DIGESTER	2	36 m	8 m	0.8 m	7,322.74 m ³	8,137.04 m ³	6.3 m	50°	8.95 day

Table 5. Other Technical Systems

TECHNICAL UNIT	QTY	CAPACITY	PROPERTIES
FEEDING UNIT	2 piece(s)	-	-
PREMIX UNIT	2x1 set	40 m ³ /hour	Differential Pressure: 4.0 bar Viscosity: Fluid Temperature: 40 ° C Max. Dry Matter Ratio: 15% PH Level: Neutral
PREMIX FEEDING OVERLINE SHREDDER & MAINT OVERLINE SHREDDER	2x1 piece(s)	80 m ³ /hour	Temperature: <60 ° C Dry Matter Ratio: <10% Density: 1 - 1.1 kg / dm ³ PH Level: Neutral
PREMIX FEED PUMP & MAIN LINE FEED PUMP	2x1 piece(s)	60 m ³ /hour	-
PRESSURE TRANSMITTER	2x4 piece(s)	-	Operating Range: -1 to +9 bar

X-RIPPER SHREDDER	2x1 piece(s)	5 ton/hour	Density 0.8 t / m ³ Temperature: <40 ° C PH Level: Neutral
DIGESTATE PUMP TO SUPPLY FROM POST FERMENTER	2x1 piece(s)	21-78 m ³ /hour	Temperature: <40 ° C Dry Matter Ratio: <10% Density: 1 - 1.1 kg / dm ³ PH Level: Neutral
QUICK MIXER	2x2 piece(s)	-	Motor power: 17.0 kW, 400 V, 50 Hz
SLOW MIXER FOR FERMENTER	2x8 piece(s)	-	Motor power: 7.5 kW, 400 V, 50 Hz
QUICK MIXER FOR FERMENTER	2x8 piece(s)	-	Motor power: 17.0 kW, 400 V, 50 Hz
SLOW MIXER FOR POST- FERMENTER	2x2 piece(s)	-	Motor power: 7.5 kW, 400 V, 50 Hz
QUICK MIXER FOR POST- FERMENTER	4x2 piece(s)	-	Motor power: 17.0 kW, 400 V, 50 Hz
FAST MIXER FOR FERMENTED LIQUID TANK BEFORE SEPERATOR	2 piece(s)	-	Motor power: 17.0 kW, 400 V, 50 Hz

Table 6. Flare's Technical Data

Capacity	2300 Nm ³ /h
Type	Ground Enclosed Flare
Height	7.5 m
Min Methane Ratio	35%
Temperature Transmitter	Ordel 0-1200 C N Type Termocupl
Flare Temperature	800-1200 C

The work flow chart of the Biogas Plant is given in the Figure below.

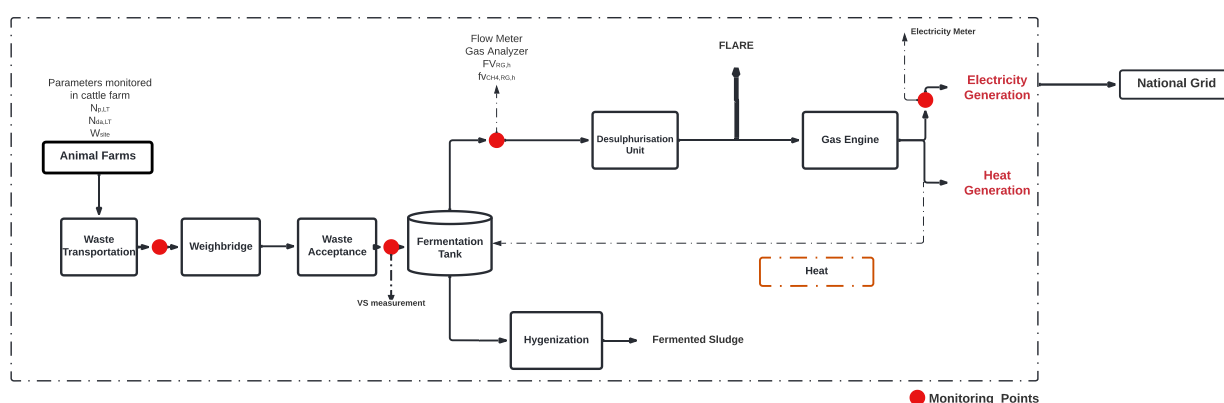


Figure 4. Flow Chart of Biogas Plant

Table 7. Milestone for implementation of the project

Time	Main actions
11/05/2017	EIA Approval by the Ministry of Environment and Urbanization in Turkey
20/09/2018	Electricity Generation License
26/10/2018	1 st Gas Engine Commissioning (1*0.600 MWe)
26/10/2018	Start date of the project, the date of starting electricity generation
08/12/2018	2 nd , 3 rd , 4 rd and 5 th Gas Engine Commissioning (4*1.067 MWe=4.268 MWe)

There are no deviations or delays compared to information in approved PDD.

During this monitoring period, there was no special event occurred, such as overhaul and downtimes of biogas digesters and power generators except the periodic maintenance activities. All the equipment operated well and no equipment was under maintenance during this monitoring period.

B.1.1. Forward Action Requests

>> As per the forward action requests during the Design Certification stage VVB was required to check for double counting at verification stage by reviewing all relevant registries that could hold RECs from the project. The list of registries examined shall be reported in the verification report.

The project activity is not registered or seeking registration under any other emissions trading program or any other mechanism that includes GHG allowance trading. So it has been also checked for double counting at the verification stage by reviewing all the relevant registries that could hold RECs from the project

Following registries have been assessed:

<https://www.climateactionreserve.org/>

<https://registry.goldstandard.org/projects?q=&page=1>

<https://iceland.itmoreregistry.net/Public/Project>

<https://biocarbonregistry.com/en/projects/>

https://projects.globalcarboncouncil.com/pages/submitted_projects

<https://registry.terra.org/app/search/VCS/All%20Projects>

The project is not registered under the international REC Mechanism e.g. I-REC Device Registry and the same is confirmed through the I-REC web site (<https://v-1.evident.app/Public/ReportDevices/>).

B.2. Post-Design Certification changes

>>

B.2.1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

>>

NA

B.2.2. Corrections

>>The project activity had planned to implement 4 biogas engines with power of 1.2 MWe each. However, due to supplier's stock lack, planned capacity has been achieved by other engines. At the moment, the project activity has total number of five biogas engines installed at the biogas power plant, with the net capacity of 0.600x1 MWe and 1.067x4 MWe. Accordingly, the biogas system installed has been designed with a total power of 4.868 MWe. These changes did not affect total capacity and additionality calculations. Previous mentioning has been corrected and commissioning report for all five engines have been shared with VVB.

The methodology is applicable where the outside temperature is higher than 5°C so in order to check the methodology applicability Outside Temperature (T) has been added to the parameters that have to be monitored.

$W_{\text{manure,Lt}}$ parameter should be monitored as required by the methodology so the parameter have been moved from Ex-Ante values to the parameters that has to be monitored.

Parameter under SDG 13 in the PDD has been mentioned as "Air Quality related to capturing and utilising GHGs from animal manure" and corrected to "Tonnes of greenhouse gas emissions avoided or removed" in this MR.

According to 'Errata and Clarifications to AM0073' publication by Verra, CDM TOOL 14 and 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories can be used for defining LF_{AD} parameter. Therefore, LF_{AD} parameter has been corrected as the digesters with steel or lined concrete or fiberglass digesters and a gas holding system (egg shaped digesters) and

monolithic construction will have a value of 0.028 as per the IPCC (2006), Flesch et al. (2011) and Kurup (2003).

B.2.3. Changes to start date of crediting period

As the project design certified on 30/12/2021 first Monitoring period start date has been defined as 01/01/2020. In the registered PD the crediting period start date is identified as 26/10/2018 (Operation start date of the Project) so MR is updated with the correct start date as per GHG Emissions Reductions & Seq. Product Requirements V.2.2⁸

B.2.4. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

N/A

B.2.5. Changes to project design of approved project

Crediting Period Start Date Change:

As the project design certified on 30/12/2021 first Monitoring period start date has been defined as 01/01/2020. In the registered PD the crediting period start date is identified as 26/10/2018 (Operation start date of the Project) so MR is updated with the correct start date as per GHG Emissions Reductions & Seq. Product Requirements V.2.28. As the crediting period start date has changed more than 2 years but less than 3 years compared to the crediting period start date in the registered PDD a design change request have been applied for the crediting period start date. Registered PD has been updated with the design change request. Design Change request includes the below explanation:

Project has been design certified on 30/12/2021. As per the GHG Emissions Reductions & Seq. Product Requirements V.2.2 para 10.2.1 start date of the crediting period is the start date of the project operation or two years prior to the date of Project Design certification whichever is later. So Crediting start date has been changed to 01/01/2020 from 26/10/2018 (which is within 2 years retroactive from the Project Design Certification date) and end date of the first crediting period is changed to 31/12/2024.

Design Certification achievement of the Project has lasted more than the time expected due to the fact that Covid 19 restrictions were in place at the time of validation. It has taken more time than expected to prepare and finalize the Validation report due to Covid restrictions at that time. Project commercial operation has started on time (26/10/2018) but due to the delay in the design certification it was forgotten to change the start date of the project in the registered PD according to the Design Certification Date according to GS's GHG Emissions Reductions & Seq. Product Requirements V.2.2 So there has been a substantive progress by the project owner to start the project activity as planned. And the project started the operation on time as it is planned.

There has been no change in the project activity and its additionality; as the proposed project activity is still a biogas-to-energy project that generates renewable energy by capturing biogas from cattle manure -via anaerobic digestion- and utilizing it to produce thermal and electric energy through cogeneration systems. All the equipment in the project design document have been successfully implemented and have been in operation since the start date of the project.

There has been some unit conversion mistakes as also due to the methodology does not state clearly the unit conversions that has to be done. These unit conversion mistakes has resulted overestimation of Emission reduction Calculations during the design certification of the project.

Unit conversion mistakes that has been corrected in this MR and in the PDD submitted for design change approval is as follows:

Changes to $VS_{LT,y}$ value:

As per the applied methodology there are five options to determine $VS_{LT,y}$ value. In the registered PD 5th option is chosen.

PP has chosen to apply the direct measurements of VS_{LT} as per the fifth option in the registered PD (Ver.07) as follows:

$$VS_{LT,y} = W_{manure,LT} * VS_{manure,LT} * ndy$$

As the methodology does not state if the parameter $W_{manure,LT}$ is determined in a dry or wet basis. $W_{manure,LT}$ is determined on wet basis and not converted to dry basis in the registered PD and approved as it is.

As of now in-light with the comments received from Sustain-cert and Gold Standard during the 1st performance review of the 4th round; the Project Developer has decided to use default values of $VS_{LT,y}$ for Eastern Europe instead of the direct measurements of $VS_{LT,y}$ as per the methodology. PD version 08 which is submitted for design change approval; has been updated to use the 4th option to calculate $VS_{LT,y}$ value and The 4th of Option is now used for $VS_{LT,y}$ calculations in this MR. And this resulted the ER estimates to drop from 1,190,971 tCO₂eq/year to 213,927 tCO₂eq/year in the updated PD version 08 submitted for design change approval.

Change to the Unit Conversion to Calculate Project Emissions from Road Transportation

Unit conversion

$$N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f} = \text{number} \times \text{km} \times \text{lt}/\text{km} = \text{lt}/\text{yr}$$

$$\rho_{dieselfuel} = \text{kg}/\text{lt}$$

$$NCV = \text{TJ}/\text{Gg} = 10^{-6} \text{ TJ}/\text{kg}$$

$$EF_{CO_2,f} = \text{kg}/\text{TJ}$$

$$PE_{CO_2,Trans,y} = \frac{\text{lt}}{\text{yr}} \times \frac{\text{kg}}{\text{lt}} \times \frac{10^{-6} \text{ TJ}}{\text{kg}} \times \frac{\text{kg}}{\text{TJ}} \times \frac{10^{-3} \text{ ton}}{\text{kg}} = 10^{-9} \text{ ton}/\text{yr}$$

According to unit conversion explanation, 10^{-9} was added to formula to find the result in tons. Since this unit conversion has not been done properly in the registered PD, and 10^{-7} has been used to calculate project emissions from road transportation. Unit conversion coefficient has been corrected to 10^{-9} in the updated PD and ER Calculations that is submitted for design change approval.

Assessment of the Impacts of the Design Changes:

Additionality of the Project:

None of the above mentioned Proposed Actual Changes affect the additionality of the certified project.

There is no change to the project start date. Project started commercial operations on the day as it is planned with the same installed output capacity within the same project boundary. The proposed changes results in a more conservative Emission Reduction. So the proposed changes do not have any effect on the investment analysis.

Applicability of the Methodology and Compliance with the Monitoring Plan

The project has been implemented as described in the design certified project documentation. There has been no-change to the baseline methodology (AM0073) applicability.

Project Scale:

Due to the proposed changes ER has been dropped from 1,190,971 tCO₂eq/year to 213,927 tCO₂eq/year in the updated PD version 09 submitted for design change approval. But the project is still a large scale project. There is no scale change in the project activity.

Stakeholder Feedback On Design Change:

There is no change in the project activity and project activity started its operations as it is planned. There is no capacity increase or any location change of the project activity compared to the design certified project. The stakeholder consultation is not necessary for this change.

Sustainable Development and Safeguarding Assessment:

There are no changes in the project location or no extension of the project boundaries according to the proposed design change. So re-assessment of the SDG impacts and Safeguarding Principles are not necessary.

Monitoring and Reporting Plan

There is no need to make any changes to design certified monitoring plan regards to Local Stakeholder's feedback; applicability of the methodology, SDG Impact, safeguarding assessments. As the proposed design change does not have any effect on principles and requirements as stated in the above analysis. There is also no changes to the EIA report so no new mitigations have been added due to the proposed design change.

Legislation:

There is no document or any approvals/licenses required or obtained from the environmental or regulatory agencies as the project has started operations on time with the licensed capacity within the same boundary of the existing approvals and licenses as outlined in the design certified PD.

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

>>Parameters to be monitored

According to section B.7.1 of the PDD, parameters need to be monitored is as following.

Table 8. The details Monitoring Process of the monitoring parameters engaged in the project

Parameter	Measurement methods and procedures
SDG 7	
EG _{d,y}	Measured continuously by the meters installed at the outlet of gas engine. The meter reading was recorded by the staff and the electricity generation is not included during the commissioning period. The readout records of electricity meter have been recorded at 24:00 of every day by the staff during the monitoring period. Monthly value is the sum of the daily electricity generation. The monitored equipment will be calibrated periodically according with manufacturer's recommendations or local/international standard to ensure accuracy and data will be recorded and backed-up.
SDG 8	
Number of males and females employed by the project; Average monthly salary; Number of trainings for employees;	Parameters for SDG 8 were determined based on record keeping book, labor contract, paychecks and training records for all employees from Human Resource Department.
SDG 8 For Mitigation Measure for Safeguarding Principles	
Employee Training of biogas safety operation	Determined by the training record which was held once a year. For this monitoring period, training about biogas and its safety operation was held on 24 November 2018, which can be proved by training notice and meeting attendance record.
SDG 13	
Volatile solid excretion rate per day on a dry-matter basis for a defined livestock population, VS	Analysis has been performed in line with the "Standard for sampling and surveys for CDM project activities and program of activities, Version 09.09" and the Annex 2: 'Method for determination for Volatile Solids in animal waste' of the approved baseline and monitoring CDM methodology of AM0073: "GHG emission reductions through multi-site manure collection and treatment in a central plant, Version 1.0¹⁰". Measurement will be conducted by lab technician.
Number of animals of type LT produced annually for the year y, N_{p,LT}	Each cattle involved in this project has a unique ear tag when was born, which is a part of the tracking system. Therefore, the number of cattle produced in the farm can be

⁹ https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20210531160756223/Meth_Stan05.pdf

¹⁰ <https://cdm.unfccc.int/methodologies/DB/2N19WQ6DCXNYRNJVZQQOHG7TK0Q2D8>

	monitored through the ear tags once cattle slaughter monthly. At the same time, the technicians in farms record manually the number of cattle produced in the farms monthly and this parameter is sourced from the data logged in each cattle farm. Monthly sale records for each farm can be crosschecked during this monitoring period. Data will be kept electronically.
Number of days animal of type LT is alive in the farm in the year y, $N_{da,LT}$	The days of cattle alive in the farm can be traced through the electronic ear tag by the technical staff in each farm. At the same time recorded manually by the technicians in farms and sourced from the data logged in each cattle farm. Data will be kept electronically.
The flare efficiency, $\eta_{flare,m}$	For enclosed flares that are defined as low height flares, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. Since the flare is enclosed flare, the default value for flare efficiency applied shall be 80%, rather than 90%.
Consumptions of fuel type f in volume per year from manure road transportation $\sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f})$	Total consumption of diesel oil consumed by transportation have taken from log-book records which are held based on daily, monthly and annually records. Data will be kept electronically.
Number of days treatment plant was operational in year y, n_{dy}	Monitored by PP and sourced from data logged in the manure treatment plant. Data will be kept electronically.
Quantity of electricity consumed by the proposed project in year y, $EC_{PJ,j,y}$	Measured continuously by the meters installed in project site. The meter reading was recorded daily by the staff and the electricity consumption is not included during commissioning period. The readout records of electricity meter have been recorded at 24:00 of every day by the staff during the monitoring period. The daily electricity consumption is the difference between the reading value at the 24:00 of first day of each month and the reading value at 24:00 of the next day of each month. Monthly data is the sum of the daily electricity consumption. The electricity meter was calibrated periodically by an officially accredited entity. Collected data is archived in both electronic and printed copies. During this monitoring

	period, all electricity consumption was sourced from the electricity generated by biogas capturing through AWMSs, no electricity consumed from the grid company or other external sources. Data will be kept electronically.
Volumetric flow rate of the captured biogas in dry basis at normal conditions in hour h, $FV_{RG,h}$	Continuously measured by the biogas flow meters (biogas flow meter 1 and 2 installed at the outlet of the anaerobic digestion,) continuously and record daily. The biogas flow meters used were calibrated periodically by an officially accredited entity. In addition, the biogas flow meter automatically measured the instantaneous flow rate, temperature and pressure per hour, it is not necessary to separately measure the instantaneous flow rate ($FV_{RG,h}$), the biogas temperature (T_t) and pressure (P_t). Collected data is archived in electronic. Measurements will be done by plant technicians. Data will be kept electronically.
Volumetric fraction of methane in the captured biogas on dry basis in hour h, $fv_{CH_4,RG,H}$	Methane fraction can be calculated directly and displayed on Scada System without the need for an additional measuring instrument. On line measurements are also verified by a hand-held gas analyzer every day and compared with the measured values. Values recorded from Scada system are archived electronically during project plus 5 years. Measurements will be done by plant technicians.

Monitoring framework

The project owner is responsible for the whole monitoring work. The GS Monitoring Team is established to collect and record monitoring data within the project boundary. The GS monitoring team is responsible for the normal operation of the AWMS and the collection and record of all the monitoring data. All the data is reviewed by the project developer and VVB. Each member of the GS monitoring team is trained by the project owner at least once a year. The overall monitoring system structure of the project shows as below:

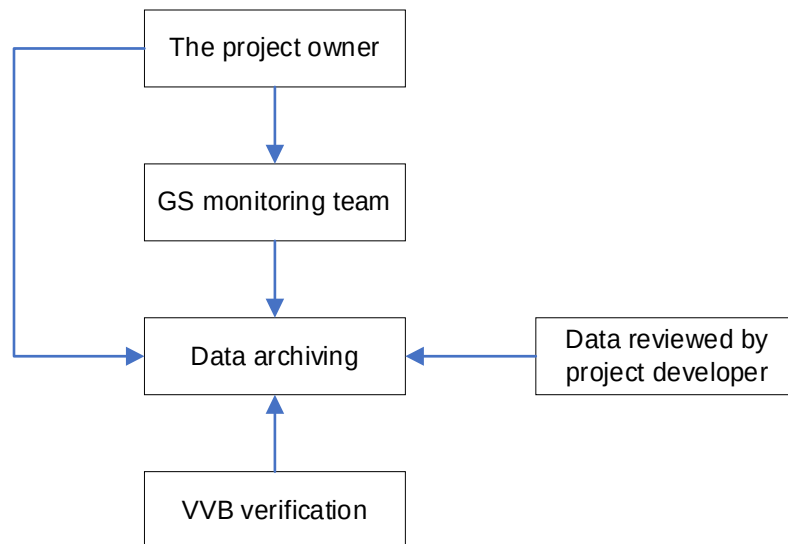


Figure 5. The Organization Structure of the Monitoring Team

Monitoring equipment and installation

Installation and configuration of monitoring equipment are shown as Figure 6. In order to ensure measurements with a low degree of uncertainty, the data monitoring equipment have been calibrated and checked by appropriately qualified third party according to appropriate national standard.

For this monitoring period, all the monitoring equipment were calibrated according to relevant regulations.

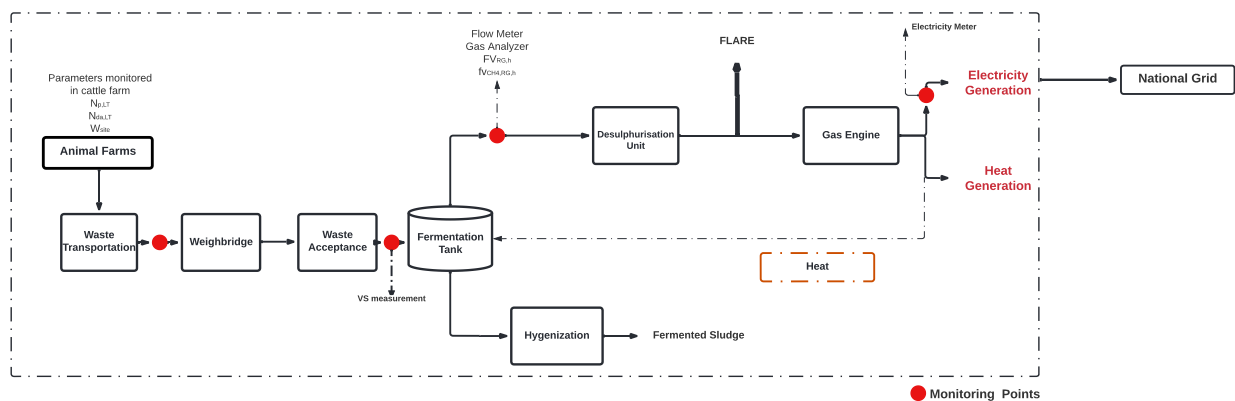


Figure 6. The monitoring system of the project

GPS Tracking for Trucks

Within the project activity, the residues are collected with tank trucks. For every charging and discharging operation should be tracked by GPS tracking system. The trucks used for the manure transportation have their own GPS devices which can be tracked during their operation. A picture of tracking operation has been shared below as an example and all the trucks are monitoring. The baseline emission from each farm are more than 900 tCO₂e individually and all are classified as upper rank farms.

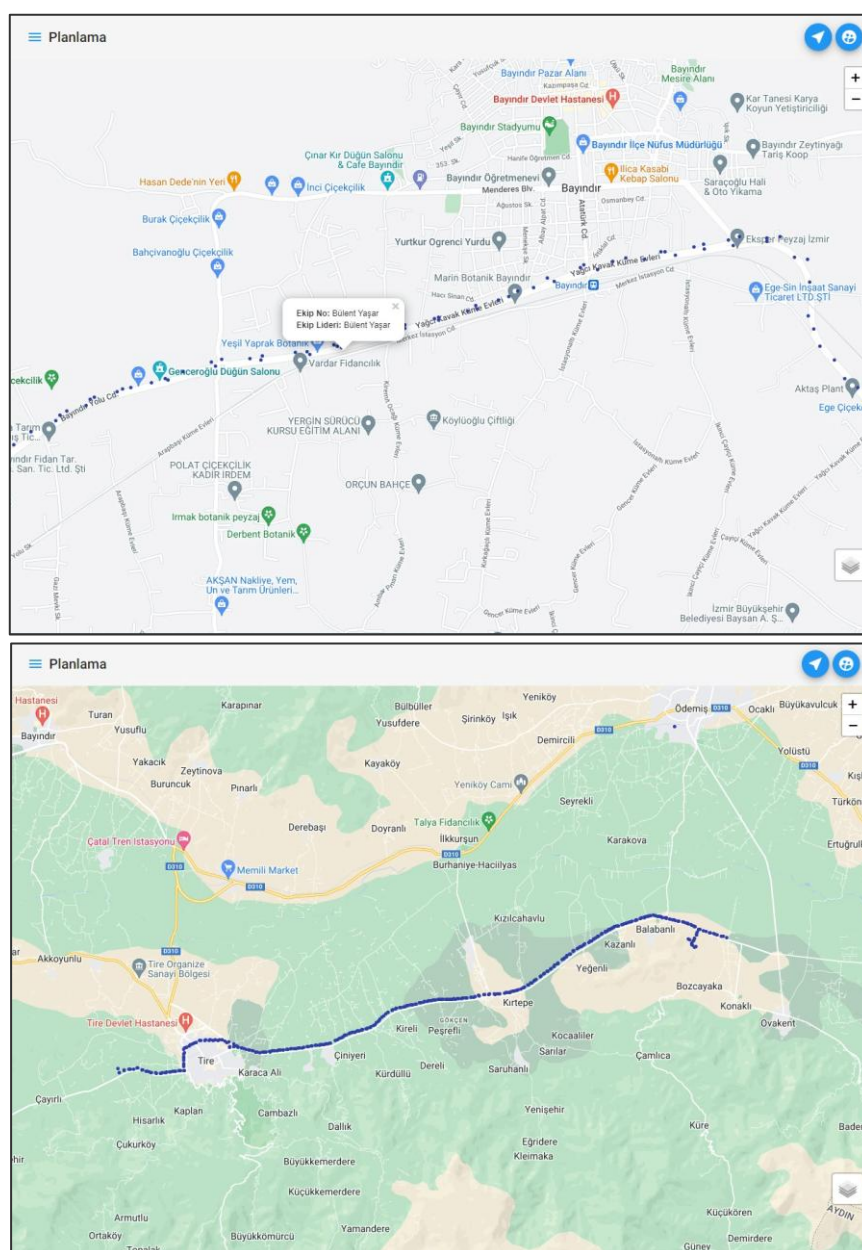


Figure 7. GPS Tracking Example

Table 6 General description of monitoring equipment

Monitoring equipment	Parameter to be monitored	Installed location	Type	Series number	Accuracy	Date of calibration	Calibration agency
Flow meter 1	V_f T_t P_t	At the outlet of the anaerobic digestion	t-mass 65 I	S4172102000	1.5	26/10/2018	Endress+Hauser Flowtec
Flow meter 2	V_f T_t P_t	At the outlet of the anaerobic digestion	t-mass 65 I	S4172002000	1.5	26/10/2018	Endress+Hauser Flowtec
Electricity meter 1	$EG_{d,y}$ $EC_{PJ,y}$	In the project site	AEL.TF.21	21010329	0.5S	26/10/2018	KÖHLER
Electricity meter 2 (spare)	$EG_{d,y}$ $EC_{PJ,y}$	In the project site	AEL.TF.21	21010254	0.5S	26/10/2018	KÖHLER
Weight bridge	w_{site}	At the entrance of the site	PWI	865	III level	27/08/2019 22/01/2021	Türk Standartları Enstitüsü
Gas analyzer	$V_{i,t,db}$	At the outlet of the anaerobic digesters	Biogas 3000	G3000320	Lower than 1%	04/09/2018 30/06/2020	RAM Ölçü ve Kontrol Sistemleri
Gas analyzer (portable)	$V_{i,t,db}$	Portable	Biogas 5000	G505630	Lower than 1%	04/09/2018 30/06/2020 16/04/2021 23/05/2022	RAM Ölçü ve Kontrol Sistemleri

Corrective actions

The whole GS monitoring team fellow recognized standard data evaluation methods to guarantee that the data was reliable and accurate. There was no correction of nonconformities occurred in implementation of the project or the monitoring plan during the 1st monitoring period. For QA/QC procedure, please refer to QA/QC procedures in section D.2 of the monitoring report.

Data management

Records are the most important exercise in relation to the monitoring process. Without accurate and efficient record keeping, project emission reductions cannot be verified.

Once missing data on a certain day or a certain period of time happened, the most appropriate values such as daily average or monthly average will be used for calculation, which is to ensure that emission reductions are conservative.

All data collected as part of the monitoring plan shall be archived in electronic form and paper until at least two years after the entry period.

The data will be archived electronically every month and invoices of electricity sales to TEİAŞ Company will be maintained. The project will employ highly skilled workers and periodic training of employees would ensure that they are well equipped to handle emergency situations.

Emergency procedure

Employees need to be familiar with the process flow and emergency situations that may occur during project operation and operate in strict accordance with the technical specifications of each process treatment equipment and monitoring equipment. During the operation of the project, all equipment and related instruments shall be checked regularly according to the manufacturer's recommendations. If necessary, calibration and/or proper repair have to be carried out immediately.

In case of malfunction and/or damage of any system or piece of the process, it may cause damage to the operation of the system, especially serious damage to the biogas generation system and combustion system it must be dealt with as soon as possible and reported to the responsible technician immediately.

There was no emergency happened during this monitoring period.

Avoiding of double counting

All cattle farms involved in this project can be identified through its GPS coordinates, which will prevent the farms counted in the project activity to be part of any other voluntary market or emission reduction mechanism (CDM, CCER, VCS etc.) as well. Besides, the project owner has signed the Declaration of No Double Counting Statement and Declaration of not involved in other GHG scheme. The emission reductions were not double counted during the 1st monitoring period.

SECTION D. DATA AND PARAMETERS

D.1. Data and parameters fixed ex ante or at renewal of crediting period

>>

SDG 7

Data/parameter	EF_{grid,CM,y}
Unit	tCO ₂ /MWh
Description	Emission factor for the Turkish National Grid
Source of data	Published data from The Ministry of the Energy and Natural Resources in Turkey ¹¹
Value(s) applied	0.5706
Choice of data or Measurement methods and procedures	"Tool to calculate the emission factor for an electricity system" version 07.0
Purpose of data	Calculation of baseline emissions and project emission
Additional comment	Value is fixed and ex-ante for the entire crediting period

Data/parameter	D_{CH4}
Unit	t/m ³
Description	Density of methane at normal (at room temperature 20°C and 1 atm pressure) conditions
Source of data	Approved Large-Scale Methodology of AM0073: GHG emission reductions through multi-site manure collection and treatment in a central plant, Version 1.0 ¹²
Value(s) applied	0.00067

¹¹

<https://enerji.gov.tr/Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TürkiyeUlusalElektrikŞebekesiEmisyonFaktörü/Belgeler/EK-2.pdf>

¹²

Choice of data or Measurement methods and procedures	0.00067 t/m ³ at room temperature 20°C and 1 atm pressure
Purpose of data	Used in Calculation of baseline emissions
Additional comment	

SDG13

Data/parameter	GWP_{CH4}
Unit	tCO _{2e} /tCH ₄
Description	Global Warming Potential of CH ₄
Source of data	IPCC Fourth/Fifth Assessment Report
Value(s) applied	Until 01.01.2021: 25 (AR4 Value) Thereafter: 28 (AR5 Value)
Choice of data or Measurement methods and procedures	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014 ¹³
Purpose of data	Used in project emission/baseline calculations
Additional comment	All monitoring, verifications and requests for performance certification of Certified products and / or Impact Statements for the period starting 01 January 2021 shall use the AR5 GWP values (28) for calculating emission reductions and removals according to applicability of global warming potential for gold standard for the global goals projects.

Data/parameter	n_{flare,m}
Unit	% (Percentage)
Description	Flare efficiency
Source of data	Default Value of TOOL06

¹³ https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Value(s) applied	Since option A conditions are met and enclosed flare could be defined low height, 80% has been chosen.
Choice of data or Measurement methods and procedures	Continuously
Purpose of data	Used in project emission calculations
Additional comment	-

Data/parameter	MCF_j
Unit	Fraction
Description	Annual methane conversion factor (MCF) for the baseline animal manure management system j
Source of data	Obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), Volume 4, Chapter 10, Table 10.A-4, page 10.77
Value(s) applied	0.76
Choice of data or Measurement methods and procedures	For the project location, İzmir province in Turkey, Mean annual temperature is 17.9°C¹⁴; Mean annual precipitation (MAP) is 710.5¹⁵; Potential Evapotranspiration (PET) is 1,725.7¹⁶. Hence, in accordance with Information Required to Determine Climate Zones According to Table 10A-4 IPCC 2006 Volume 4 Chapter 10, page 10.77, İzmir is considered as Warm Temperate Dry as its climate zone. J is Uncovered anaerobic lagoon. Thus, MCF_{uncoveredanaerobic} lagoon is accounted as 0.76
Purpose of data	Used in Calculation of baseline emissions

¹⁴ <https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=undefined&m=IZMIR>

¹⁵ <https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=undefined&m=IZMIR>

¹⁶ <http://eced.csb.gov.tr/ced/jsp/ek1/24313>

Additional comment	A conservativeness factor has been applied by multiplying MCF value with a value of 0.94, to account for the 20 per cent uncertainty in the MCF values as reported by IPCC 2006.
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Data/parameter	B_{0,LT}
Unit	m ³ CH ₄ /kg-dm
Description	Maximum methane producing potential of the volatile solid generated for animal type 'LT'
Source of data	IPCC 2006, Volume 4, Chapter 10, Table 10.A-4, page 10.77
Value(s) applied	AS described in IPCC Sixth Assessment report Turkey is regarded under Europe so Bo values are used from Eastern Europe and Western Europe ¹⁷ Dairy Cattle: 0.24; Non Dairy Cattle: 0.17
Choice of data or Measurement methods and procedures	In accordance with IPCC Sixth Assessment report under Chapter 13 Turkey is regarded under Southern Europe Region ¹⁷
Purpose of data	Used in Calculation of baseline emissions
Additional comment	As described in IPCC Sixth Assessment report under Chapter 13 Turkey is regarded under Southern Europe Region. Also Project Location is just 150 kms away from the Greece Border. More importantly, in accordance with the relevant law and regulations, the farm owners are mandated to keep the track of each animal that they have at their farm. Each animal has their ear tags stating their names, ages, types, vaccinations These official records that need to be prepared and be submitted to the governmental offices. And all animal farms that the Manure is collected have either Hollstein Dairy Cows, Brown Swiss Dairy Cows or Symental Cattle where these dairy cows and cattles are exported originally from Switzerland or Holland as can be seen from the governmental records of each animal farms.

Data/parameter	TDL_{j,y}
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¹⁷ <https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-13/>

Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Calculated from the Data Provided by Turkish Electricity Transmission Corporation (TEİAŞ) ¹⁸ in accordance with Methodological Tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, Version 3.0 ¹⁹
Value(s) applied	0.11
Choice of data or Measurement methods and procedures	The annual average value based on the most recent data available within Turkey is used from the data provided by TEİAŞ. In accordance with the Methodological Tool, for the data from the relevant year, 2021, is absence, most recent figures are used, but not older than 5 years. Accordingly, the annual network losses for the years of 2022, 2020, and 2019 are taken into account in calculating $TDL_{j,y}$.
Purpose of data	Used in Calculation of project emissions
Additional comment	-

Data/parameter	$LF_{AD} = EF_{CH_4, default}$
Unit	Fraction
Description	Default Methane leakage from anaerobic digesters/reactor
Source of data	IPCC (2006), Flesch et al. (2011) and Kurup (2003)
Value(s) applied	0.028: Digesters with steel or lined concrete or fiberglass digesters and a gas holding system (egg shaped digesters) and monolithic construction
Choice of data or Measurement methods and procedures	
Purpose of data	Used in

¹⁸ <https://webapi.teias.gov.tr/file/512cbf1d-0ca3-4492-b901-3722c7b682f7?download>

¹⁹ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-05-v3.0.pdf>

	Calculation of project emissions
Additional comment	

Data/parameter	$EF_{CO_2,f}$
Unit	Fraction (tCO ₂ e/TJ)
Description	CO ₂ emission factor of the fossil fuel type f used in transportation vehicles
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.4, page 1.23 – Gas/Diesel Oil – Upper Limits – Conservative ²⁰
Value(s) applied	74,800
Choice of data or Measurement methods and procedures	
Purpose of data	Used in Calculation of project emissions
Additional comment	

Data/parameter	NCV_f
Unit	Fraction
Description	Net calorific value of fuel type f in TJ per volume or mass units
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.2, page 1.18 – Gas/Diesel Oil – Upper Limits – Conservative ²¹
Value(s) applied	43.3
Choice of data or Measurement methods and procedures	

²⁰ https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

²¹ https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

Purpose of data	Used in Calculation of project emissions
Additional comment	

Data/parameter	MS%BI, j
Unit	Fraction
Description	Fraction of manure handled in system j in the baseline
Source of data	Project proponent
Value(s) applied	100%
Choice of data or Measurement methods and procedures	In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon assumed for baseline is 100%
Purpose of data	Used in Calculation of baseline emissions
Additional comment	Project Owner has signed agreements with the farm owners that the manure will be supplied only to the ARF Biogas Plant

Data/parameter	SPEC_{flare}
Unit	Temperature - °C Flow rate or heat flux - kg/h or m3/h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Aris Enerji – specialist in Biogas technology
Value(s) applied	Document in the CDM-PDD the flare operating specifications set by the manufacturer for the correct operation of the flare for the following parameters: (a) Minimum and maximum inlet flow rate, if necessary, converted to flow rate at reference conditions or heat flux;

	(b) Minimum and maximum operating temperature; and (c) Maximum duration in days between maintenance events According to Arış Enerji Flare Datasheet; Max Capacity: 2,300 Nm³/h Operating Temperature: 800-1200°C Maintenance Schedule: Depending on the maintenance, periodical controls should be done every 6 months for partial equipment changes or every 2 years for flame holder changes.
Choice of data or Measurement methods and procedures	Flow meter, Temperature Sensor, Booster Records, The operator will decide whether to start and ignite the Flare with Cogeneration either on or off (see settings page on Data sheet specifications)
Purpose of data	Calculation of project emissions from residual gas
Additional comment	This in an enclosed flare.

Data / Parameter:	$f_{CH_4,EG,m}$
Data unit:	kg/m ³
Description:	Concentration of methane in the exhaust gas of the flare on a dry basis at reference conditions in the minute <i>m</i>
Source of data	Measurements by project operator using a continuous gas analyzer
Description of measurement methods and procedures to be applied	Extractive sampling analyzers with water and particulates removal
Value(s) applied	0.1929 ²²

²² https://www.engineeringtoolbox.com/methane-density-specific-weight-temperature-pressure-d_2020.html?vA=900°ree=C&pressure=1bar#

QA/QC procedures to be applied	Average density of methane @1000K has been applied
Purpose of the data	Calculation of emissions from flaring
Calculation method	
Comments	This parameter is monitored, project implements enclosed flare

D.2. Data and parameters monitored

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SDG 7

Data / Parameter	EG _{d,y}					
Unit	MWh/yr					
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y					
Source of data	Electricity meter / Bill generated					
Value(s) applied	Year			Total Net Electricity Generation Supplied to the Grid (MWh)		
	2020			13,303.14		
	2021			18,769.352		
	2022			17,011.02		
	01/01/2020-31/01/2020	706.084		01/01/2021-31/01/2021	1,689.534	
	01/02/2020-29/02/2020	750.449		01/02/2021-29/02/2021	1,374.381	
	01/03/2020-31/03/2020	1.163.075		01/03/2021-31/03/2021	1,628.775	
	01/04/2020-30/04/2020	1.057.174		01/04/2021-30/04/2021	1,788.215	
	01/05/2020-31/05/2020	915.493		01/05/2021-31/05/2021	1,664.785	

	01/06/2020-30/06/2020	1.051.667	01/06/2021-30/06/2021	1,475.049
	01/07/2020-31/07/2020	987.273	01/07/2021-31/07/2021	1,467.928
	01/08/2020-31/08/2020	1,019.241	01/08/2021-31/08/2021	1,440.571
	01/09/2020-30/09/2020	1,152.501	01/09/2021-30/09/2021	1,312.355
	01/10/2020-31/10/2020	1,307.021	01/10/2021-31/10/2021	1,378.057
	01/11/2020-30/11/2020	1,533.263	01/11/2021-30/11/2021	1,637.039
	01/12/2020-31/12/2020	1,659.899	01/12/2021-31/12/2021	1,912.663
	01/01/2022-31/01/2022	1,738.980		
	01/02/2022-29/02/2022	1,545.939		
	01/03/2022-31/03/2022	1,742.876		
	01/04/2022-30/04/2022	1,703.656		
	01/05/2022-31/05/2022	1,499.974		
	01/06/2022-30/06/2022	1,115.248		
	01/07/2022-31/07/2022	991.892		
	01/08/2022-31/08/2022	1,216.356		
	01/09/2022-30/09/2022	1,193.674		
	01/10/2022-31/10/2022	1,269.502		
	01/11/2022-30/11/2022	1,235.982		
01/12/2022-31/12/2022	1,756.941			
Measurement methods and procedures	Continuous measurements and monthly recorded.			
Monitoring frequency	Monthly			
QA/QC procedures	The monitored equipment will be calibrated periodically according with manufacturer’s recommendations or local/international standard to ensure accuracy and data will be recorded and backed-up.			

Purpose of data	Calculation of baseline emissions
Additional comment	This parameter will be monitored energy meter Class 0.5S. Electricity meters will be calibrated every 10 years according local standard (MEASUREMENT AND MEASURING INSTRUMENTS INSPECTION REGULATION ²³) to ensure accuracy and data will be recorded and backed- up.

SDG 8

Data / Parameter	Quality of employment									
Unit	Number of trainings for employees									
Description	Without the Project, local people have no such opportunities to work in safe and healthy environment like in the project; or no chance to be trained on the technology and the monitoring of the plant operation, and the emergency and safety procedures.									
Source of data	Training records for all employees from Human Resource Department									
Value(s) applied	<table><tr><th>Year</th><th>Number of Trainings</th></tr><tr><td>2020</td><td>32</td></tr><tr><td>2021</td><td>20</td></tr><tr><td>2022</td><td>11</td></tr></table>		Year	Number of Trainings	2020	32	2021	20	2022	11
Year	Number of Trainings									
2020	32									
2021	20									
2022	11									
Measurement methods and procedures	The PP will conduct a number of trainings and development policy for all employees every year and/or once required to improve their knowledge and also performance.									
Monitoring frequency	Every year and/or once required.									
QA/QC procedures	Together with the technology supplier, the Project will organize training for the staff on the technology and the									

²³

<https://mevzuat.gov.tr/mevzuat?MevzuatNo=6381&MevzuatTur=7&MevzuatTertip=5>

	monitoring of the plant operation, and the emergency and safety procedures as much as possible. The project owner's office space will be kept complying with the detailed principles of working environment.
Purpose of data	To enhance capacity of all employees working in the project.
Additional comment	Training content for employees is about environmental awareness, waste management, work health and safety, personal protective equipment usage, technical information about biogas technology, equipment usage and emergency case actions.

Data / Parameter	Quantitative employment and income generation									
Unit	Number of recruited staff and their social security records									
Description	Ensuring that the staff receives their full salaries on time									
Source of data	Salary slips to be provided by the Project Owner									
Value(s) applied	<table><tr><th>Year</th><th>Employee Number</th></tr><tr><td>2020</td><td>31</td></tr><tr><td>2021</td><td>27</td></tr><tr><td>2022</td><td>29</td></tr></table>		Year	Employee Number	2020	31	2021	27	2022	29
Year	Employee Number									
2020	31									
2021	27									
2022	29									
Measurement methods and procedures	The Project Owner is committed to ensuring that the staff receives their full salaries on time. Number of employees and the evidence for their wages being paid will be checked from the social security records, which will be provided by the Project Owner.									
Monitoring frequency	Annually									
QA/QC procedures	-									
Purpose of data	To monitor the proposed Project’s contribution to SDG 8.									
Additional comment	NA									

SDG 13

Data / Parameter	Tonnes of greenhouse gas emissions avoided or removed
Unit	tCO ₂ eq/yr
Description	Emission reductions achieved due to project activity
Source of data	ER sheet

Value(s) applied	Year	Emission Reduction (tCO₂e/year)
	2020	169,956
	2021	188,914
	2022	177,833
Measurement methods and procedures	Project Owner Records, Farm Records	
Monitoring frequency	Monthly/Yearly	
QA/QC procedures		
Purpose of data	To calculate project emission reduction	
Additional comment	This parameter in the PDD has been mentioned as "Air Quality related to capturing and utilising GHGs from animal manure" and corrected in this MR report.	

Data / Parameter	VSLT,y			
Unit	kg-dm/animal/day			
Description	Volatile solid excretion rate per day on a dry-matter basis for a defined livestock population			
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), Annex 10A.2 from Table 10A-4 and Table 10A-5 Eastern Europe values.			
Value(s) applied	YEARLY	UNIT	DAIRY	CATTLE
	VSLT ₂₀₂₀	kg-VS-dm/animal/yr	1,642.50	949
	VSLT ₂₀₂₁	kg-VS-dm/animal/yr	1,642.50	949
	VSLT ₂₀₂₂	kg-VS-dm/animal/yr	1,642.50	949
	VSdefault,Dairy Cattle =4.5 kg-dm/animal/day VSdefault,Other Cattle=2.6 kg-dm/animal/day			
Measurement methods and procedures	As per the applied methodology, there are five ways to determine the VSLT,y value. Project proponents have chosen to use the 4th option. As it has also been observed during this monitoring period; the Direct measurements of VSLT,y as per the fifth option to calculate VSLTy (VSLT,y =			

	W _{manure,LT} *V _{Smanure,LT} * ndy) is less conservative compared to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), Annex 10A.2 from Table 10A-4 and Table 10A-5 Eastern Europe values.
Monitoring frequency	Annually, estimated or based on published information such as IPCC
QA/QC procedures	Utilizing default values of IPCC 2006, Table 10A-4 through 10A-9, Chapter 10, Volume 4, multiply the value by ndy (number of days the central treatment plant was operational in year y);
Purpose of data	Calculation of baseline emissions
Additional comment	As described in IPCC Sixth Assessment report under Chapter 13 Turkey is regarded under Southern Europe Region. Also project location is just 150 kms away from the Greece Border. So as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), Annex 10A.2 from Table 10A-4 and Table 10A-5 Eastern Europe values are used which is more conservative compared to the direct measurements. V_{Sdefault,Dairy Cattle} =4.5 kg-dm/animal/day V_{Sdefault,Other Cattle}=2.6 kg-dm/animal/day Direct Measurements: V_{Sdairycattle 2020}=6.03 kg-dm/animal/day V_{Sothercattle,2020}=2.40 kg-dm/animal/day V_{Sdairycattle2021}= 5.98 kg-dm/animal/day V_{Sothercattle2021}=2.31 kg-dm/animal/day V_{Sdairycattle2022}=6.34 kg-dm/animal/day V_{Sothercattle2022}=2.56 kg-dm/animal/day

Data/parameter	W_{manure,LT}
Unit	kg/day/head dry basis
Description	Average manure weight excreted by a defined population at the project site in kg/animal/day on dry basis

Source of data	Animal manure is received daily from animal farms involved in the project activity. The animal manure, collected from the farms, and supplied to the biogas plant, is weighed for each farm by the weighbridge installed at the entrance of the facility, and the daily amounts and animal type of manure are recorded through the weighbridge operational logbook. Number of animals from different farms and different animal types are recorded separately.														
Value(s) applied	<table><tr><th>Monitoring Period</th><th>Wmanure,cattle (Wmanure /day/head dry basis (kg))</th><th>Wmanure,dairy (Wmanure /day/head dry basis (kg))</th></tr><tr><td>01/01/2020-31/12/2020</td><td>3.18</td><td>8.03</td></tr><tr><td>01/01/2021-31/12/2021</td><td>3.03</td><td>7.80</td></tr><tr><td>01/01/2022-31/12/2022</td><td>3.36</td><td>8.20</td></tr></table>			Monitoring Period	Wmanure,cattle (Wmanure /day/head dry basis (kg))	Wmanure,dairy (Wmanure /day/head dry basis (kg))	01/01/2020-31/12/2020	3.18	8.03	01/01/2021-31/12/2021	3.03	7.80	01/01/2022-31/12/2022	3.36	8.20
Monitoring Period	Wmanure,cattle (Wmanure /day/head dry basis (kg))	Wmanure,dairy (Wmanure /day/head dry basis (kg))													
01/01/2020-31/12/2020	3.18	8.03													
01/01/2021-31/12/2021	3.03	7.80													
01/01/2022-31/12/2022	3.36	8.20													
Measurement methods and procedures	Wmanure,LT on wet basis will be calculated as follows ; $Wmanure,LT=Wweighbridge,y\times1000\div NLT,y\div ndy$ Where; Wmanure,LT= Average manure weight excreted by a defined population at the project site, in a wet basis(kg/day) Wweighbridge,y= Weighbridge data related to the specific farm, in a wet basis (ton/y) 1000 = Conversion of ton to kg NLT,y= Average annual livestock population at the manure supplying farm ndy= Number of days central plant is operational in the year y. Wmanure on wet basis will be converted to Wmanure dry basis by using below formula $Wmanure,LT\ [Dry] = Wmanure,LT\ [Wet] * TS$														

	TS= Total Solids (Moisture Content or the Total Solids (%TS) in the wet manure is determined in laboratory also as part of the determination of the VS_{manure}, LT in the project case. Lab results for %TS value is used for calculation of W_{manure} in dry basis) Dry matter values (TS% wb) for other cattle and for dairy is as follows $\%TS_{\text{dairy},2020}=37.89\%$ $\%TS_{\text{dairy},2021}=36.14\%$ $\%TS_{\text{dairy},2022}=37.29\%$ $\%TS_{\text{cattle},2020}=18.26\%$ $\%TS_{\text{cattle},2021}=17.73\%$ $\%TS_{\text{cattle},2022}=18.69\%$
Monitoring frequency	Daily aggregated to yearly
QA/QC procedures	Each Truck entering the facility are weighed for each farm by the weighbridge installed at the entrance of the facility, and the daily amounts and animal type of manure are recorded through the weighbridge operational logbook.
Purpose of data	Comparison of direct VSLT _y measurement values to IPCC default values
Additional comment	

Data / Parameter	Total Solids
Unit	%TS
Description	Dry matter
Source of data	Lab Log book records
Value(s) applied	$\%TS_{\text{dairy},2020}=37.89\%$

	%TSdairy,2021=36.14% %TSdairy,2022=37.29% %TScattle,2020=18.26% %TScattle,2021=17.73% %TScattle,2022=18.69%
Measurement methods and procedures	Evaporate free water until constant weight to obtain the Total Solids. Measured by Mositure analyzer automatically. Results are recorded to the lab log book.
Monitoring frequency	Weekly, accumulated to monthly records
QA/QC procedures	Moisture Analyzer: Radwag MA 50.X2.A with Serial Number:538413. Moisture Analyzer is calibrated every 2 years according to the manufacturer's recommendations.
Purpose of data	Calculation of baseline emissions. To convert Wmanure wet basis to dry basis. Used in comparison of direct VSLT,y measurement values to IPCC default values.
Additional comment	Measurements are done in the Quality Lab. within the project boundary.

Data / Parameter	FE								
Unit	%								
Description	The flare efficiency								
Source of data	Log book records								
Value(s) applied	<table border="1"> <thead> <tr> <th>Year</th><th>Flare Efficiency (%)</th></tr> </thead> <tbody> <tr> <td>2020</td><td>90</td></tr> <tr> <td>2021</td><td>90</td></tr> <tr> <td>2022</td><td>90</td></tr> </tbody> </table>	Year	Flare Efficiency (%)	2020	90	2021	90	2022	90
Year	Flare Efficiency (%)								
2020	90								
2021	90								
2022	90								
Measurement methods and procedures									

Monitoring frequency	Once per minute
QA/QC procedures	Regular maintenance will be carried out according with manufacturer recommendation to ensure optimal flare operation.
Purpose of data	Calculation of project emissions
Additional comment	Enclosed flare In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute m ($\eta_{\text{flare},m}$) and shall document in the CDM-PDD which option is selected: Option A: Apply a default value for flare efficiency. Option B: Measure the flare efficiency. For this project, the Option A is selected. Option A: Default value The flare efficiency for the minute m ($\eta_{\text{flare},m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating: (1) The temperature of the flare (TEG,m) and the flow rate of the residual gas to the flare (FRG,m) is within the manufacturer's specification for the flare ($SPEC_{\text{flare}}$) in minute m; and (2) The flame is detected in minute m ($Flamem$). Otherwise $\eta_{\text{flare},m}$ is 0%. For enclosed flares that are defined as low height flares, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. Both flow rate of the residual gas and the temperature of the flare records have been shared with VVB. It can be seen that records for both parameters are coherent with flare specifications. Therefore, PP has chosen to apply a default value of 80% for low height enclosed flare efficiency in accordance with section 6.2.2.1 of TOOL 06.

Data / Parameter	N _p																				
Unit	Numbers																				
Description	Number of animals produced annually of type LT for the year y																				
Source of data	Project developer records																				
Value(s) applied	<table><tr><th>Year</th><th>Type of Animal</th><th>Number of Animals</th></tr><tr><td rowspan="2">2020</td><td>Dairy Cattle</td><td>37,066</td></tr><tr><td>Non-dairy Cattle</td><td>1,619</td></tr><tr><td rowspan="2">2021</td><td>Dairy Cattle</td><td>36,075</td></tr><tr><td>Non-dairy Cattle</td><td>1,822</td></tr><tr><td rowspan="2">2022</td><td>Dairy Cattle</td><td>34,625</td></tr><tr><td>Non-dairy Cattle</td><td>1,406</td></tr></table>			Year	Type of Animal	Number of Animals	2020	Dairy Cattle	37,066	Non-dairy Cattle	1,619	2021	Dairy Cattle	36,075	Non-dairy Cattle	1,822	2022	Dairy Cattle	34,625	Non-dairy Cattle	1,406
Year	Type of Animal	Number of Animals																			
2020	Dairy Cattle	37,066																			
	Non-dairy Cattle	1,619																			
2021	Dairy Cattle	36,075																			
	Non-dairy Cattle	1,822																			
2022	Dairy Cattle	34,625																			
	Non-dairy Cattle	1,406																			
Measurement methods and procedures	N_p used to calculate N_{LT,y} will be measured based on the annual <i>monitoring</i> surveys that conducted by the project developer with the animal farm owners, whilst the farm owners’ official records will be cross-checked. Here, it is important to note that all of the farms from which the biogas plant receives animal manure are managed under confined conditions, in accordance with the relevant Turkish laws and regulations. More importantly, in accordance with the relevant law and regulations, the farm owners are mandated to keep the track of each animal that they have at their farm. Each animal has their ear tags stating their names, ages, weights, vaccinations etc. These official records that need to be prepared and be submitted to the governmental offices.																				
Monitoring frequency	Reported Monthly aggregated to Annually																				
QA/QC procedures	Farmer’s record will be checked																				
Purpose of data	To calculate Baseline emission																				
Additional comment	NA																				

Data / Parameter	N _{da}																				
Unit	Numbers																				
Description	Number of days animal is alive in the farm in the year y																				
Source of data	Project developer records																				
Value(s) applied	<table><tr><th>Year</th><th>Type of Animal</th><th>Days</th></tr><tr><td rowspan="2">2020</td><td>Dairy Cattle</td><td>365</td></tr><tr><td>Non-dairy Cattle</td><td>270</td></tr><tr><td rowspan="2">2021</td><td>Dairy Cattle</td><td>365</td></tr><tr><td>Non-dairy Cattle</td><td>270</td></tr><tr><td rowspan="2">2022</td><td>Dairy Cattle</td><td>365</td></tr><tr><td>Non-dairy Cattle</td><td>270</td></tr></table>			Year	Type of Animal	Days	2020	Dairy Cattle	365	Non-dairy Cattle	270	2021	Dairy Cattle	365	Non-dairy Cattle	270	2022	Dairy Cattle	365	Non-dairy Cattle	270
Year	Type of Animal	Days																			
2020	Dairy Cattle	365																			
	Non-dairy Cattle	270																			
2021	Dairy Cattle	365																			
	Non-dairy Cattle	270																			
2022	Dairy Cattle	365																			
	Non-dairy Cattle	270																			
Measurement methods and procedures	N_{da} used to calculate N_{LT,Y} will be measured based on the annual <i>monitoring</i> surveys that conducted by the project developer with the animal farm owners, whilst the farm owners’ official records will be cross-checked. Here, it is important to note that all of the farms from which the biogas plant receives animal manure are managed under confined conditions, in accordance with the relevant Turkish laws and regulations. More importantly, in accordance with the relevant law and regulations, the farm owners are mandated to keep the track of each animal that they have at their farm. Each animal has their ear tags stating their names, ages, weights, vaccinations etc. These official records that need to be prepared and be submitted to the governmental offices.																				
Monitoring frequency																					
QA/QC procedures	Farmer’s record will be checked																				
Purpose of data	To calculate Baseline emission																				
Additional comment	-																				

Data/parameter	V _f																			
Unit	m ³																			
Description	Biogas flow																			
Source of data	Daily operation record																			
Value(s) applied	<table><tr><th>Year</th><th>Total Biogas Flow (m³)</th><th>Biogas Flow to the Gas Engine (m³)</th><th>Biogas Flow to the Flare (m³)</th></tr><tr><td>2020</td><td>40,078,459</td><td>39,389,620</td><td>688,839</td></tr><tr><td>2021</td><td>38,738,614</td><td>38,354,223</td><td>384,390</td></tr><tr><td>2022</td><td>42,816,733</td><td>42,315,233</td><td>501,499</td></tr></table>				Year	Total Biogas Flow (m ³)	Biogas Flow to the Gas Engine (m ³)	Biogas Flow to the Flare (m ³)	2020	40,078,459	39,389,620	688,839	2021	38,738,614	38,354,223	384,390	2022	42,816,733	42,315,233	501,499
Year	Total Biogas Flow (m ³)	Biogas Flow to the Gas Engine (m ³)	Biogas Flow to the Flare (m ³)																	
2020	40,078,459	39,389,620	688,839																	
2021	38,738,614	38,354,223	384,390																	
2022	42,816,733	42,315,233	501,499																	
Measurement methods and procedures	Monitored continuously, record hourly and saved automatically in the SCADA system. The data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in daily operation record.																			
Monitoring frequency	Continuously measured by flow meter 1, and flowmeter 2.																			
QA/QC procedures																				
Purpose of data	Used in Calculation of project emissions																			
Additional comment																				

Data / Parameter	$\sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f})$
Unit	Liters
Description	Average consumptions of fuel type f in volume per year from manure road transportation
Source of data	Log-book records

Value(s) applied	<table> <tr> <th>Year</th><th>Average Consumption (lt)</th></tr> <tr> <td>2020</td><td>83,027</td></tr> <tr> <td>2021</td><td>86,365</td></tr> <tr> <td>2022</td><td>104,131</td></tr> </table>	Year	Average Consumption (lt)	2020	83,027	2021	86,365	2022	104,131
Year	Average Consumption (lt)								
2020	83,027								
2021	86,365								
2022	104,131								
Measurement methods and procedures	Each and Every truck diesel oil bills								
Monitoring frequency	Annually, based on daily records, monthly aggregation								
QA/QC procedures	Diesel oil bills related to both the manure and treated fermented products transportation are recorded in the operational logbooks daily.								
Purpose of data	Calculation of project emissions								
Additional comment	The project activity keeps track of the fuel consumed for each dedicated truck that supplies manure to the project boundary or transfers fermented product/sludge outside the project boundary. Biogas plant have special agreements with the diesel fuel supplier and all bills are generated electronically and at the end of each calendar month The amount of fuel is tracked by the bills that states the number of Liters of diesel fuel, which is the fuel type used in these trucks. Hence, using such data does not lead to any discrepancy. This approach is taken by the PP because the project owner owns all the special manure carrying vehicles, bulldozers and company cars where the diesel fuel is supplied from the same diesel station. Thus, taking the litres of diesel oil consumed by the vehicles is reliable, conservative and realistic								

Data / Parameter	n_{dy}		
Unit	<i>Numbers</i>		
Description	Number of days the central treatment plant was operational in year y		
Source of data	Project developer records		
Value(s) applied	<table> <tr> <th>Year</th><th>n_{dy} (numbers)</th></tr> </table>	Year	n_{dy} (numbers)
Year	n_{dy} (numbers)		

	<table> <tr> <td>2020</td><td>365</td></tr> <tr> <td>2021</td><td>365</td></tr> <tr> <td>2022</td><td>365</td></tr> </table>	2020	365	2021	365	2022	365
2020	365						
2021	365						
2022	365						
Measurement methods and procedures	Annually						
Monitoring frequency							
QA/QC procedures	Shall be measured according to the weight scale in the entrance of the facility.						
Purpose of data	To calculate Baseline emission						
Additional comment							

Data / Parameter	$EC_{PJ,j,y}$																			
Unit	MWh/yr																			
Description	Quantity of electricity consumed by the project electricity consumption source j in year y																			
Source of data	Electricity meter / Bill generated																			
Value(s) applied	<table><tr><th>Year</th><th>Electricity from biogas captured (MWh)</th><th>Electricity supplied the national grid (MWh)</th><th>Electricity consumed by the project activity (MWh)</th></tr><tr><td>2020</td><td>16,725.963</td><td>13,303.140</td><td>3,422.809</td></tr><tr><td>2021</td><td>21,488.186</td><td>18,769.352</td><td>2,718.834</td></tr><tr><td>2022</td><td>19,840.527</td><td>17,011.020</td><td>2,829.507</td></tr></table>				Year	Electricity from biogas captured (MWh)	Electricity supplied the national grid (MWh)	Electricity consumed by the project activity (MWh)	2020	16,725.963	13,303.140	3,422.809	2021	21,488.186	18,769.352	2,718.834	2022	19,840.527	17,011.020	2,829.507
Year	Electricity from biogas captured (MWh)	Electricity supplied the national grid (MWh)	Electricity consumed by the project activity (MWh)																	
2020	16,725.963	13,303.140	3,422.809																	
2021	21,488.186	18,769.352	2,718.834																	
2022	19,840.527	17,011.020	2,829.507																	
Measurement methods and procedures																				
Monitoring frequency	Continuous measurements and monthly recorded.																			
QA/QC procedures	Concerning metering system accuracy, project participants have to comply with relevant national legislation. The project must ensure that the metering devices are in line with the																			

	technical requirements which are set out by the Communiqué for Metering Devices to be used in the Electricity Market, which describes the minimum accuracy requirement the metering devices have to fulfil, which are categorized according to the installed capacity. Maintenance and calibration of Electricity Distribution Company meters will be carried out according to the System Usage Agreement. The periodical calibration or maintenance is under the responsibility of the distribution company and has been fixed as once in 10 years. • The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. Electricity meters will be calibrated every 10 years according local standard (MEASUREMENT AND MEASURING INSTRUMENTS INSPECTION REGULATION²⁴ dated 15-12-2019) to ensure accuracy and data will be recorded and backed- up.
Purpose of data	Calculation of project emissions
Additional comment	

Data/parameter	FV _{RG,h}										
Unit	m ³ /h										
Description	Volumetric flow rate of the captured biogas in dry basis at normal conditions in hour h										
Source of data	Log book records										
Value(s) applied	<table><tr><td>Year</td><td>Captured biogas (m³/h)</td></tr><tr><td>2020</td><td>4,575.166</td></tr><tr><td>2021</td><td>4,422.216</td></tr><tr><td>2022</td><td>4,887.754</td></tr></table>			Year	Captured biogas (m ³ /h)	2020	4,575.166	2021	4,422.216	2022	4,887.754
Year	Captured biogas (m ³ /h)										
2020	4,575.166										
2021	4,422.216										
2022	4,887.754										
Choice of data or Measurement methods and procedures	Continuously by flow meter										
Purpose of data	Used in Calculation of project emissions										

²⁴ <https://mevzuat.gov.tr/mevzuat?MevzuatNo=6381&MevzuatTur=7&MevzuatTertip=5>

Additional comment	Periodic calibration will be done of the meters as per agreement
--------------------	--

Data/parameter	fvCH4,RG,H										
Unit	fraction										
Description	Volumetric fraction of methane in the captured biogas on dry basis in hour h										
Source of data	Log book records										
Value(s) applied	<table><tr><th>Year</th><th>Volumetric fraction of methane (%)</th></tr><tr><td>2020</td><td>62.65</td></tr><tr><td>2021</td><td>61.70</td></tr><tr><td>2022</td><td>63.80</td></tr></table>			Year	Volumetric fraction of methane (%)	2020	62.65	2021	61.70	2022	63.80
Year	Volumetric fraction of methane (%)										
2020	62.65										
2021	61.70										
2022	63.80										
Choice of data or Measurement methods and procedures	Continuously										
Purpose of data	Periodic calibration will be done of the meters as per agreement										
Additional comment	Used in Calculation of project emissions										

Data/parameter	T		
Unit	°C		
Description	Monthly average ambient temperature at the livestock farms included in the project boundary		
Source of data	Turkish General Directorate of Meteorology ²⁵		
Value(s) applied	Year	Month	Average Ambient Temperature (°C)

²⁵ <https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=A&m=IZMIR>

	<table><tr><td rowspan="12">2020-2022</td><td>January</td><td>8.8</td></tr><tr><td>February</td><td>9.6</td></tr><tr><td>March</td><td>11.6</td></tr><tr><td>April</td><td>15.9</td></tr><tr><td>May</td><td>20.8</td></tr><tr><td>June</td><td>25.4</td></tr><tr><td>July</td><td>27.9</td></tr><tr><td>August</td><td>27.7</td></tr><tr><td>September</td><td>23.8</td></tr><tr><td>October</td><td>18.9</td></tr><tr><td>November</td><td>14.3</td></tr><tr><td>December</td><td>10.6</td></tr><tr><td colspan="2">Yearly Average</td><td>17.9</td></tr></table>	2020-2022	January	8.8	February	9.6	March	11.6	April	15.9	May	20.8	June	25.4	July	27.9	August	27.7	September	23.8	October	18.9	November	14.3	December	10.6	Yearly Average		17.9
2020-2022	January		8.8																										
	February		9.6																										
	March		11.6																										
	April		15.9																										
	May		20.8																										
	June		25.4																										
	July		27.9																										
	August		27.7																										
	September		23.8																										
	October		18.9																										
	November		14.3																										
	December	10.6																											
Yearly Average		17.9																											
Choice of data or Measurement methods and procedures	-																												
Purpose of data	Used to select the annual MCFj from 2019 Refinement to the IPCC 2006 Guidelines.																												
Additional comment																													

Data / Parameter:	$V_{CH_4, RG, m}$								
Data unit:	m ³ gas/m ³ dry gas								
Description:	Volumetric fraction of component <i>CH₄</i> in the residual gas on a dry basis in the minute <i>m</i>								
Source of data	Measurements by project operator using a continuous gas analyzer (values are recorded with the same frequency as the flow).								
Description of measurement methods and procedures to be applied	Measurement may be made on wet basis. Analyzers are periodically calibrated according to the manufacturer's recommendation.								
Frequency of monitoring/recording	Continuously. Values are to be averaged on a minute basis if flare is on operation 100% status								
Value monitored	<table> <tr> <th>Year</th><th>$V_{CH_4, RG, m}$ (%)</th></tr> <tr> <td>2020</td><td>62.65</td></tr> <tr> <td>2021</td><td>61.70</td></tr> <tr> <td>2022</td><td>63.80</td></tr> </table>	Year	$V_{CH_4, RG, m}$ (%)	2020	62.65	2021	61.70	2022	63.80
Year	$V_{CH_4, RG, m}$ (%)								
2020	62.65								
2021	61.70								
2022	63.80								
Monitoring equipment	Gas Analyzer								

QA/QC procedures to be applied	Analyzers must be periodically calibrated according to the manufacturer's recommendation.
Purpose of the data	Calculation of emissions from flaring
Calculation method	
Comments	Project operator measure the content CH ₄ , CO, CO ₂ and H ₂ S

Data / Parameter:	$V_{RG,m}$									
Data unit:	m ³									
Description:	Volumetric flow of the residual gas on a dry basis at reference conditions in the minute m									
Source of data:	Measurements by project participants using a flow meter									
Description of measurement methods and procedures to be applied	Measurements by project operator using a calibrated flow meter									
Frequency of monitoring/recording	Continuously. In flare operation is 100% or on.									
Value monitored	<table><tr><th>Year</th><th>$V_{RG,m}$ (m³)</th></tr><tr><td>2020</td><td>688,838.96</td></tr><tr><td>2021</td><td>384,390.51</td></tr><tr><td>2022</td><td>501,499.13</td></tr></table>		Year	$V_{RG,m}$ (m³)	2020	688,838.96	2021	384,390.51	2022	501,499.13
Year	$V_{RG,m}$ (m³)									
2020	688,838.96									
2021	384,390.51									
2022	501,499.13									
Monitoring equipment										
QA/QC procedures to be applied	Flow meters are to be periodically calibrated according to the manufacturer’s recommendation									
Purpose of the data	Calculation of emissions from flaring									
Calculation method										
Comments	This parameter is monitored, project implements enclosed flare									

Data / parameter:	Flame _m	
Data unit:	Flame on	
Description:	Flame detection of flare in the minute m	
Source of data:	Booster System	
Description of measurement methods and procedures to be applied	Measure using a fixed installation optical flame detector	
Frequency of monitoring/recording	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off	
Value monitored	Year	Flame On Duration (h)
	2020	424
	2021	285
	2022	357
Monitoring equipment	Flame Detector ORDEL 0-1200 °C N type thermocouple	
QA/QC procedures to be applied	-	
Purpose of the data	Project emissions from flaring	
Calculation method	-	
Comments	-	

D.3. Comparison of monitored parameters with last monitoring period

This is the 1st monitoring period; no last monitoring period can be compared.

Data/Parameter	Value obtained in this monitoring period			Value obtained last monitoring period
EG _{d,y}	2020	13,303.14		NA
	2021	18,769.352		
	2022	17,011.02		
Quality of employment (training)	2020	32		NA
	2021	20		
	2022	11		
Quantitative employment	2020	31		NA
	2021	27		
	2022	29		
Air Quality related to capturing and utilising GHGs from animal manure (tCO2e/yr)	2020	169,956		NA
	2021	188,914		
	2022	177,833		
VS (%)	2020	Dairy Cattle	75.86%	NA
		Non-dairy Cattle	74.59%	
	2021	Dairy Cattle	77.02%	
		Non-dairy Cattle	76.34%	
	2022	Dairy Cattle	77.52%	
		Non-dairy Cattle	77.28%	
N _p	2020	38,684		NA
	2021	37,897		
	2022	36,031		
N _{da}	2020	Dairy Cattle	365	NA
		Non-dairy Cattle	270	
	2021	Dairy Cattle	365	
		Non-dairy Cattle	270	
	2022	Dairy Cattle	365	
		Non-dairy Cattle	270	

n _{dy}	2020		365	NA	
	2021		365		
	2022		365		
EC _{PJ,j,y}	2020	3,422.809	NA		
	2021	2,718.834			
	2022	2,829.507			
FV _{RG,h}	2020	4,575.166	NA		
	2021	4,422.216			
	2022	4,887.754			
fV _{CH4,RG,H}	2020	62.65	NA		
	2021	61.70			
	2022	63.80			
FE	2020	90	NA		
	2021	90			
	2022	90			
V _{RG,m}	Year	V _{RG,m} (m ³)	NA		
	2020	688,838.96			
	2021	384,390.51			
	2022	501,499.13			
V _{CH4,RG,m}	Year	V _{CH4,RG,m} (%)	NA		
	2020	62.65			
	2021	61.70			
	2022	63.80			
$\sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f})$	2020	83,027	NA		
	2021	86,365			
	2022	104,131			
V _f	Year	Total Biogas Flow (m ³)	Biogas Flow to the Gas Engine (m ³)	Biogas Flow to the Flare (m ³)	NA
	2020	40,078,459	39,389,620	688,839	

2021	38,738,6 14	38,354,2 23	384,390
2022	42,816,7 33	42,315,2 33	501,499

T

Year	Month	Average Ambient Temperature (°C)
2020-2022	January	8.8
	February	9.6
	March	11.6
	April	15.9
	May	20.8
	June	25.4
	July	27.9
	August	27.7
	September	23.8
	October	18.9
	November	14.3
	December	10.6
Yearly Average		17.9

NA

W_{manure,LT}

Year	Dairy Cattle	Other Cattle
2020	8.03	3.18
2021	7.80	3.03
2022	8.20	3.36

NA

Flame_m

Year	Flame On Duration (h)
2020	424
2021	285
2022	357

D.4. Implementation of sampling plan

>> Project proponent has decided to use all data from animal farms instead of using sampling method. Therefore, all data has been taken into account while monitoring parameters calculated.

SECTION E. CALCULATION OF SDG IMPACTS

E.1. Calculation of baseline value or estimation of baseline situation of each SDG Impact

>>

SDG 7 Impact of baseline situation

From 01/01/2020 to 31/12/2020, total electricity produced is 0 MWh without the project activity.
From 01/01/2021 to 31/12/2021, total electricity produced is 0 MWh without the project activity.
From 01/01/2022 to 31/12/2022, total electricity produced is 0 MWh without the project activity.

In baseline scenario, total electricity produced is 0 MWh during the 1st monitoring period from 01/01/2020 to 31/12/2022.

SDG 8 Impact of baseline situation

From 01/01/2020 to 31/12/2020, 0 full-time jobs created in the baseline situation without the project activity.
From 01/01/2021 to 31/12/2021, 0 full-time jobs created in the baseline situation without the project activity.
From 01/01/2022 to 31/12/2022, 0 full-time jobs created in the baseline situation without the project activity.

SDG 13 Impact of baseline situation

From 01/01/2020 to 31/12/2020, the amount of GHGs emission avoided or sequestered in baseline is 0 tCO₂e.
From 01/01/2021 to 31/12/2021, the amount of GHGs emission avoided or sequestered in baseline is 0 tCO₂e.
From 01/01/2022 to 31/12/2022, the amount of GHGs emission avoided or sequestered in baseline is 0 tCO₂e.
Without the project activity, 0 tCO₂e GHGs emission can be avoided or sequestered during the 1st monitoring period from 01/01/2020 to 31/12/2022

E.2. Calculation of project value or estimation of project situation of each SDG Impact

>>

SDG 7 Impact of project situation

From 01/01/2020 to 31/12/2020, 13,303.14 MWh of electricity was generated through capturing biogas.

From 01/01/2021 to 31/12/2021, 18,769.352 MWh of electricity was generated through capturing biogas.

From 01/01/2022 to 31/12/2022, 17,011.02 MWh of electricity was generated through capturing biogas.

For the 1st monitoring period from 01/01/2020 to 31/12/2022, total 49,083.512 MWh of electricity generation supplied by the project to the grid was generated through capturing biogas.

SDG 8 Impact of project situation

From 01/01/2020 to 31/12/2020, 31 jobs for local people were created (including 5 females and 26 males), the average monthly earnings of employees were 3,065 TL/person. Equal salaries were paid for men and women in the same position.

From 01/01/2021 to 31/12/2021, 27 jobs for local people were created (including 4 females and 23 males), the average monthly earnings of employees were 3,530 TL/person. Equal salaries were paid for men and women in the same position.

From 01/01/2022 to 31/12/2022, 29 jobs for local people were created (including 6 females and 23 males), the average monthly earnings of employees were 6,680 TL/person. Equal salaries were paid for men and women in the same position.

SDG 13 Impact of project situation

As per section B.6 of the PDD, baseline emissions in year y (BE_y) can be calculated as follows, Baseline emissions are:

(Equation 1)

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

where:

BE_y	Baseline emissions in year y (t CO ₂ /yr)
$BE_{CH_4,y}$	Baseline CH ₄ emissions in year y (t CO ₂ /yr)
$BE_{N_2O,y}$	Baseline N ₂ O emissions in year y (t CO ₂ /yr)
$BE_{elec/heat,y}$	Baseline CO ₂ emissions from electricity and/or heat used in the baseline (t CO ₂ /yr)

i) Baseline CH₄ emissions (BE_{CH₄, y})

(Equation 2)

$$BE_{CH_4,y} = GWP_{CH_4} * D_{CH_4} * \sum_{j,LT} (MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{BL,j})$$

where:

BE _{CH₄, y}	Baseline CH ₄ emissions in year y (t CO ₂ /yr)
GWP _{CH₄}	Global Warming Potential (GWP) of CH ₄ (t CO ₂ e/t CH ₄)
D _{CH₄}	Density of CH ₄ (t/m ³). 0.00067t/m ³ at room temperature(20°C)and 1 atm pressure.
MCF _j	Annual methane conversion factor (MCF) for the baseline AWMS _j . IPCC 2006, table 10.17, chapter 10,volume 4.
B _{0,LT}	Maximum methane producing potential of the volatile solid generated by animal type LT (m ³ CH ₄ /kg -dm)
N _{LT}	Annual average number of animals of type LT for the year y (number)
VS _{LT,y}	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
MS% _{BL,j}	Fraction of manure handled in system j in the baseline. In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%. MS% _{BL,j} =100%
LT	Type of livestock
j	Type of treatment system

Estimation of various variables and parameters for above equations:

(A) VS_{LT,y} shall be determined in following way

As per AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant" version 01.0, there are five ways to determine the VSLT,y value. The project participants have chosen to use the 4th option but in order to apply the most conservative value Project participants have also compared direct measurement results with the IPCC Eastern Europe default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), Annex 10A.2, Table 10A-4 and Table 10A-5 (Eastern Europe values) for dairy cows and other cattle.

The reasoning behind the elimination of the first four options is as follows:

In the 1st option, there are no published country-specific data for Turkey.

For the 2nd option, data related to the dietary intake of livestock is not available. This is because animal manure from multiple farms cannot track or supply specific dietary intake data. Furthermore, farm owners tend to constantly change the livestock feed due to changes in its prices and availability in the Turkish market.

The 3rd option is not applicable because it is not practical and/or doable to receive regular Wsite data from the multiple farms that supply animal manure to the biogas project. While laws and regulations²⁶ mandate the farm owners to track the number of animals through ID numbers specific to each animal, there are no rules to follow the weight of the animals. This is why the PPs are not able to request such information from the livestock farms as per how such data is requested to be obtained in the applied Meth.

²⁶ [https://www.resmigazete.gov.tr/eskiler/2011/12/20111202-9.htm#:~:text=MADDE%2021%20-%20\(1\)%20Hayvan,gün%20içinde%20ilgili%20il%20Flçe](https://www.resmigazete.gov.tr/eskiler/2011/12/20111202-9.htm#:~:text=MADDE%2021%20-%20(1)%20Hayvan,gün%20içinde%20ilgili%20il%20Flçe)

The 4th option requires the use of IPCC default values

As described in IPCC Sixth Assessment report under Chapter 13²⁷ Turkey is regarded under Southern Europe Region. Also project location is just 150 kms away from the Greece Border. The project-specific animal weights (all animal farms that the Manure is collected have either Hollstein Dairy Cows, Brown Swiss Dairy Cows or Simental Cattle where these dairy cows and other cattle are exported originally from Switzerland or Holland) are more similar to developed country IPCC default values.

So project proponent has utilized default values of IPCC 2006, Table 10A-4 through 10A-9, Chapter 10, Volume 4, multiply the value by ndy (number of days the central treatment plant was operational in year y);

(B) Annual average number of animals of type LT (N_{LT}) shall be determined in following way

(Equation 4)

$$N_{LT} = N_{da,LT} * \left(\frac{N_{p,LT}}{365} \right)$$

where:

N_{LT}	Annual average number of animals of type LT for the year y (number)
$N_{da,LT}$	Number of days animal of type LT is alive in the farm in the year y (number)
$N_{p,LT}$	Number of animals of type LT produced annually for the year y (number)

(C) Maximum methane producing potential($B_{0,LT}$)

In line with the requirements of AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, 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 2006 IPCC Refinement, Table 10A-4 (p. 10.77, West or East Europe -specific to the country where the proposed project activity is implemented).The values are taken 0.24 m³ CH₄/kg dm for dairy cattle and 0.17 m³ CH₄/kg dm for other cattle. As described in IPCC Sixth Assessment report under Chapter 13²⁷ Turkey is regarded under Southern Europe Region. Also Project Location is just 150 kms away from the Greece Border.

More importantly, in accordance with the relevant law and regulations, the farm owners are mandated to keep the track of each animal that they have at their farm. Each animal has their ear tags stating their names, ages, types, vaccinations These official records that need to be prepared and be submitted to the governmental offices. And all animal farms that the Manure is collected have either Hollstein Dairy Cows, Brown Swiss Dairy Cows or Simental Cattle where these dairy cows and cattles are exported originally from Switzerland or Holland as can be seen from the governmental records of each animal farms.

IPCC Sixth Assessment Report Section 13.1.1 ScreenShot

²⁷ <https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-13/>

Geographical subdivision of land and ocean regions of Europe

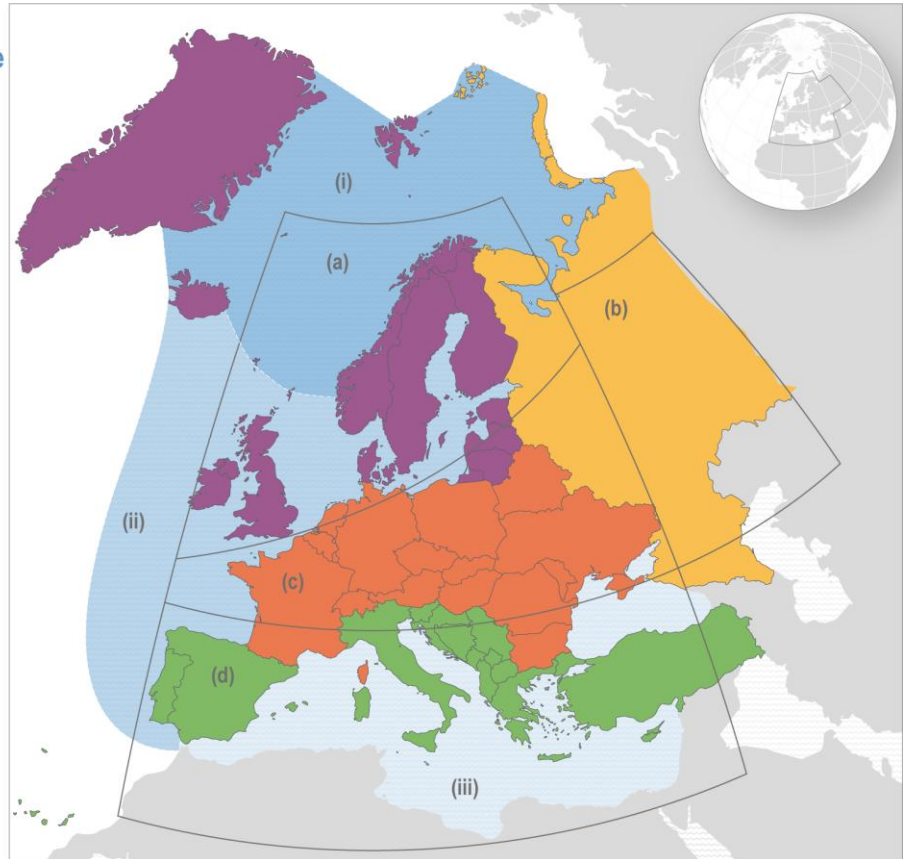
Polygon delineations represent the boundaries used for the regional synthesis of historical trends and future climate change projections used in the Assessment Reports of the IPCC WGI.

- (a) Northern Europe (NEU)
- (b) Eastern Europe (EEU)
- (c) Western and Central Europe (WCE)
- (d) Southern Europe (SEU) *

European marine sub-regions

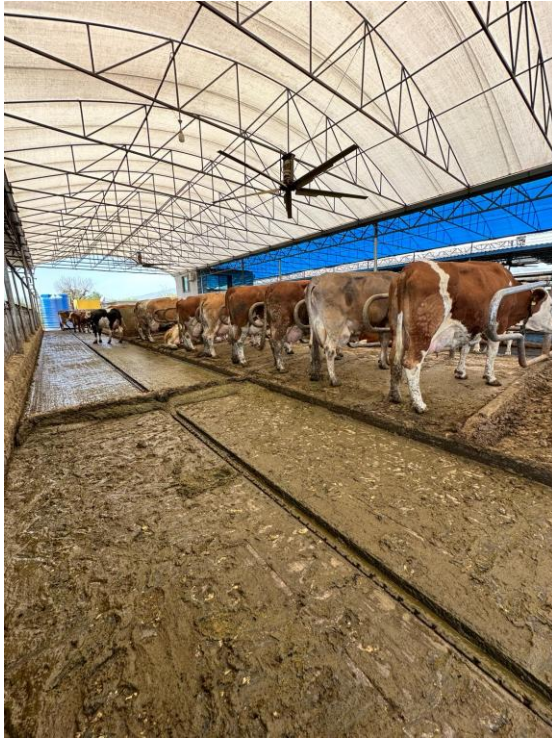
- (i) Northern European Seas (NEUS)
- (ii) Temperate European Seas (TEUS)
- (iii) Southern European Seas (SEUS)

* Different from the WGI Mediterranean (MED) which includes also the eastern and southern countries bordering the Mediterranean.



Sample Pictures from the Dairy Farms and Official Records (To Represent the Animal Types)





HAYVANLARIN TANIMLANMASI, KAYIT GÜNCELLEME VE VETERİNER BİYOLOJİK ÜRÜN UYGULAMA BELGESİ

Rapor Tarihi : 15.04.24
Sayfa No : 1/8

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Önceki Sahibi : -

Aşağıda bilgileri yazılı olan hayvanların, şahıma ait olduğunu, işletiminde bulunduğunu ve işletimdeki kayıtlarını mevcut hayvan varlığına göre güncellenmesini kabul ederim. Ayrıca yapılan tanımlama işlemi sonucunda köpeksi hayvanların bulunmadığını taahhüt ederim. Hayvanlarıma uygulanan ve aşağıdaki tabloda detaylı olarak belirtilen veteriner biyolojik ürünlerin ve tanımlama araçlarının bedelleri ile bunların uygulama ücretleri olan mahsuplağın kabul ediyorum / kabul etmiyorum. /nin Tanımlama, Desteklemeler kapsamında yapılacak ödemelerden kesinti yoluyla saymanlığına ödeyeceğimi ve ödeme yapıldığına dair evrakı il/ilçe müdürlüğüne teslim edeceğimi, teslim etmemem halinde tüm yasal sorumlulukları şahıma ait olduğunu kabul ve taahhüt ederim.

Tanımlama / Biyolojik Ürün *	Adedi	Tanımlama Aracı Veteriner Biyolojik Ürün Birim Bedeli **	Uygulama Ücreti Birim Bedeli	Toplam Bedel

* Yapılan işlem biyolojik ürün ise seri numaraları yazılacaktır.
**Tanımlama aracı veya biyolojik ürünün döner sermaye ücreti buraya yazılacaktır.

Sıra	Var Yok	Köpe No	Yapılan İş	İlk	Ortalama	Brusella Antijen Testi	Doğum Tarihi	İşletmeye Geliş Tarihi	Sığılma No	Fideler Aşağı No	Son Doğum Tarihi	Tahmini Doğum Tarihi	Tahmini Doğum Tarihi
1		DESD140466702		HOBEN-CA	DİŞİ	+	24.09.14	25.06.16	1	DESD1403001481	14.01.24	-143	05.09.24
2		DESD1404769772		HOBEN-CA	DİŞİ	+	25.06.14	25.06.16	1	DESD1403009900	10.06.23	Uygun	31.01.24
3		DESD1404646463		HOBEN-CA	DİŞİ	+	23.11.14	25.06.16	1	DESD1403002724	12.11.23	-40	04.07.24
4		DESD1404676797		HOBEN-CA	DİŞİ	+	05.10.14	25.06.16	1	DESD1403006063	24.06.23	Uygun	15.04.24
5		DESD1405011554		HOBEN-CA	DİŞİ	+	25.12.14	25.06.16	1	DESD1404109442	24.07.23	Uygun	15.03.24
6		DESD1501461116		HOBEN-CA	DİŞİ	+	09.08.14	25.06.16	1	DESD0032767238	07.07.21	Uygun	27.02.22
7		DESD1501501781		HOBEN-CA	DİŞİ	+	08.08.14	25.06.16	1	DESD1501509507	17.03.23	Uygun	07.11.23
8		DESD1603405049		HOBEN-CA	DİŞİ	+	04.10.14	25.06.16	1	DESD1603163309	29.10.21	Uygun	21.09.22
9		TR35000270343		HOBEN-CA	DİŞİ	+	19.08.16	19.08.16	1	DESD1604745044	09.03.23	Uygun	30.10.23
10		TR350002702670		HOBEN-CA	DİŞİ	+	24.09.16	24.09.16	1	DESD1601461118	06.01.23	Uygun	29.09.23
11		TR350002702685		HOBEN-CA	DİŞİ	+	03.10.16	03.10.16	1	DESD1603442066	18.11.23	-86	10.07.24
12		TR35000274112		HOBEN-CA	DİŞİ	+	11.10.16	11.10.16	1	DESD1604812424	13.01.24	-142	04.09.24

(D) Annual methane conversion factor (MCF_j) for the baseline AWMS_j

The values for Methane conversion factors (MCF_j) are obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Table 10A-4, (p. 10.77), depending on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For the project location, İzmir province in Turkey,

Mean annual temperature is 17.9 °C;

Mean annual precipitation (MAP) is 710.5;

Potential Evapotranspiration (PET) is 1,725.7.

Hence, in accordance with Information Required to Determine Climate Zones According to Table 10A-4 IPCC 2006 Volume 4 Chapter 10, page 10.77, İzmir is considered as Warm Temperate Dry as its climate zone.

J is Uncovered anaerobic lagoon. Thus, MCF_{uncoveredanaerobic lagoon} is accounted as 0.76

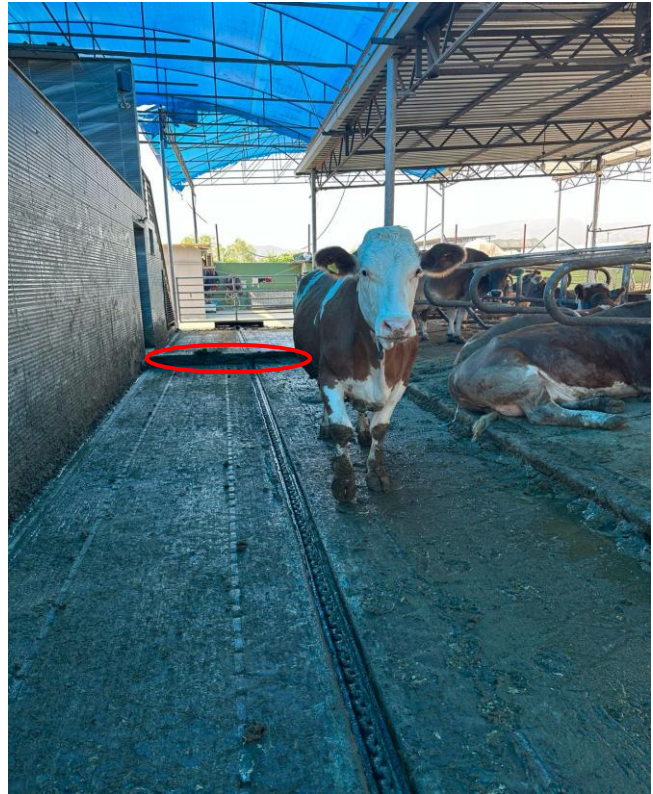
As noted in AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, IPCC 2006 Guidelines for National Greenhouse Gas Inventories are taken into account. Note that a conservativeness factor applied by multiplying MCF value (estimated as per above) with a value of 0.94, to account for the 20% uncertainty in the MCF values as reported by IPCC 2006.

The Regulation on Livestock Farms implemented after 2006²⁸ 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 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 more than 1 meter.

All the dairy farms from where the manure is collected in the project case are all commercial farms for dairy production and were built after 2006. Although It is mandated by the law collecting all the manure in the anaerobic open lagoons by a sweeping system is the common practice (for hygiene purposes as well) for all the farms in the project boundary.

²⁸ <https://www.resmigazete.gov.tr/eskiler/2006/08/20060809-4.htm>

Sample Pictures from the Farms (Sweeping System and Uncovered Anaerobic Lagoon)



Sample Pictures from the Farms (Sweeping System)



ii) Baseline N₂O emissions (BE_{N₂O,y})

Baseline emissions of N₂O has been considered 0.

iii) Baseline CO₂ emission from electricity and/or heat used in the baseline

(Equation 5)

$$BE_{\frac{elec}{heat},y} = EG_{Bl,y} \times CEF_{Bl,elec,y} + EG_{d,y} \times CEF_{grid} + HG_{Bl,y} \times CEF_{Bl,therm,y}$$

Where:

$BE_{\frac{elec}{heat},y}$	=	Baseline CO ₂ emissions from electricity and/or heat used in the baseline, in tCO ₂ e/year
$EG_{Bl,y}$	=	Amount of electricity in the year y that would be consumed in the absence of the project activity (MWh) for operating all AWMs facilities
$CEF_{Bl,elec,y}$	=	Carbon emissions factor for electricity consumed at the project site in the absence of the project activity (tCO ₂ e/MWh)
$EG_{d,y}$	=	Amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh)
CEF_{grid}	=	Carbon emissions factor for the grid in the project scenario (tCO ₂ e/MWh)
$HG_{Bl,y}$	=	Quantity of thermal energy that would be consumed in year y in the absence of the project activity (MJ) using fossil fuel for operating all AWMs
$CEF_{Bl,therm,y}$	=	CO ₂ emissions intensity for thermal energy generation (tCO ₂ e/MJ)

In accordance with the methodology of AM0073, the baseline emissions with electricity generation in year y ($BE_{\frac{elec}{heat},y}$) shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” However, the Tool 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 03.0²⁹.

Generic approach

As per “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, version 03.0, in the generic approach, baseline emissions from consumption of electricity are calculated based on the quantity of

²⁹ https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-05-v1.pdf/history_view

electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

Equation (6)

$$BE_{elec/heat,y}^{elec} = EG_{d,y} \times CEF_{grid}$$

Where:

- $BE_{elec/heat,y}^{elec}$ = Baseline CO2 emissions from electricity and/or heat used in the baseline, in tCO2e/year
- $EG_{d,y}$ = Amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh)
- CEF_{grid} = Carbon emissions factor for the grid in the project scenario (tCO2e/MWh)

Determination of the emission factor for electricity generation ($EF_{EL,k,y} = CEF_{grid}$)

The emission factor, $EF_{EL,k,y}$, for the electricity generation in accordance with Scenario A (Electricity consumption from the grid) as defined under "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", version 3.0.

According to Tool to calculate the emission factor for an electricity system version 07.0, 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.

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.

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.

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 CO₂ emissions per unit net electricity generation (t CO₂/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 CO₂ 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.

Ministry of Energy and Natural resources of Turkey has published the data for OM using simple OM calculation³⁰

$$EF_{grid,OM,y} = 0.7258$$

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

³⁰<https://enerji.gov.tr/Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TürkiyeUlusalElektrikŞebekesiEmisyonFaktörü/Belgeler/EK-2.pdf>

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.

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

Based on 2020 data³¹, Ministry of Energy and Natural resources of Turkey has calculated build margin and published the data:

$$EF_{grid,BM,y} = 0.3680 \frac{tCO_2e}{MWh}$$

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:

The combined margin emissions factor is calculated as follows:

Equation (7)

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

Where:

$EF_{grid,CM,y}$	=	Build margin CO2 emission factor in year y (tCO2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO2 emission factor in year y (tCO2/MWh)
$EF_{grid,BM,y}$	=	Combined margin CO2 emission factor in year y (t CO2/MWh)
w_{OM}	=	Weighted of operating margin emissions factor (per cent)
w_{BM}	=	Weighted of build margin emissions factor (per cent)

³¹

<https://enerji.gov.tr/Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TürkiyeUlusalElektrikŞebekesiEmisyonFaktörü/Belgeler/EK-2.pdf>

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:

$$w_{OM} = 0.50$$

$$w_{BM} = 0.50$$

Based on 2020 data³², Ministry of Energy and Natural resources of Turkey has calculated combined margin and published the data:

$$EF_{grid,CM,y} = 0.5706 \text{ tCO}_2\text{e/MWh}$$

TIME	Electricity supplied to the national grid (MWh)	BE _{elec/heat} (tCO ₂ eq)
01/01/2020-31/12/2020	13,303.140	7,591
01/01/2021-31/12/2021	18,769.352	10,710
01/01/2022-31/12/2022	17,011.020	9,706
TOTAL	49,083.512	28,007

Table 4. Basic parameter

DATES	N _{LT}	N _{LT}	W _{manure,LT} (kg/animal/day)		VS _{default} (kg-dm/animal/year)		n _{dy} (day)	MS% _{BI,j}	N _P (number)	
	Dairy Cattle	Other Cattle	Dairy Cattle	Other Cattle	Dairy Cattle	Other Cattle			Dairy Cattle	Other Cattle
01/01/2020-31/12/2020	37,066	1,197	8.03	3.18	1,642.50	949	365	100%	37,066	1,619
01/01/2021-31/12/2021	36,075	1,347.41	7.80	3.03	1,642.50	949	365	100%	36,075	1,822
01/01/2022-31/12/2022	34,625	1,040.30	8.20	3.36	1,642.50	949	365	100%	34,625	1,406

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<https://enerji.gov.tr/Media/Dizin/EVCED/tr/ÇevreVeİklim/İklimDeğişikliği/TürkiyeUlusalElektrikŞebekesiEmisyonFaktörü/Belgeler/EK-2.pdf>

Table 5. The calculation result of BE_{CH_4}

Parameter	Value		Unit
species	Dairy Cattle	Other Cattle	
GWP_{CH_4}	25/28	25/28	tCO ₂ /tCH ₄
D_{CH_4}	0.00067	0.00067	t/m ³
MCF_j	76%	76%	%
Conservative Factor	0.94	0.94	/
$B_{0,LT}$	0.24	0.18	m ³ CH ₄ /kg_dm
N_{LT}	Refer to Table 5		
VS_{LT}	Refer to Table 5		
$MS\%_{BI,j}$	Refer to Table 5		
n_{dy}	Refer to Table 5		
01/01/2020-31/12/2020	177,289		tCO ₂ e
01/01/2021-31/12/2021	193,333		tCO ₂ e
01/01/2022-31/12/2022	185,309		tCO ₂ e
$BE_{CH_4,y}$	555,931		tCO ₂ e

Table 10 The calculation results of baseline emissions

Period	$BE_{CH_4}(tCO_2e)$	$BE_{N_2O,y}(tCO_2e)$	$BE_{elec/heat}(tCO_2e)$	$BE_y(tCO_2e)$
01/01/2020-31/12/2020	177,289	-	7,591	184,880
01/01/2021-31/12/2021	193,333	-	10,710	204,043
01/01/2022-31/12/2022	185,309	-	9,706	195,015
1st monitoring period	555,931	-	28,007	583,938

Total Calculated baseline impact (baseline emissions) of the 1st monitoring period was 583,938 tCO₂e.

(Equation 8)

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{Comp,y} + PE_{N_2O,y} + PE_{PL,y} + PE_{flare,y} + PE_{elec_{heat},y} + PE_{CO_2,Trans,y} + PE_{storage,y}$$

where:

PE_y = Project emissions (tCO₂e/yr)

$PE_{AD,y}$	=	Leakage from treatment stage that captures methane (tCO ₂ e/yr)
$PE_{Aer,y}$	=	Methane emissions from the aerobic treatment stage (tCO ₂ e/yr)
$PE_{Comp,y}$	=	Total project emissions due to composting (tCO ₂ e/yr)
$PE_{N2O,y}$	=	Nitrous oxide emission from project treatment system (tCO ₂ e/yr)
$PE_{PL,y}$	=	Physical leakage of emissions from biogas network to flare the captured methane or supply to the facility where it is used for heat and/or electricity generation (tCO ₂ e/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream (tCO ₂ e/yr)
$PE_{elec/heat}$	=	Project emissions from use of heat and/or electricity in the project case (tCO ₂ e/yr)
$PE_{CO2,Trans,y}$	=	Project emissions from manure road transportation (tCO ₂ e/yr)
$PE_{storage,y}$	=	Project emissions from manure storage (tCO ₂ e/yr)

Since the proposed project activity does not consist of aerobic AWMS treatment, $PE_{Aer,y}$ shall be accounted as "0". In addition, for the proposed project does not involve composting, $PE_{Comp,y}$ shall also be accounted as "0". Moreover, since the manure is not stored in outdoor open storage tanks more than 24 hours, $PE_{storage,y}$ shall be accounted as "0" too. Accordingly, the equation (8) above could be simplified as shown in the equation (9) below.

As per section B.6 of the PDD, project emissions can be calculated as follows,

Equation (9)

$$PE_y = PE_{AD,y} + PE_{PL,y} + PE_{flare,y} + PE_{elec/heat,y} + PE_{CO2,Trans,y}$$

i) Project emissions associated with the anaerobic digester in year y ($PE_{AD,y}$)

In accordance with AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, IPCC guidelines specify physical leakage from anaerobic digesters as being 15% of total biogas production. Where project participants use lower values for percentage of physical leakage, they should provide measurements or other source of evidence proving that this lower value is appropriate for the project.

To calculate leakage from AWMS systems, methane leakage coefficient which is 0.028 for concrete digesters is taken from Tool 14: Project and leakage emissions from anaerobic

digesters³³. Ex ante leakage to be reported in the PD will be estimated using the equation 10 below,

Equation (10)

$$PE_{AD,y} = GWP_{CH_4} \times \rho_{CH_4,n} \times \frac{LF_{AD}}{(1 - LF_{AD})} \times \sum_{h=1}^{8760} (FV_{RG,h} \times fv_{CH_4,RG,h})$$

Where:

$PE_{AD,y}$	=	Leakage from AWMS systems that capture's methane in tCO ₂ e/yr
GWP_{CH_4}	=	Global Warming Potential (GWP) of CH ₄
$\rho_{CH_4,n}$	=	Density of methane at normal (at room temperature 20°C and 1 atm pressure) conditions (6.7x10 ⁻⁴ t/m ³)
$FV_{RG,h}$	=	Volumetric flow rate of the captured biogas in dry basis at normal conditions in hour h (m ³ /h)
$fv_{CH_4,RG,h}$	=	Volumetric fraction of methane in the captured biogas on dry basis in hour h (fraction)
LF_{AD}	=	Methane leakage from anaerobic digesters/reactor, default of 0.028 (Taken from Tool 14. Source of data: IPCC (2006), Flesch et al. (2011) and Kurup (2003))

ii) N₂O emissions from the central treatment plant

Since Baseline emissions from N₂O has been considered zero. Hence project emissions from N₂O also taken as zero and not considered in the project activity.

iii) Physical Leakage from distribution network of the captured methane in (PE_{PL})

In accordance with AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, this refers to leaks in the biogas system from the biogas pipeline delivery system. The sum of the quantities of captured methane fed to the flare, to the power plant and to the boiler (measures as per the monitoring plan) must be compared annually with the total methane generated as measured by meter at the outlet of the methane generating digester. The difference between the monitored value of methane

³³ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v2.pdf>

generated and that consumed in flare/electricity generation/heat shall be accounted as leakage from the pipelines.

In the case where biogas is just flared and the pipeline from collection point to flare is short (i.e., less than 1 km, and for on-site delivery only), one flow meter can be used. In such cases the physical leakage may be considered as zero.

iv) Project emissions from heat use and electricity use ($PE_{elec/heat}$)

In accordance with AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, project emissions from heat use and electricity use ($PE_{elec/heat}$) are calculated as follows:

Equation (11)

$$PE_{\frac{elec}{heat},y} = PE_{elec,y} + \sum_j PE_{heat,j,y}$$

Where:

$PE_{Elec,y}$ = Are the emissions from consumption of electricity in the project case. The project emissions from electricity consumption ($PE_{Elec,y} = PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

$PE_{heat,j,y}$ = Are the emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{heat,j,y} = PE_{FC,j,y}$) will be calculated following the latest version of "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the plant established as part of the project activity, as well as any other on-site fuel combustion for the purposes of the project activity.

It is 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)

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

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (tCO 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

v) Project emissions from flaring

In case, there is residual gas stream which will be flared by flaring and the project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the Tool 06 “Project emissions from flaring” version 04.0³⁴.

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The calculation procedure of project emissions from flaring is given in the following steps:

- STEP 1: Determination of the methane mass flow of the residual gas;
- STEP 2: Determination of the flare efficiency;
- STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The tool 08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” shall be used to determine the following parameter $FCH4,m$:

The following requirements apply:

- (a) The gaseous stream to which the tool is applied is the residual biogas for flaring;
- (b) The flow of the gaseous stream shall be measured continuously;
- (c) CH₄ is the greenhouse gas i for which the mass flow should be determined;
- (d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- (e) The time interval t for which mass flow should be calculated is every minute m. $FCH4,m$, which is measured as the mass flow during minute m, shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($FCH4,RG,m$). $FCH4,m$ shall be determined on a dry basis.

³⁴ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf>

Therefore, option A is adopted to calculate the mass flow of the residual biogas for flaring as per Too 08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”

The mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

Equation (13)

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$$

Where:

- $F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
- $V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)
- $v_{i,t,db}$ = Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas)
- $\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³ gas i)

Step 2: Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. For open flares a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer’ s specifications for operating conditions shall be met.

The proposed project will adopt enclosed flare.

Enclosed flare

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute m ($\eta_{\text{flare},m}$) and shall document in the CDM-PDD which option is selected:

Option A: Apply a default value for flare efficiency.

Option B: Measure the flare efficiency.

For this project, the Option A is selected.

Option A: Default value

The flare efficiency for the minute m ($\eta_{\text{flare},m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare (TEG,m) and the flow rate of the residual gas to the flare (FRG,m) is within the manufacturer's specification for the flare (SPECflare) in minute m; and

(2) The flame is detected in minute m (Flamem).

Otherwise $\eta_{flare,m}$ is 0%.

For enclosed flares that are defined as low height flares, the flare efficiency shall be adjusted, as a conservative approach, by subtracting 10 percentile points. Since the flare is enclosed flare, the default value for flare efficiency applied shall be 80%, rather than 90%.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

Equation (14)

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

Where:

$PE_{flare,y}$ = Project emissions from flaring of the residual gas in year y (tCO₂e)

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO₂e/CH₄)

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

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

As described above, $F_{CH4,RG,m}$ will be determined according to equation 25 and 26, so the Project emissions from flaring can be calculated by:

Equation (15)

$$PE_{flare,y} = GWP_{CH4} \times V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Since the gaseous stream will be distributed through the same pipeline, and the temperature and pressure of gaseous stream can be stable. Therefore the $v_{i,t,db}$ and $\rho_{i,t}$ of residual gas will be same with the biogas produced in the anaerobic digester.

vi) Project emissions from road transportation

In accordance with AM0073 "GHG emission reductions through multi-site manure collection and treatment in a central plant", version 01.0, the project emissions from manure transportation from the collection points to the central treatment plant are to be calculated using distance traveled by trucks and the fuel emission factor, as follows:

Equation (16)

$$PE_{CO_2,Trans,y} = \left\{ \sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f}) \times \rho_{fuel} \times \left[\sum_f NCV_f \times EF_{CO_2,f} \right] \right\}$$

Where:

- $PE_{CO_2,Trans,y}$ = Project emissions from manure road transportation in tCO₂e/yr
- $N_{vehicles,i,y}$ = Number of trips of vehicleIs type i used for transportation, with similar loading capacity
- $Dist_{i,y}$ = Average distance per trip travelled by transportation vehicleIs types i during the year y (km)
- ρ_{fuel} = Density of diesel fuel (kg/lt)
- $FC_{i,f}$ = Specific consumption of fuel type f in volume or mass units per km for vehicle type j
- NCV_f = Net calorific value of fuel type f in TJ per volume or mass units
- $EF_{CO_2,f}$ = CO₂ emission factor of the fossil fuel type f used in transportation vehicles, (tCO₂e/TJ)

Emissions arising from the road transportation of treated manure shall be calculated as described above. Such emission shall be considered as project emissions if the final destiny and itinerary between the treatment plant are included in the project boundary. Otherwise such emission shall be considered as leakage ($LE_{CO_2,Trans,y}$), which shall be calculated in the same manner as depicted above.

In the equation, $\sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f})$ is the part that the methodology is calculating the total consumption of fuel type f in volume per year from manure road transportation. Since, the PP is actively recording the data on the total consumption of diesel fuel f in volume by the vehicles, $\sum_i (N_{vehicles,i,y} \times Dist_{i,y} \times FC_{i,f})$ shall be taken from the PP's accounting records.

Table 11 The calculation result of $PE_{EC,y}$

Time	$EC_{PJ,j,y}$ (MWh)	$EF_{EF,j,y}$ (tCO ₂ /MWh)	$TDL_{j,y}$	$PE_{EC,y}$ (tCO ₂ e/yr)
01/01/2020-31/12/2020	3,422.809	0.5706	11%	2,167.89
01/01/2021-31/12/2021	2,718.834	0.5706	11%	1,722.02
01/01/2022-31/12/2022	2,829.507	0.5706	11%	1,792.11

Table 12 The calculation result of $PE_{CO_2,trans,y}$

Time	$I_{\text{vehicles},i,y}$ $\ast \text{Dist}_{i,y} \ast \text{FC}_{i,f}$ (lt)	$\text{EF}_{\text{CO}_2,f}$ (kg/TJ)	NCV_f (TJ/GG)	$\text{PE}_{\text{CO}_2,\text{Trans},y}$ (tCO ₂ e/yr)
01/01/2020-31/12/2020	83,027	74,800	43.3	224.51
01/01/2021-31/12/2021	86,365	74,800	43.3	233.54
01/01/2022-31/12/2022	104,131	74,800	43.3	281.58

Table 13 The calculation result of $\text{PE}_{\text{AD},y}$

Period	$\text{FV}_{\text{RG},h}$ (m ³ /h)	$\text{fv}_{\text{CH}_4,\text{RG},h}$	$\text{PE}_{\text{AD},y}$ (tCO ₂ e/yr)
01/01/2020-31/12/2020	4,575.166	62.65%	12,115.43
01/01/2021-31/12/2021	4,422.216	61.70%	12,916.77
01/01/2022-31/12/2022	4,887.754	63.80%	14,762.46

Table 14 The calculation result of $\text{PE}_{\text{Flare},y}$

Period	GWP_{CH_4}	$V_{t,db}$ (m ³)	$v_{\text{CH}_4,t,db}$ (%)	$\rho_{\text{CH}_4,t}$ (kg/m ³)	$n_{\text{flare},m}$	$\text{PE}_{\text{flare},y}$ (tCO ₂ e)
01/01/2020-31/12/2020	25	688,838.96	62.65%	0.1929	0.80	416.24
01/01/2021-31/12/2021	28	384,390.51	61.70%	0.1929	0.80	256.20
01/01/2022-31/12/2022	28	501,499.13	63.80%	0.1929	0.80	345.63

Table 15 Calculation results of project emissions for SDG 13

Period	$\text{PE}_{\text{AD},y}$ (tCO ₂ e)	$\text{PE}_{\text{CO}_2,\text{trans},y}$ (tCO ₂ e)	$\text{PE}_{\text{EC},y}$ (tCO ₂ e)	$\text{PE}_{\text{flare},y}$ (tCO ₂ e)	PE_y (tCO ₂ e)
01/01/2020-31/12/2020	12,115.43	224.51	2,167.89	416.24	14,924
01/01/2021-31/12/2021	12,916.77	233.54	1,722.02	256.20	15,129
01/01/2022-31/12/2022	14,762.46	281.58	1,792.11	345.63	17,182
1st monitoring period	39,794.66	739.63	5,682.02	1,018.07	47,235

E.3. Calculation of leakage

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While leakage calculations are determined, the net leakage of N₂O and CH₄ are calculated as negative hence, the net leakage of N₂O and CH₄ are not considered.

As per the applied Meth., 'Such emission shall be considered as project emissions if the final destiny and itinerary between the treatment plant are included in the project boundary. Otherwise, such emission shall be considered as leakage (LE_{CO₂,Trans,y}). Since this project considers the road transportation within the project boundary, leakage emission from road transportation is considered as zero.

E.4. Calculation of net benefits or direct calculation for each SDG Impact

According to applied methodology, AM0073 States that "if the calculated CH₄ emissions from the baseline are higher than the measured CH₄ generated in the anaerobic digester in the project situation (this is calculated as the product of biogas flow at the digester outlet and methane fraction in the biogas), then the latter shall be used to calculate the emissions reduction for claiming certified emissions reductions. Thus, the calculated methane emission from the baseline are less than the actual methane capture (where the actual methane capture is 1,431,917 tCO₂e and calculated methane emissions from the baseline is 516,136 tCO₂e during this monitoring period) Calculated methane emissions from the baseline has been used for Emission Reduction Calculations.

Measured Methane Emission Generated in the Anaerobic Digester			
Year	Q _{biogas,y} (Nm ³)	f _{CH₄} (Nm ³ CH ₄ /Nm ³ biogas)	BE _{CH₄,y} (actual methane capture) (tCO ₂ e/y)
2020	40,078,459	62.65%	471,050
2021	38,738,614	61.70%	448,398
2022	42,816,733	63.80%	512,470
TOTAL			1,431,917

The Baseline emission calculated as;

$$ER_y = BE_{CH_4,y}(\text{calculated}) - PE_{AD,y} - PE_{PL,y}$$

As per the above formula PE_{AD,y} and PE_{PL,y} is not considered to compare calculated CH₄ emissions from the baseline.

Year	$BE_{CH_4,y}$ (calculated methane capture) (tCO _{2e} /y)	$PE_{AD,y}+PE_{PL,y}$ (tCO _{2e} /y)	$BE_{CH_4,y} - (PE_{AD,y}+PE_{PL,y})$ (Calculated methane from the baseline) (tCO _{2e} /y)
2020	177,289	12,115	165,174
2021	193,333	12,917	180,416
2022	185,309	14,762	170,546
1st monitoring period	555,931	39,794	516,137

As per above explanations Total Emission Reduction is calculated as

$$ER_y = BE_y - PE_y - LE_y$$

Monitoring Period	TOTAL EMISSION REDUCTION				
	BE_y		PE_y	LE_y	ER_y
	$BE_{CH_4,y}$	$BE_{elec/heat}$			
2020	177,289	7,591	14,924	-	169,956
2021	193,333	10,710	15,129	-	188,914
2022	185,309	9,706	17,182	-	177,833
TOTAL	555,931	28,007	47,235	-	536,703

SDG	SDG Impact	Baseline estimate	Project estimate	Net benefit
13	Emission Reductions	2020/01/01- 2020/12/31: 0 tCO _{2e}	2020/01/01- 2020/12/31: 169,956 tCO _{2e}	2020/01/01- 2020/12/31: 169,956 tCO _{2e}
		2021/01/01- 2021/12/31: 0 tCO _{2e}	2021/01/01- 2021/12/31: 188,914 tCO _{2e}	2021/01/01- 2021/12/31: 188,914 tCO _{2e}
		2022/01/01- 2022/12/31: 0 tCO _{2e}	2022/01/01- 2022/12/31: 177,833 tCO _{2e}	2022/01/01- 2022/12/31: 177,833 tCO _{2e}

7	EG _{d,y}	2020/01/01- 2020/12/31: 0 MWh	2020/01/01- 2020/12/31: 16,725.963 MWh	2020/01/01- 2020/12/31: 16,725.963 MWh
		2021/01/01- 2021/12/31: 0 MWh	2021/01/01- 2021/12/31: 21,488.186 MWh	2021/01/01- 2021/12/31: 21,488.186 MWh
		2022/01/01- 2022/12/31: 0 MWh	2022/01/01- 2022/12/31: 19,840.527 MWh	2022/01/01- 2022/12/31: 19,840.527 MWh
8	Number of males and females employed by the project	2020/01/01- 2020/12/31: 0 jobs for local people were created	2020/01/01- 2020/12/31: 31 jobs for local people were created (including 5 females and 26 males)	2020/01/01- 2020/12/31: 31 jobs for local people were created (including 5 females and 26 males)
	Number of males and females employed by the project	2021/01/01- 2021/12/31: 0 jobs for local people were created	2021/01/01- 2021/12/31: 27 jobs for local people were created (including 4 females and 23 males)	2021/01/01- 2021/12/31: 27 jobs for local people were created (including 4 females and 23 males)
	Number of males and females employed by the project	2022/01/01- 2022/12/31: 0 jobs for local people were created	2022/01/01- 2022/12/31: 29 jobs for local people were created (including 6 females and 23 males)	2022/01/01- 2022/12/31: 29 jobs for local people were created (including 6 females and 23 males)
8	Average monthly salary	2020/01/01- 2020/12/31: 0 jobs created, 0 income	2020/01/01- 2020/12/31: 3,065 TL/person, and equal salaries were paid for men and women in the same position.	2020/01/01- 2020/12/31: 3,065 TL/person, and equal salaries were paid for men and women in the same position.

	Average monthly salary	2021/01/01-2021/12/31: 0 jobs created, 0 income	2021/01/01-2021/12/31: 3,530 TL/person, and equal salaries were paid for men and women in the same position.	2021/01/01-2021/12/31: 3,530 TL/person, and equal salaries were paid for men and women in the same position.
	Average monthly salary	2022/01/01-2022/12/31: 0 jobs created, 0 income	2022/01/01-2022/12/31: 6,680 TL/person, and equal salaries were paid for men and women in the same position.	2022/01/01-2022/12/31: 6,680 TL/person, and equal salaries were paid for men and women in the same position.

E.5. Comparison of actual SDG Impacts with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values ³⁵ achieved during this monitoring period
13	1 st monitoring period: 3,732,939 tCO ₂ e (668,247 tCO ₂ e as per the PDD version 08 submitted for Design Change approval)	2020/01/01-2022/12/31: 536,703 tCO ₂ e
7	1 st monitoring period: 93,345 MWh of electricity generation by capturing biogas	2020/01/01-2022/12/31: 49,083.512 MWh of electricity generation by capturing biogas
8	1 st monitoring period: 20 jobs for local people created	2020/01/01-2022/12/31: 31/27/29 jobs for local people created respectively for years 2020/2021 and 2022 (including 6 females and 25/21/23 males). Average monthly salary 6,680 TL/person, and equal salaries paid for men and women in the same position.

³⁵ Whenever emission reductions are capped, both the original and capped values used for calculations must be transparently reported. Use brackets to denote original values.

E.5.1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

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According to PDD, the estimated outcomes of SDG 7 for the 1st monitoring period are 93,345 MWh of electricity generation which is calculated according to electricity generation license outcome of biogas power plant. While the actual outcomes of SDG 7 are total of 49,083.512 MWh (Average of 16,361.171 MWh/year) of electricity generation in the 1st monitoring period, which is extended from operation start date to at the end of 2022 and lower by 47% than the estimated value in the PDD.

The estimated value of the outcomes of SDG 13 for the 1st monitoring period is 3,732,939 tCO₂e as per the registered PD (668,247 tCO₂e in the PD Version 08 submitted for design Change approval) , while the actual outcomes of SDG13 is total of 536,703 tCO₂e (average of 178,901 tCO₂e/year) in the 1st monitoring report where the actual value is 75% lower than the estimated value in the registered PDD and %19.7 lower than the estimated value in the PD version 08 submitted for design change approval. The calculation of the estimated and actual value of SDG 13 is based on methodology ACM0073" GHG emission reductions through multi-site manure collection and treatment in a central plant", Version 1.0.

Number of males and females employed by the project and average monthly salary during the 1st monitoring period were determined by the Record Keeping Book and Labor contracts and Payrolls. 31/27/29 jobs for local people were created respectively in 2020/2021 and 2022 (including 6 females and in 25/21/23 males in 2020/2021 and 2022). The average monthly salary was 6,680/person for 2022 (equal salaries paid for men and women in the same position). Outcomes of SDG 8 are higher than the estimated outcomes in the PDD.

E.6. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

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Outcomes of SDG 8 are higher than the estimated outcomes in the PDD. Employment number had increased within time due to need handling higher amount of manure intake and methane production.

SECTION F. SAFEGUARDS REPORTING

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According to the Section D.1 and Appendix 1 in PDD, only one assessment question answered 'Potentially' i.e., in case of biogas is not handled properly during the operation period of the project, methane explosion may be caused. Therefore, mitigation measure for safeguarding principles is required and the parameter of Employee Training of biogas safety operation during the operation period shall be monitored, which is described in section D.2 of this MR.

During this monitoring period, no biogas explosion or leakage was happened. The monitoring of this parameters was fully implemented in accordance with the monitoring plan in PDD and the monitoring activities was successful, so there is no need to update the mitigation measures.

SECTION G. STAKEHOLDER INPUTS AND LEGAL DISPUTES

G.1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

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Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.
Continuous Input / Grievance Expression Process Book (mandatory)	A grievance book was put in Front Desk Administration of the project owner. All stakeholders are allowed to record their grievances or comments in the book. The project owner will assign specific person to deal with related issues. When assessing the relevance and appropriateness of the stakeholders' comments, the project owner will apply a gender lens.
GS Contact (mandatory)	help@goldstandard.org
Other	Feedback can be made directly through visiting ARF Bio Yenilenebilir Enerji Üretim A.Ş. or through e-mail meliharslan3@gmail.com.

No inputs/grievances received during the 1st monitoring period through all the methods.

G.2. Report on any stakeholder mitigations that were agreed to be monitored.

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No inputs/grievances received during the 1st monitoring period; therefore, stakeholder mitigations do not need to be reported.

G.3. Provide details of any legal contest that has arisen with the project during the monitoring period

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No legal contest or dispute has been arisen with the project during the 1st monitoring period.

Revision History

Version	Date	Remarks
1.1	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Section for POA monitoring Forward action request section Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on safeguard reporting Clarity on design changes Leakage section added for VER/CER projects Addition of Comparison of monitored parameters with last monitoring period Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.0	10 July 2017	Initial adoption