Verified Carbon Standard

ZONGULDAK LANDFILL GAS TO ELECTRICITY PROJECT

Document Prepared by Life İklim ve Enerji Ltd. Şti.

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Zonguldak Landfill Gas to Electricity Project (hereafter referred to as the project) is located at Zonguldak Landfill Site in Sofular Neighborhood, Central District, Zonguldak Province Turkey. The project is owned by Arel Yenilenebilir Enerji Teknolojileri ve Elektrik Üretim Ltd. Şti. (hereafter referred to as the project owner). The project is designed to utilize the gas produced in the existing landfill to generate electricity. The facility started operation on 03/06/2021 with capacity of 3.088 MWm / 3.002 MWe with two generators. The total installed capacity will be 4.539 MWm / 4.415 MWe = (2x1.544) MWm / (2x1.501) MWe + (1x1.451 MWm / 1x1.413 MWe), consisting of 2 sets of generators, and installation of third generator is planned to be completed as of 2023.

Prior to the implementation of the project, the landfill site did not have gas extraction and utilization systems installed, and the LPG was directly emitted to the atmosphere. The project collects and utilizes LFG generated by Zonguldak landfill for power generation. Therefore, the project drastically reduces methane emissions, and at the same time, electricity is generated from the collected gas. Electricity generated is provided to the grid and the facility utilizes electricity generated by the project instead of drawing electricity from the grid.

The environmental, socio-economic, and technological benefits of the Project are described as follows:

- Reduction in fossil fuel use (imported or local) by using renewable energy resources,
- Reduction in greenhouse gas emissions from the landfill area by using biogas for electricity production,
- Reduction in energy production costs and imported energy amounts,
- Improvement of environmental conditions (GHG and odour) and safety in the landfill area.

The project is expected to reduce 79,423 tCO_2e/year in average in the first 7-year crediting period between starting date of 28-June-2021 and ending date of 27-June-2028. Vintage reductions are given in the table below:

Audit Type	Period	Program	VVB Name	Number of years
Validation/ Verification	28-June-2021 to 30- April -2023	VCS	-	1 year 10 months
Total	28-June-2021 to 30- April -2023			1 year 10 months

1.2 Sectoral Scope and Project Type

Scope 1: Energy Industries (renewable-/non-renewable sources)

Scope 13: Waste handling and disposal.

1.3 Project Eligibility

The project is an LFG power generation project, utilizing landfill gas (LFG), which consists mainly of methane, for electricity generation, which is eligible under the scope of the VCS Program.

1.4 Project Design

☒ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☐ The project is a grouped project

Eligibility Criteria

The project is not a grouped project.

1.5 Project Proponent

Organization name	Arel Yenilenebilir Enerji Teknolojileri ve Elektrik Üretim Ltd. Şti.
Contact person	Damla Yiğit
Title	Public Relations and Environmental Management Manager
Address	Mutlukent Mahallesi 1977. Sokak No:17 Çankaya /ANKARA
Telephone	+90 312 435 80 32
Email	damla@arelenerji.com

1.6 Other Entities Involved in the Project

Organization name	Life İklim ve Enerji Ltd. Şti.
Role in the project	Carbon Certification Consultant

Contact person	Nazire Gür
Title	Consultant
Address	Oğuzlar Mah. 1377. Sk. No:19/9 06520, Balgat, Çankaya/Ankara
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Email	nazire.gur@lifeenerji.com

1.7 Ownership

Arel Yenilenebilir Enerji Teknolojileri ve Elektrik Üretim Ltd. Şti. holds all licenses, permits, and land use rights related to Zonguldak LFG and has obtained and owns all equipment used for its implementation.

1.8 Project Start Date

The start date of the project is 28/06/2021 which is commissioning date of the project.

1.9 Project Crediting Period

Crediting Period Type: 7 years twice renewable (Renewable twice for a total of 21 years)

Crediting Period Start date: 28-June-2021

Crediting Period End date: 27-June-2028

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☒ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	

Large project	√

Year	Estimated GHG emission reductions or removals (tCO_2e)
28-June- 2021 to 31-December-2021	37,859
Year 2022	76,035
Year 2023	77,556
Year 2024	78,887
Year 2025	80,053
Year 2026	81,076
Year 2027	81,954
27-June- 2028 to 31-December-2028	42,541
Total estimated ERs	555,961
Total number of crediting years	7 years
Average annual ERs	79,423

1.11 Description of the Project Activity

Greenhouse gas (GHG) emissions will be reduced by avoiding CO2 emissions from those fossil fuel-based power plants connected to the grid and by avoiding GHG emissions from releasing LFG into atmosphere at the landfill site.

The purpose of the project is to utilize landfill gas (LFG), which consists mainly of methane, for electricity generation. It includes LFG collection system, LFG pre-treatment system, electricity generation system and flare system.

Waste is collected and deposited to the landfill by the Municipality. Then, landfill gas is extracted via landfill gas collection system. Collected gas is flared and utilized for electricity generation.

Steps in the landfill gas to electricity project:

1- Storage of waste in landfill
2- Generation of LFG at the landfill
3- Collection of LFG via pipelines
4- Booster system that draws collected LFG
5- Treatment of LFG via Chiller Unit
6- Electricity and thermal energy generation in gas engines
7- Electricity feeding to national power grid
8- Flaring process of extra gas that is not burnt in the engines.

The working principles of landfill gas are as follows. The LFG caused by the organic content of the landfill is collected by pipelines connected to the booster system. The gas which Booster collects also blew the gas to the engine to be burnt down. If there is a failure of the engines, the collected gas is directed to the flare system. In the system, there is no need for auxiliary fuels for the start-up of the engines. The LFG can be burnt directly.

LFG collection system

LFG is extracted from MSW under negative pressure by blower pumps and moved through wells, then collected by gas collection stations and transferred by sub-pipes and a main pipe to LFG treatment equipment. Flow rate of the LFG is regulated at the collection points in order to always fit with the consumption capacity of the generation engines.

LFG treatment system

Prior to electricity generation, LFG is treated to remove impurities and moisture, to avoid corrosion in the engines. The treatment consists of filtration, de-moisturing, cooling and pressurization.

Electricity generation and grid connection system

3 motor engines and 3 generators are fed with the LFG to generate electricity, which is then exported to the grid. Technical parameters of the motor engines and generators are given below Table.

Table 1. Technical parameters of the gas generators and motor engines

Main Equipment	Parameter	Value
Generators	Type	LSA 52.3 L9./4P
	Manufacturer	Leroy Somer Nidec
	Rated Power	(2 x 1870 kVA) + (1 x 1748 kVA)
	Rated rotation speed	1544 rpm

	Frequency	50 Hz
Motor Engines	Type	J420GS-B25
	Manufacturer	Innio Jenbacher GmbH & Co OG
	Rated Power	(2 x 1544 kW) + (1 x 1451 kW)
	Rated rotation speed	1500 rpm

The total annual power generation is estimated to be 33,113 MWh/year. The expected average annual emission reductions are 79,423 tCO_2e in the first 7-year crediting period. The total estimated emission reductions over the crediting period of the project will be 555,961 tCO_2e. The milestone table of the project is presented below.

Table 2. Milestone of the Project

Event	Date
Environmental Impact Assessment Exemption	13/04/2021
EMRA granted the PA Generation License	03/06/2021
System Connection Agreement	08/06/2021
Provisional Acceptance Protocol	28/06/2021

1.12 Project Location

The Project is located in Zonguldak landfill site, Sofular neigborhood, Central District, Zonguldak Province, Turkey. Location of the project is given below in the Figure 1. The geographical coordinates of the project site are given below Table.

Table 3. Corner Coordinates of the Project site

Corner No	E	N
1	410207,071	4589413,679
2	410190,652	4589432,518
3	410244,750	4589446,517
4	410244,750	4589446,517

Figure 1 Location of the Project

Figure 2 Google Earth view of the Project and Landfill Site

1.13 Conditions Prior to Project Initiation

The scenario existing prior to the implementation of the Project is the same as the baseline scenario described in Section 3.4.

- Prior to the implementation of the project, the landfill site did not have gas extraction and utilization systems installed.
- Gas generated due to decaying organic matter was released directly to the atmosphere.
- Equivalent electricity generated by the project was supplied by the grid, which is dominated by fossil fuel-based power plants.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Zonguldak LFG complies with all applicable laws and regulations such as;

1 – Electricity Market Law (Law Number: 6446, ratified 14/03/2013, enacted 30/03/2013)[1]

2 – Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy (Law Number: 5346, ratified 10/05/2005, enacted 11/08/1983)[2]

3 – Energy Efficiency Law (Law Number: 5627, ratified 18/04/2007, enacted 02/05/2007)[3]

4 – Environment Law (Law Number: 2872, ratified 09/08/1983, enacted 11/08/1983)[4]

1.15 Participation under Other GHG Programs

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

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

1.15.2 Projects Rejected by Other GHG Programs

Since the Project did not apply for any other programs, it did not get rejection from any either.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

[1] https://www.mevzuat.gov.tr/MevzuatMetin/1.5.6446.pdf

[2] https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5346.pdf

[3] https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5627.pdf

[4] https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=2872&MevzuatTur=1&MevzuatTertip=5

☐ Yes ☒ No

Not applicable. The project activity is neither included in an emissions trading program nor does it take place in a jurisdiction or sector which has binding limits on GHG emissions.

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

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

1.16.3 Supply Chain (Scope 3) Emissions

The project will remove methane emissions by capturing and destroying LFG and will remove carbon by electricity supplying to the national grid. Apart from that project activity will not impact on any scope 3 emissions.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

Zonguldak Landfill Gas to Power Generation Project is located at Zonguldak Landfill Site, Zonguldak, Turkiye. whose objective is to collect the landfill gas (LFG) from Zonguldak landfill site and utilize it to generate electricity. The project involves the installation of LFG collection, pre-treatment system, with subsequent electricity generation and grid connection system.

The Project will contribute to sustainable development in the following ways:

- Increasing labor demand of skilled labor for the fabrication, installation, operation and maintenance of the methane recovery and electricity generation system and thus, contributing to the sustainable economic growth of the region,
- Generating and dispatching electricity from a renewable and sustainable energy source to a grid nowadays reliant on fossil,
- Contributing to the climate change fight by reducing CH_4 emissions.
- Constituting a new, clean and efficient technology model for the disposal and handling of waste
- Improving air quality (i.e. by reducing odor) and therefore having positive effects on the local environment.

Project will make positive contributions to at least three Sustainable Development Goals (SDGs).

These are:

SDG 7: Affordable and Clean Energy

The proposed Project is a waste to power project that will generate renewable energy by capturing methane from municipal waste and utilizing it to produce thermal and electric energy through gas engine systems. By supplying renewable energy generated at the plant to the national grid, the proposed Project will contribute to increasing the share of renewable energy in the global energy mix and the proportion of the population with primary reliance on clean fuels and technology.

SDG 8: Decent Work and Economic Growth

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

SDG 13: Climate Action

The proposed project activity will reduce GHG emissions by capturing and utilizing methane, one of the most potent GHGs triggering climate change. It is estimated that the average annual emission reduction that the proposed Project will generate is around 79,423 tCO_2eq.

1.17.2 Sustainable Development Contributions Activity Monitoring

The project, located in Zonguldak Turkey, reduces GHG emissions by capturing and utilizing methane generated in the landfill. Project prevents direct methane emissions from the landfill to the atmosphere via collection system and generates renewable energy via flaring methane and by doing so increases renewable energy share in the Turkish electricity grid. Reduces amount of wastewater generated by displacing energy generated by fossil fuel plants that use water for cooling. The project also creates equal and safe employment opportunities in the region.

Table 4: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	Increase substantially the share of renewable energy in the global energy mix	Implemented activities to decrease	The annual electricity generation estimation is 33,113 MWh. The generated electrical energy is directly fed to the Turkish national grid.	The annual electricity generation estimation is 33,113 MWh.
2)	8.5	Achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.	Implemented activities to decrease	The Project Activity will provide employment to at least 5 people	Project Proponent provides employment to at least 5 people during the project lifetime complying with Labor Law in Turkey.
3)	8.8	Protect labour rights and promote safe working environments	Implemented activities to increase	Occupational Health and Safety training is provided to employees at least once a year	Occupational Health and Safety training is provided to employees at least once a year
4)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	Since the project collects and utilizes LFG, it will eliminate around 79,423 tCO_2 annually.	Project aims reducing carbon emission by 555,961 tons for the first crediting period. (7 years)

1.18 Additional Information Relevant to the Project

Leakage Management

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

Commercially Sensitive Information

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

Further Information

N/A

2 SAFEGUARDS

2.1 No Net Harm

Ministry of Environment and Urbanization in Turkey has exempted the Project activity from carrying out an Environmental Impact Assessment on April 13th, 2021. The Project is entirely in line with national laws and regulations, including environment, health and safety.

The current practice on the site is a managed landfill with no methane recovery. The Project has several environmental benefits:

- It will cover the landfill area with soil, reducing the adverse visual impacts.
- The cover and an effective landfill gas collection system will reduce odour from the landfill
- The LFG recovery will reduce GHG emissions and help in tackling global warming
- It will set a good example for proper waste management with improved health and safety impacts
- It will minimize explosion and fire risks by decreasing gas accumulation
- It will feed clean energy to the grid, thereby reducing emissions from power generation

As one of the sustainable renewable energy generation technologies, the Project reduces the environmental impacts of the current practice on the landfill site considerably.

2.2 Local Stakeholder Consultation

The project's local stakeholder consultation meeting will be held soon.The local stakeholders will be informed about the stakeholder meeting via announcements. The announcements will be placed around high populated areas of the neighbourhood to be seen by the locals.

The company will invite all potential stakeholders to participate in the local stakeholder consultation meeting to brief them about the project and gather their feedback regarding the implementation of the project and VCS application of the project. In addition, potential stakeholders such as NGOs, ministries, governments etc. will be invited to the meeting through email.
The agenda which will be shared with stakeholders during the local stakeholder meeting can be seen below.

Agenda of presentation:

-Opening of the meeting and introduction

-Explanation of the project

-Environmental and Social Impact Assessment and Sustainable Development contributions of the Project

-Explanation of the grievance mechanism of the Project

-Q&A about the project

-Closure of the meeting

In addition, during local stakeholder consultation meeting, participant form and evaluation form about the project will be filled by participants to collect positive and negative opinions and suggestions about the project.

2.3 Environmental Impact

The environmental matters in Turkey are jurisdiction of the Ministry of Environment and Urbanization. The Law defines among others the general requirements of the Environmental Impact Assessment (EIA) states specific requirements according to the type of project, location, size, and other characteristics.

Project owner applied for an evaluation regarding Environmental Impact Assessment (EIA) Regulation to Zonguldak Provincial Directorate of Environment and Urbanization and the Project received EIA Exemption after evaluation of the project from the Directorate on 13/04/2021.

2.4 Public Comments

Following initial project listing, the VCS/Verra project Zonguldak Landfill Gas to Electricity Project will be open for 30 days of public consultation.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The United Nations approved consolidated baseline methodology applicable to this project is ACM0001.: Flaring or use of landfill gas--- Version 19. [5]

ACM0001 refers to the following tools:

1. Combined tool to identify the baseline scenario and demonstrate additionality. (Ver. 07.0) [6]

2. Emissions from solid waste disposal sites (Ver. 08.0) [7]

3. Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Ver. 03.0) [8]

4. Tool to calculate the emission factor for an electricity system (Ver. 07.0)[9]

5. Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Ver. 03.0) [10]

6. Positive list of technologies (Ver. 04.0) [11]

7. Project emissions from flaring (Ver. 04.0)[12]

[5] https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf

[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf

[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v4.0.pdf

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf

3.2 Applicability of Methodology

No.	Applicability Criteria	Justification	Applicable to the Project or not?
1	The methodology is applicable under the following conditions: (a) Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or (b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that: (i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and (ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available; (c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generating electricity; (ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or (iii) Supplying the LFG to consumers through a natural gas distribution network; (iv) Supplying compressed/liquefied LFG to consumers using trucks; (v) Supplying the LFG to consumers through a dedicated pipeline; (d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	In the absence of the project, there was no LFG capture system at Zonguldak landfill site and LFG was emitted directly into atmosphere. The project will install a new LFG capture system at Zonguldak landfill site and capture and use LFG for power generation. The project does not reduce the amount of organic waste that would be recycled in the absence of the project activity. Prior to the project being implemented, the organic waste that was brought to the site was sent to the landfill and was not used for any purpose, as such there was no recycling of organic waste prior to project implementation.	Applicable

2	The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is: (a) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and (b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln: (i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or (ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary; (c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas. (d) In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.	The most feasible baseline scenario of the project is as follows: Atmospheric release of the LFG; and For electricity generation: that electricity would be generated in the grid.	Applicable

3	This methodology is not applicable: (a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace (b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	Only ACM0001 is applied in the project. The management of the SWDS in the project activity will not be deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	N/A

3.3 Project Boundary

Define the project boundary and identify the relevant GHG sources, sinks and reservoirs for the project and baseline scenarios (including leakage if applicable).

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted for since the CO2 is also released under the project activity
		CH_4	Yes	Major source of emissions in the baseline.
		N_2O	No	N_2O emissions are small compared to CH4 emissions from SWDS. This is conservative
		Other	No	Excluded for simplification. This is conservative.
	Emissions from electricity generation	CO_2	Yes	Major emission source if power generation is included in the project activity
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative

Source		Gas	Included?	Justification/Explanation
		Other		
Project	Emissions from electricity consumption due to the Project activity	CO_2	Yes	May be an important emission source.
		CH_4	No	excluded for simplification. This emission source is assumed to be very small
		N_2O	No	excluded for simplification. This emission source is assumed to be very small
		Other	No	Excluded for simplification. This is conservative
	LFG capture and flaring	CO_2	No	It is part of the natural carbon cycle, where the carbon was previously sequestered from the atmosphere.
		CH_4	Yes	When flare does not operate, methane emissions are subtracted.
		N_2O	No	Excluded for simplification. This is conservative.
		Other	No	Excluded for simplification. This is conservative.

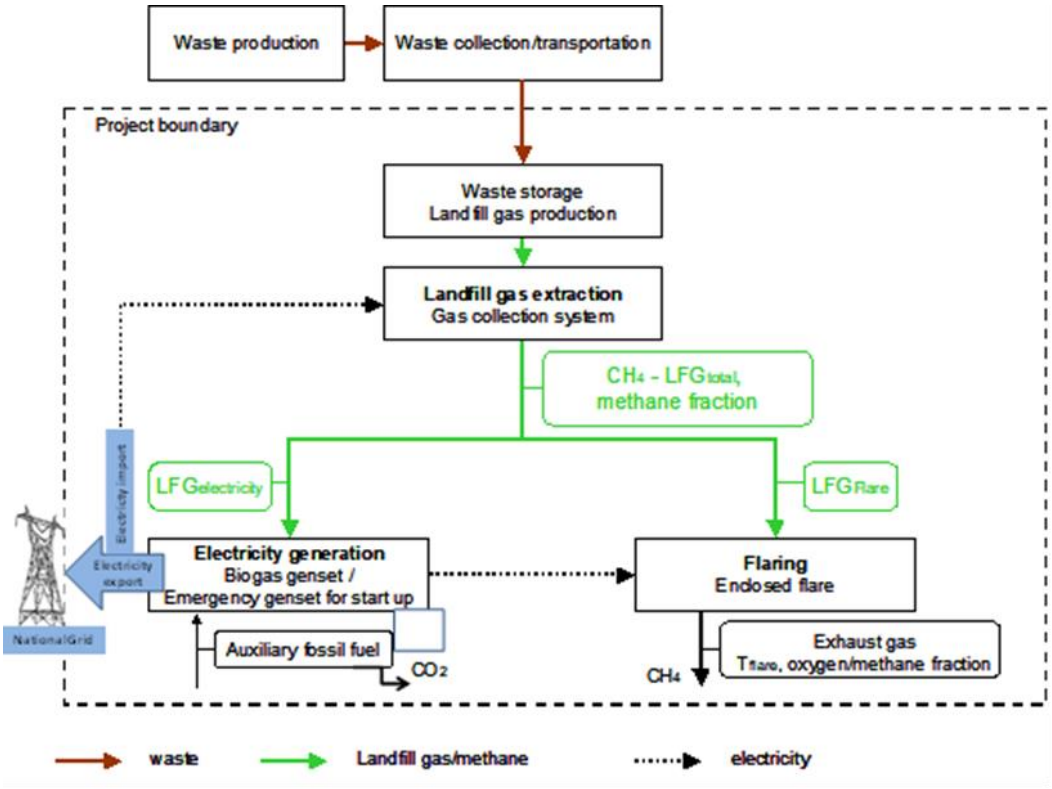

Figure 3 Boundary of the Project

3.4 Baseline Scenario

The baseline scenario is the situation where biomass and other organic matter are left to decay within the project boundary, and methane is emitted to the atmosphere in the absence of the project activity. Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations. However, since Turkey has no legal requirements for LFG emission capture and utilization, these emissions are taken as zero for this Project Activity.

Besides, the recovered methane from landfill gas is used for electricity generation; the baseline emissions are the electricity produced by the renewable generating unit multiplied by the grid emission factor. Since the electricity produced by the proposed Project will be exported to Turkish National Grid, which is mainly based on thermal power plants using fossil fuels, the baseline scenario for electricity replacement is the product of electricity energy baseline expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor. Combined margin (CM) is adopted for emission factor.

Therefore, as explained above, baseline emissions for the Landfill Gas Project are:

A. Landfill Gas: In the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted into the atmosphere

B. Electricity: Product of electricity energy baseline expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor. Combined margin (CM) is adopted for emission factor.

3.5 Additionality

For the simplified procedure to demonstrate additionality, the methodological tool "TOOL32: Positive lists of technologies" is applied in the project.

According to the descriptions above, it is demonstrated that prior to the implementation of the project, the LFG was only vented, and the LFG is used to generate electricity in the project plant with a total nameplate capacity of 4 MW, i.e. below 10 MW. Therefore, the project is deemed automatically additional.

3.6 Methodology Deviations

No methodology deviation is applied in the project.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The project has started operation as of 28 June 2021 During the operation phase of the project there is no major event that impacts the GHG emission reductions occurred.

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the methodology ACM0001 (V19.0), baseline emissions are determined according to equation (1) and comprise the following sources:

$$BEy = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad (1)$$

Where:

BE_y = Baseline emissions in year y (t CO2e/yr)

$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year y (t CO2e/yr)

$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year y (t CO2/yr)

$BE_{HG,y}$ = Baseline emissions associated with heat generation in year y (t CO2/yr)

$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year y (t CO2/yr)

The project is not involved in heat generation and natural gas use; thus, the baseline emissions is calculated as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y} \quad (2)$$

Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) Baseline emissions of methane from the SWDS are determined as follows, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is considered:

$$BE_{CH4} = ((1 - OXtop\_layer) \times FCH4,PJ,y - FCH,BL,y) \times GWP_{CH4} \quad (3)$$

Where:

$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year y (t CO2e/yr)

OX_{top_layer} = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr)

$F_{CH4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y (t CH4/yr)

GWP_{CH4} = Global warming potential of CH4 (t CO2e/t CH4)

Ex post determination of $F_{CH4,PJ,y}$

During the crediting period, $F_{CH4,PJ,y}$ is determined as the sum of the quantities of methane flared and used in power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) and natural gas distribution, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad (4)$$

Where:

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr)

$F_{CH4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (t CH4/yr)

$F_{CH4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year y (t CH4/yr)

$F_{CH4,HG,y}$ = Amount of methane in the LFG which is used for heat generation in year y (t CH4/yr)

$F_{CH4,NG,y}$ = Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year y (t CH4/yr)

The flare will not be used when the power plant is in normal operation, thus, the project proponent decides not to claim the emission reduction from the flare, even if any methane is destroyed by flare during the crediting period. Meanwhile, the project is not involved in heat generation and natural gas use, thus,

$$F_{CH4,PJ,y} = F_{CH4,EL,y} \quad (5)$$

$F_{CH4,EL,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year y (Opj,h,y).

For the project, the flow of gaseous stream is volume flow-wet basis, and the volumetric fraction is wet basis, thus, as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), Option C is applied to determine the parameter of $F_{CH4,EL,y}$.

Option C The mass flow of greenhouse gas i (Fi,t) is determined as follows:

$$F_{i,t} = V_{t,wb,n} \times v_{i,t,wb} \times \rho_{i,n} \quad (6)$$

With:

$$\rho_{i,n} = \frac{P_n \times MM_i}{R_u \times T_n} \quad (7)$$

Where:

Fi,t = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)

Vt,wb,n = Volumetric flow of the gaseous stream in time interval t on a wet basis at normal conditions (m^3 wet gas/h)

v i,t,wb = Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a wet basis (m^3 gas i/m^3 wet gas)

ρi,n = Density of greenhouse gas i in the gaseous stream at normal conditions (kg gas i/m³ wet gas i)

Pn = Absolute pressure at normal conditions (Pa)

Tn = Temperature at normal conditions (K)

MMi = Molecular mass of greenhouse gas i (kg/kmol)

Ru = Universal ideal gases constant (Pa.m3 /kmol.K)

The following equation should be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} \times \left[\left(T_n / T_t \right) \times \left(P_t / P_n \right) \right] \quad (8)$$

Where:

Vt,wb,n = Volumetric flow of the gaseous stream in a time interval t on a wet basis at normal conditions (m3 wet gas/h)

Vt,wb = Volumetric flow of the gaseous stream in time interval t on a wet basis (m³ wet gas/h)

Pt = Pressure of the gaseous stream in time interval t (Pa)

Tt = Temperature of the gaseous stream in time interval t (K)

Pn = Absolute pressure at normal conditions (Pa)

Tn = Temperature at normal conditions (K)

The following requirements apply:

(a) CH4 is the greenhouse gas for which the mass flow will be determined;

(b) The mass flow will be calculated on an hourly basis for each hour h in year y;

(c) The mass flow calculated for hour h is 0 if the equipment is not working in hour h (Opj,h=not working), the hourly values are then summed to a yearly unit basis.

Ex ante estimation of $F_{CH4,PJ,y}$ An ex ante estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the PSF. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4} \quad (9)$$

Where:

FCH4,PJ,y = Amount of methane in the LFG which is flared and/or used in the project activity in year y (t CH4/yr)

η_{PJ} = Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (t CO2e/yr)

$BE_{CH4,SWDS,y}$ = Efficiency of the LFG capture system that will be installed in the project activity

GWP_{CH4} = Global warming potential of CH4 (t CO2e/t CH4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites" (version 08.0). The following guidance should be taken into account when applying the tool:

a) fy in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation (2) of this methodology;

b) In the tool, x begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and

c) Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

The $BE_{CH4,SWDS,y}$ is calculated as follows:

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} \left(W_{j,x} \times DOC_j \times e^{-k_j (y-x)} \times (1 - e^{-k_j}) \right) \quad (10)$$

Where:

$BE_{CH4,SWDS,y}$ = Baseline methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO2e/yr)

x = Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)

y = Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)

DOCf,y = Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)

Wj, x = Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)

ϕ y = Model correction factor to account for model uncertainties for year y

fy = Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y

GWP_{CH4} = Global Warming Potential of methane

OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)

F = Fraction of methane in the SWDS gas (volume fraction)

MCFy = Methane correction factor for year y

DOCj = Fraction of degradable organic carbon in the waste type j (weight fraction)

k = Decay rate for the waste type j (1 / yr)

j = Type of residual waste or types of waste in the MSW

Determination of $F_{CH4,BL,y}$

This section provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, to address safety and odour concerns, or for other reasons (collectively referred to as requirement in this section). The four cases in Table 4 are distinguished. The appropriate case should be identified, and the corresponding instructions followed.

Table 5 Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

There was no regulation or standard that enforces methane destruction in LFG when Zonguldak Landfill site started operation. However, there is an existing LFG power generation project at Zonguldak landfill site prior to the implementation of the project activity. Therefore, this project is in line with case 3: No requirement to destroy methane exists and an LFG capture system exists.

In this situation:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y} \quad (11)$$

The project proponent of the project is not able to provide monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, therefore:

$$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y} \quad (12)$$

Baseline emissions associated with electricity generation ($BE_{EC,y}$)

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool:

(a) The electricity sources k in the tool correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario; and

(b) $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EG_{PJ,y}$).

According to methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y}) \quad (13)$$

Where:

BEEC, y = Baseline emissions from electricity consumption in year y (t CO2 / yr)

ECBL,k , y = Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/yr)

EFEL,k , y = Emission factor for electricity generation for source k in year y (t CO2/MWh)

TDLk , y = Average technical transmission and distribution losses for providing electricity to source k in year y

k = Sources of electricity consumption in the baseline

According to the tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0), the project belongs to the case of Scenario A, use as default values of 3% for baseline emission, i.e., TDLk, y =3%.

Determination of the emission factor for electricity generation (EFgrid,y)

For the emission factors for electricity generation, the publication of the Turkish Ministry of Energy and Natural Resources, which indicates Turkey's National Electric Grid Emission Factor for 2019, was used. The publication includes calculated Emission Factor values that are Operating Margin (OM), Growth Based Margin (Build Margin-BM) and Combined Margin (CM) Emission Factors, for the relevant year with the usage of the IPCC's Clean Development Methodology Tool 07-V06.0. For this calculation, information regarding the data set employed is given below in detail;

- TEİAŞ Turkey's electricity generation-consumption and loss statistics,

- Commonly prepared report under Turkey's National Greenhouse Gas Inventory Reporting Format. - Common Reporting Format (CRF) tables for electricity generation (1.A.1.a.i) emission values
- Chronological order of power generation plants from TEİAŞ Load Dispatch Department with commissioning dates, plant names, fuel types, installed power values, electricity generation for the calculated year
- Checking off Volunteers from the websites of Gold Standard (GS) and Verified Carbon Standard (VCS) for the ownership status of the carbon reduction certificate and,
- From Clean Development Mechanism (CDM) Tool 009- V2.0, Power plant efficiency figures are used

According to this publication;

- Operating Margin-OM; 0.7424 tCO_2/MWh
- Build Margin-BM; 0.3680 tCO_2/MWh
- Combined Margin-CM (for other renewable than solar and wind); 0.5552 tCO_2/MWh[13]

5.2 Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad (14)$$

Where:

PEy = Project emissions in year y (t CO2/yr)

PEEC,y = Emissions from consumption of electricity due to the project activity in year y (t CO2/yr)

PEFC,y = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO2/yr)

PEDT,y = Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (t CO2/yr)

PESP,y = Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (t CO2/yr)

The project is only included the emissions from consumption of electricity, not involved in the emissions from consumption of fossil fuels, the distribution of compressed/liquefied LFG using trucks and the supply of LFG to consumers through a dedicated pipeline, thus,

[13] Please see; https://enerji.gov.tr//Media/Dizin/EVCED/tr/%C3%87evreVe%C4%B0klim/%C4%B0klimDe%C4%9Fi%C5%9Fikli%C4%9Fi/TUESEmisyonFktr/Belgeler/Bform2020.pdf

$$PE_y = PE_{EC,y} \quad (15)$$

The project emissions from consumption of electricity by the project activity (PEEC,y) shall be calculated using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool:

(a) ECPJ,j,y in the tool is equivalent to the amount of electricity consumed by the project activity in year y (EGEC,y); and

(b) If in the baseline a proportion of LFG is destroyed (FCH4,BL,y>0), then the electricity consumption in the tool (ECPJ,j,y) should refer to the net quantity of electricity consumption (i.e. the increase due to the project activity). The determination of the amount of electricity consumed in the baseline shall be transparently documented in the PSF.

The calculation equation is as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (16)$$

Where:

PEEC, y = Project emissions from electricity consumption in year y (t CO2 / yr)

ECPJ , j, y = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

EFEL, j, y = Emission factor for electricity generation for source j in year y (t CO2/MWh)

TDLj, y = Average technical transmission and distribution losses for providing electricity to source j in year y

j = Sources of electricity consumption in the project

As stated above, according to the tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"(version 03.0), for the project is in the case of Scenario A: Electricity consumption from the grid, the project participants choose Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" (version 07.0) (EFEL,j,y = EFgrid,CM,y).

According to the tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0), the project belongs to the case of Scenario A, use as default values of 20% for project emission, i.e ,TDLj, y =20%.

ECPJ , j, y is ex ante determined as 0 in the PD and will be monitored ex post in the verification period.

5.3 Leakage

As per ACM0001 (version 19.0), no leakage emissions are considered under this methodology.

5.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (17)$$

Where:

ERy = Emission reductions in project year y (t CO2)

BEy = Baseline emissions in project year y (t CO2)

PEy = Project emissions in project year y (t CO2)

LEy = Leakage emissions in project year y (t CO2)

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
28-June-2021 to 31-December-2021	37,859	0	0	37,859
Year 2022	76,035	0	0	76,035
Year 2023	77,556	0	0	77,556
Year 2024	78,887	0	0	78,887
Year 2025	80,053	0	0	80,053
Year 2026	81,076	0	0	81,076
Year 2027	81,954	0	0	81,954
27-June-2028 to 31-December-2028	42,541	0	0	42,541
Total	555,961	0	0	555,961

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	OX
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value applied:	0.1
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Baseline emission calculation
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	t CO2e/t CH4
Description	Global warming potential of CH4
Source of data	*IPCC AR5*[14]
Value applied	*28*
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC fifth Assessment Report (AR5). Shall be updated according to any future COP/MOP decisions.

[14]Please see; https://www.ipcc.ch/report/ar5/syr/

Purpose of Data	-
Comments	-

Data / Parameter	ηPJ
Data unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	*Feasibility Study*
Value applied	*0.65*
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Baseline emission calculation*
Comments	-

Data / Parameter	ϕ y
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	*ACM0001 (version 19.0)*
Value applied	*0.75*
Justification of choice of data or description of measurement methods and procedures applied	The project selects Option 1 :Use a default value to determine ϕ y in the tool "Emissions from solid waste disposal sites" (version 08.0), and the project belongs to the situation of Application A: The project activity mitigates methane emissions from a specific existing SWDS, thus 0.75 is chosen for ϕy
Purpose of Data	*Baseline emission calculation*
Comments	-

Data / Parameter	F
Data unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	*0.5*
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Baseline emission calculation*
Comments	-

Data / Parameter	$DOC_{f,y}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	*0.5*
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Baseline emission calculation*
Comments	-

Data / Parameter	MCFy
Data unit	-
Description	Methane correction factor
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*

Value applied	*1.0*
Justification of choice of data or description of measurement methods and procedures applied	The landfill is controlled, including the following activities: (i) cover material; (ii) mechanical compacting; (iii) levelling of the waste. Therefore, 1.0 for anaerobic managed solid waste disposal sites is recommended by "Emissions from solid waste disposal sites (Version 08.0)."
Purpose of Data	*Baseline emission calculation*
Comments	-

Data / Parameter	DOC_j
Data unit	-
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)*
Value applied	See table below
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	*Baseline emission calculation*
Comments	-

Waste type j	DOCj (% wet waste)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal other inert waste	0

Data / Parameter	kj
Data unit	1/yr

Description	Decay rate for the waste type j
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)*
Value applied	See table below
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	
Comments	*Climatic conditions for Zonguldak where project site located in:* *MAT – mean annual temperature: 13.7 °C* *MAP – Mean annual precipitation: 1225.6 mm* *PET – potential evapotranspiration: 350 mm*

Waste type j		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET<1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP > 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

	Therefore, Boreal (MAT≤20 °C) and wet (MAP/PET >1) conditions are observed in the project site. *Sources: https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ZONGULDAK* *https://www.mgm.gov.tr/arastirma/buharlasma.aspx?s=2020*

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO2/MWh
Description	Operating margin CO2 emission factor for grid connected power generation in year y in Turkey
Source of data	Calculated by Turkish Ministry of Energy and Natural Resources.
Value applied	0.7424 tCO2/MWh
Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from Turkish Ministry of Energy and Natural Resources.
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	This parameter is fixed ex-ante for the first crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO2/MWh
Description	Build Margin emission factor for Turkey's national grid.
Source of data	Calculated by Turkish Ministry of Energy and Natural Resources.
Value applied	0.3680 tCO2/MWh
Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from Turkish Ministry of Energy and Natural Resources.
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	This parameter is fixed ex-ante for the first crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO2/MWh
Description	Combined margin CO2 emission factor for grid connected power generation in year y
Source of data	Calculated by Turkish Ministry of Energy and Natural Resources. Also, "Tool to calculate the emission factor for an electricity system (Version 07.0)"is applied.
Value applied	0.5552 tCO2/MWh
Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from Turkish Ministry of Energy and Natural Resources. Also, "Tool to calculate the emission factor for an electricity system (Version 07.0)"is applied.
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	This parameter is fixed ex-ante for the first crediting period.

Data / Parameter	Ru
Data unit	Pa.m3/kmol.K
Description	Universal ideal gases constant
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous Stream (Tool 8 Ver 03.0)
Value applied	8,314
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	-

Data / Parameter	MMi
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas CH4

Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value applied	16.04
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	-

Data / Parameter	Pn
Data unit	Pa
Description	Total pressure at normal conditions
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value applied	101,325
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	-

Data / Parameter	Tn
Data unit	K
Description	Temperature at normal conditions
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Value applied	273.15
Justification of choice of data or description of	-

measurement methods and procedures applied	
Purpose of Data	*For the calculation of the Baseline Emission*
Comments	-

Data / Parameter	TDLy
Data unit	%
Description	Average technical transmission and distribution losses
Source of data	Obtained from https://webapi.teias.gov.tr/file/9248a331-e529-47ca-8c49-22f8705f5810?download
Value applied	10.0%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	
Comments	-

6.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generated using LFG by the project activity in year y
Source of data	*Electricity meter*
Description of measurement methods and procedures to be applied	The quantity of electricity consumed by the project plant will be monitored based on the main meter (also referred as TEİAŞ meters) readings and/or through protocols where and when appropriate.
Frequency of monitoring/recording	Continuously measured and monthly recorded

Value applied	-
Monitoring equipment	The quantity of electricity consumed by the project plant will be monitored based on the main meter (also referred as TEİAŞ meters) readings and/or through protocols where and when appropriate.
QA/QC procedures to be applied	The electricity meters are used to measure the net electricity exported to the grid and used for billing purposes. Therefore the meters are sealed by TEİAŞ (Turkish Electricity Transmission CO) and/or through protocols where and whenappropriate. The grid company is responsible for maintenance and calibrationof the device. In accordance with the "Regulation on "Measurement and Measuring Tools", electricity meters have to be calibrated within a frequency of once per 10 years. The accuracy class of the device is 0.5s.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$EC_{pj,y}$
Data unit	*MWh*
Description	*Quantity of electricity consumed by the project activity in year y*
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	The quantity of electricity consumed by the project plant will be monitored via the main meter (also referred as TEİAŞ meters) readings and/or through protocols where and when appropriate.
Frequency of monitoring/recording	*Continuously measured and monthly recorded*
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	*The electricity meters are used to measure the net electricity exported to the grid and used for billing purposes. Therefore the meters are sealed by TEİAŞ (Turkish Electricity Transmission CO). The grid company is responsible for maintenance and calibration of the device. In accordance with the "Regulation on "Measurement and Measuring Tools", electricity meters have to*

	be calibrated within a frequency of once per 10 years. The accuracy class of the device is at least 0.5s
Purpose of data	Calculation of project emissions
Calculation method	The quantity of electricity consumed by the project plant will be monitored based on the main meter (also referred as TEİAŞ meters) readings and/or through protocols where and when appropriate.
Comments	The quantity of electricity consumed is monitored by the same equipment, which monitors the net quantity of electricity generated by the project activity.

Data / Parameter	FCH_4,sent flare,y
Data unit	tCH4 /y
Description	Quantity of methane in LFG sent to the flare in year y
Source of data	Calculated based on the flow of LFG and the concentration of methane in the LFG that will be sent to the flare(s)
Description of measurement methods and procedures to be applied	-Flow meter will be subject to regular (in accordance to the manufacturer) maintenance and testing to ensure accuracy.
Frequency of monitoring/recording	Continuously
Value applied	Will be monitored ex post
Monitoring equipment	Flow meter and gas analyzer. Data to be aggregated monthly and yearly. Measured by a flow meter and a gas analyser. Data to be aggregated monthly and yearly
QA/QC procedures to be applied	Flow meter will be subject to regular (in accordance to the manufacturer) maintenance and testing to ensure accuracy.
Purpose of data	Baseline emission calculation
Calculation method	-
Comments	-

Data / Parameter	Opj,h

Data unit	h
Description	Operation of the equipment that consumes the LFG
Source of data	Project participants
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Hourly
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Baseline emission calculation
Calculation method	-
Comments	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns. Opj,h=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute);

	(b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h. Otherwise, Opj,h=1

Data / Parameter	$F_{CH4,PJ.y}$
Data unit	m^3
Description	Methane captured and destroyed/gainfully used by the project activity in the year y
Source of data	Flow meter
Description of measurement methods and procedures to be applied	Calibration and frequency of calibration is according to manufacturer's specifications or applicable law and regulations.
Frequency of monitoring/recording	Continuous
Value applied	-
Monitoring equipment	Flow meter
QA/QC procedures to be applied	Calibration and frequency of calibration is according to manufacturer's specifications or applicable law and regulations.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	The amount of landfill gas utilized shall be monitored ex post, using continuous flow meters.

Data / Parameter	$F_{CH4,EL,y}$
Data unit	*tCH4 /year*
Description	*Amount of methane in LFG which is sent to the genset for electricity generation in year y*
Source of data	*Calculated based on the flow of LFG and the concentration of methane in the LFG that will be sent to the genset*

Description of measurement methods and procedures to be applied	*Flow meter will be subject to regular (in accordance to the manufacturer). Maintenance and testing to ensure accuracy.*
Frequency of monitoring/recording	*Continously*
Value applied	*Will be monitored ex post*
Monitoring equipment	*Measured by a flow meter and a gas analyser. Data to be aggregated monthly and yearly. Measured by a flow meter and a gas analyser. Data to be aggregated monthly and yearly*
QA/QC procedures to be applied	*Flow meter will be subject to regular (in accordance to the manufacturer). Maintenance and testing to ensure accuracy.*
Purpose of data	*Calculation of baseline emissions (ex post)*
Calculation method	Calculated based on the flow of LFG and the concentration of methane in the LFG that will be sent to the genset
Comments	-

Data / Parameter	w_{CH4}
Data unit	% (m^3CH4/m^3LFG)
Description	Methane fraction in the landfill gas in the year y
Source of data	Measured by using a methane analyser(measuring methane content directly)
Description of measurement methods and procedures to be applied	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according to manufacturer's specifications.
Frequency of monitoring/recording	Continuously.
Value applied	50%(Will be monitored ex post)
Monitoring equipment	The gas analysing system is a modular construction and designed for stationary operation for measuring directly the fraction of methane in the landfill gas. The gas analyser provides three analogue signals, CH4, CO2 and O2. The values are measured continuously. The proportion of the data to be monitored is 100%.

QA/QC procedures to be applied	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy. The gas analyser will be calibrated according to manufacturer's specifications.
Purpose of data	Calculation of baseline emissions(ex post)
Calculation method	-
Comments	Methane fraction of the landfill gas and LFG flow has to be measured on the same basis (either wet or dry).

Data / Parameter	Tt
Data unit	K
Description	Temperature of the landfill gas
Source of data	Thermometer
Description of measurement methods and procedures to be applied	The device is subject to regular maintenance and testing regime to ensure accuracy. They will be periodically calibrated according to the manufacturer's recommendation by project participants.
Frequency of monitoring/recording	Continuous. The measurement interval will be equal to or more than one sampling each hour (average value in a time interval not greater than an hour will be used in the calculations of emission reductions). All the data will be aggregated hourly, daily, monthly and yearly.
Value applied	Will be monitored ex post
Monitoring equipment	Thermometer
QA/QC procedures to be applied	The device is subject to regular maintenance and testing regime to ensure accuracy. They will be periodically calibrated according to the manufacturer's recommendation by project participants.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

6.3 Monitoring Plan

Monitoring will be carried out following the procedures set by applicable methodology and all applicable tools of the above explained parameters. The monitoring consists of:

Responsibilities for monitoring

The project owner is responsible for the operation and maintenance of the landfill and the installed equipment. The project owner is also responsible for the administration of the data, setting up a VER team who will be responsible for monitoring all data required to estimate emission reductions.

Registration of the monitored data

The Zonguldak LFG VER-Team will be responsible for quality assurance and quality control of the monitoring equipment. The data measured by the monitoring equipment will be stored and will be processed into a monitoring report, which will be submitted by the project owner. All the monitored data will be stored during the crediting period and for at least two years after the end of the crediting period, whichever occurs later.

Corrective actions and emergency preparedness

The VER-Team will regularly check the monitoring system for errors. In the case of errors, corrective actions will be undertaken by the VER-Team, or if required, by the supplier of the monitoring equipment.

QA/QC procedure

Strong quality assurance and quality control procedures will be taken to monitor the equipment and data collection. Equipment and facilities will be subject to a regular maintenance and testing regime to ensure accuracy following the supplier's manual. In case of data deficiency or in correct data reading, the data will be crosschecked with other parameters and data leading to the most conservative emission reductions will be considered for the calculation of the emission reductions.

Measuring of exported and imported electricity

The main meter that monitors electricity import and export is placed at the grid connection. Monthly protocols based on the readings that are confirmed by both TEIAŞ and the project participant are prepared by the end of each month and stored. These protocols are also the basis of invoicing for the electricity sales from the proposed project activity. The electricity meters are bidirectional and will measure both the imported and exported electricity from and to the grid.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

After the Project completes the Listing in the Pipeline, this section will be provided under the validation and verification phase.

7.2 Baseline Emissions

After the Project completes the Listing in the Pipeline, this section will be provided under the validation and verification phase.

7.3 Project Emissions

After the Project completes the Listing in the Pipeline, this section will be provided under the validation and verification phase.

7.4 Leakage

After the Project completes the Listing in the Pipeline, this section will be provided under the validation and verification phase.

7.5 Net GHG Emission Reductions and Removals

After the Project completes the Listing in the Pipeline, this section will be provided under the validation and verification phase.