AL MULTAQA LANDFILL GAS RECOVERY PROJECT

Document Prepared by OQ Trading Limited

Project Title	Al Multaqa Landfill Gas Recovery Project
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Prepared By	OQ Trading Limited
Contact	Level 7, Building 6 (Legatum Plaza), DIFC, P.O. Box 506515, Dubai, United Arab Emirates said.almaawali@oq.com +968 9137 0000 www.oqt.com

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Al Multaqa Landfill Gas Recovery Project (hereafter referred to as "the proposed project") is a landfill gas (LFG) recovery and utilization project developed by Oman Environmental Services Holding Company S.A.O.C (be'ah). The proposed project is located in the Al Multaqa Landfill of the Al Amerat city, Muscat Governorate, the Sultanate of Oman, and the landfill is the first engineered landfill in Oman which began its operations in early 2011.

The proposed project started operation in November 2021, and it is to capture LFG from the landfill and utilized the gas to generate electricity. At the time of requesting VCS registration, only cell 1 (half of the landfill) is closed and LFG from this cell has been captured and flared. After the closure and the installation of gas capture system of Cell 2 (the rest half of the landfill), gas engine(s) will be installed and fed with the LFG to generate electricity. The rated capacity of the engine is estimated to be 0.5MW.

Prior to the implementation of the proposed project, the LFG generated from Al Multaqa landfill was released into the atmosphere, the equivalent amount of electricity to be generated by the proposed project would be supplied by the fossil-fuel dominated power grid. The baseline scenario is the same as the conditions existing prior to the implementation of the proposed project.

The proposed project is expected to generate GHG emission reductions from two aspects: 1) by avoiding methane emissions from capturing and destroying LFG which would have been released to atmosphere in the baseline scenario; 2) by reducing CO_2 emissions from displacing part of the electricity that would otherwise be supplied fossil-fuel dominated power grid.

The proposed project is expected to have an annual average of 103,249 tCO2 emission reduction over the crediting period, and the estimated emission reductions are 1,032,493 tCO_2 over a fixed 10-year crediting period (from 01-Nov-2021 to 31-Oct-2031).

1.2 Sectoral Scope and Project Type

As the proposed project will used captured LFG for electricity generation, the sectoral scopes applicable are:

Scope 1: energy industries (renewable/no-renewable sources), and

Scope 13: waste handling and disposal.

The proposed project is not a grouped project.

1.3 Project Eligibility

The proposed project reduces greenhouse gases emissions from two aspects: 1) by avoiding methane emissions from capturing and destroying LFG which would have been released to atmosphere in the baseline scenario; 2) by reducing CO_2 emissions from displacing part of the electricity that would otherwise be supplied fossil-fuel dominated power grid. The project reduces CH_4 and CO_2 emissions, which are Kyoto Protocol greenhouse gases.

The proposed project does not fall into the excluded project activities listed in the section 2.1.3 of VCS Standard Version 4.4.

Therefore, the proposed project is eligible under the scope of 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

Not applicable.

1.5 Project Proponent

Organization name	OQ Trading Limited
Contact person	Mr. Said Al Maawali
Title	Executive Director Middle East
Address	Level 7, Building 6 (Legatum Plaza), DIFC, P.O. Box 506515, Dubai, United Arab Emirates
Telephone	+968 9137 0000
Email	said.almaawali@oq.com

1.6 Other Entities Involved in the Project

Organization name	Oman Environmental Services Holding Company S.A.O.C

Role in the project	Project Owner
Contact person	Ms. Kadhya Al-Hinai
Title	Landfill Operation Manager
Address	Muscat, Sultanate of Oman
Telephone	+968 7174 3369/ +968 9639 2002
Email	Kadhya.alhinai@beah.om

1.7 Ownership

Oman Environmental Services Holding Company S.A.O.C (Be'ah) is the project owner, and OQ Trading Limited is the buyer of the carbon credits.

The project ownership could be evidenced by a Royal Decree 46/2009[1], which granted Be'ah the mandate and legal status as the entity responsible for solid waste management in Sultanate of Oman. In accordance with the Economic Activities License Certificate issued by the Ministry of Commerce, Industry & Investment Promotion, all legal right of the project belongs to Oman Environmental Services Holding Company S.A.O.C.

In September 2022, a cooperation agreement relating to a Framework of Emission reduction Project Development in the Oman Waste Management Industry was signed between Oman Environmental Services Holding Company S.A.O.C and OQ Trading Limited (carbon credits buyer); In 2023, Emission Reduction Purchase Agreement (ERPA) was signed for the specific proposed project.

1.8 Project Start Date

The project start date is 01-Nov-2021, when the LFG flare device started operation.

1.9 Project Crediting Period

The proposed project adopts a fixed 10-year crediting period from 01-Nov-2021 to 31-Oct-2031 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

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

[1] https://decree.om/2009/rd20090046/

☐ <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)
2021	14,571
2022	95,639
2023	104,308
2024	113,526
2025	122,384
2026	115,660
2027	109,936
2028	104,524
2029	98,862
2030	93,531
2031	74,122
Total estimated ERs	1,032,493

Total number of crediting years	10
Average annual ERs	103,249

1.11 Description of the Project Activity

The Al Multaqa landfill includes two cells. Cell 1 was closed in 2021 when the cell reached its full capacity. The cell 2 closure is expected to be carried out in 2025.

Landfill gas collection and control system has been installed in Cell 1 and the LFG flare device started operation in Nov 2021.

The gas collection system in cell 1 is made of 30 vertical wells installed after the waste is placed by drilling and 11 lateral wells. LFG is extracted under negative pressure by blower and moved across wells. Prior to flare device, LFG is sent through knockout pot (KOP) to remove moisture.

The type of the enclosed biogas flare system is BGX 2000. After the closure and the installation of gas capture system of Cell 2, gas engine(s) will be installed and fed with the LFG to generate electricity. The rated capacity of the engine is estimated to be 0.5MW.

1.12 Project Location

The proposed project is located in the Al Multaqa Landfill of the Al Amerat city, Muscat Governorate, the Sultanate of Oman. The coordinates of the project site are east longitude 58°26’57” (58.449288) and north latitude 23°20’21” (23.339261).

SULTANATE OF OMAN

Administrative Boundaries Of Governorates

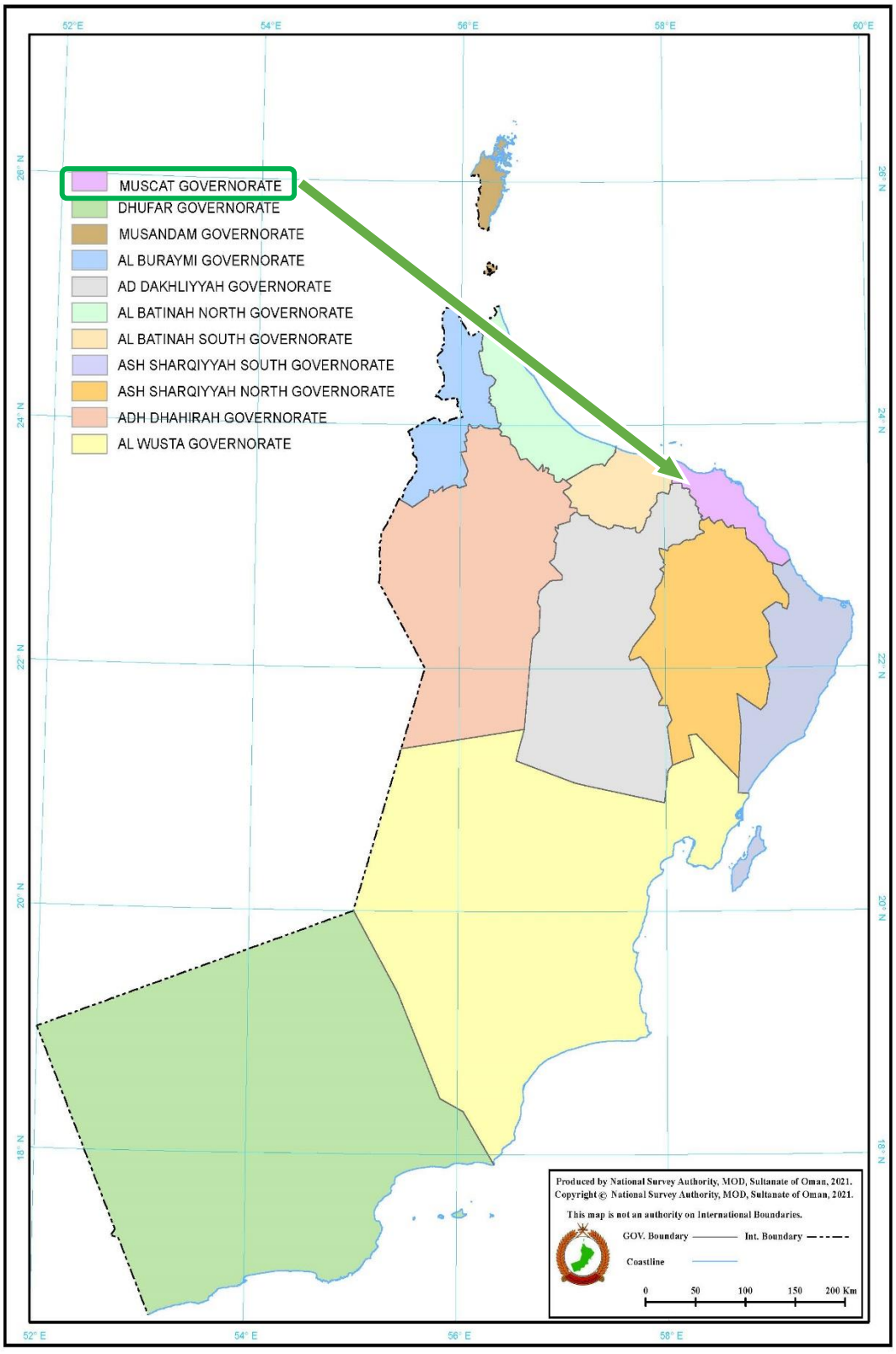


Figure 1 Map of the project location

1.13 Conditions Prior to Project Initiation

Prior to the implementation of the proposed project, the LFG generated from Al Multaqa landfill was released into the atmosphere, the equivalent amount of electricity to be generated by the proposed project would be supplied by the fossil-fuel dominated power grid. The baseline scenario is the same as the conditions existing prior to the implementation of the project initiation, please refer to Section 3.4 (Baseline Scenario).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The proposed project complies with all relevant laws and regulations by the Sultanate of Oman, mainly include:

1. Regulation for the conservation of the environment and prevention of pollution issued by Royal Decree No. (114/2001)
2. Regulation of Management of the non-hazardous solid waste issued by Ministerial Decision No. (17/93)
3. Regulation of management of hazardous waste issued by Ministerial Decision No. (18/93)
4. Regulation of controlling air pollutants emitted from stationary sources issued by Ministerial Decision No. (118/2004)
5. Regulation of specifications anaerobic decomposition and absorption pits and detention tanks issued by Ministerial Decision No. (421/98)
6. Ministerial Decree No. 41/2017 issuing the Air Quality Regulation

The proposed project obtained environmental permit from the Ministry of Environment Authority, and it demonstrated that the government permits the construction and operation of the proposed project. Consequently, the proposed project is in compliance with the laws, status and other regulatory requirements.

1.15 Participation under Other GHG Programs

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

The project has neither been registered nor seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

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

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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?

☐ Yes ☒ No

Oman has not launched any mandatory carbon emission scheme and GHG emission reduction scheme, thus GHG emission reductions and removals generated by the project has no way in legislation to be used for compliance in Oman.

The proposed project has not been and will not apply for any other GHG emission reduction scheme, such as GCC, GS, etc.

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

1.16.3 Supply Chain (Scope 3) Emissions

The proposed project is to capture and utilize the landfill gas which otherwise will be released to atmosphere, and it will not impact the emissions of goods and services in a supply chain, i.e. Scope 3 emissions.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The proposed project will contribute to sustainable development through the following ways:

Providing clean electricity by displacing power generation of fossil fuel power plants, reducing CO_2, SO_X and NO_X emissions, thus mitigating the air pollution and its harm.

Job creation: Creating employment opportunities for local staff to operate LFG recovery and utilization devices.

Increasing adoption of clean and environmentally sound technologies, and reducing the CO_2 emission per unit of value added compared with the baseline scenario.

Reduction in GHG emissions: Achieving significant reductions by destroying and utilizing methane

1.17.2 Sustainable Development Contributions Activity Monitoring

In the first monitoring period, the proposed project contributed to the sustainable development through the following SDGs:

1. The proposed project created 2 job opportunities for the operation of the LFG recovery and flare devices by the end of this monitoring period and achieved SDG 8 Decent Work and Economic Growth. Oman government has been encouraging creation of job opportunities and promoting knowledge-based labour market[2].

[2] Oman set National Employment Program (NEP) to create a labor market filled with nationals who are qualified and skilled in their respective fields. The program, which stems from Oman Vision 2040, seeks to fill the gap between knowledge and skills needed by the labor market so that the unemployed get jobs depending on their availability. https://www.zawya.com/en/economy/omans-national-employment-programme-to-create-a-knowledge-based-labour-market-f1zwy8s6?amp=1

2. The proposed project helps adaption of clean energy technologies by implementing LFG recovery and power generation, and achieved SDG 9 Industry, Innovation and Infrastructure. The Al Multaqa landfill is the 1st engineered sanitary landfill in the Sultanate of Oman and designed and constructed in accordance to USEPA 40 CFR regulatory. The LFG recovery facilities are operated and maintained by Suez Al Bashaer LLC (a joint venture company between Suez and Omani partner), which may potentially transfer the state-of-the-art technology to Oman and help capacity building in waste management area. During this monitoring period, 1962.48 tons of methane were captured and thus prevented its direct releasing to the atmosphere.

3. The proposed project annually prevented the release of 39,371 tonnes of CO_2e into the atmosphere during this monitoring period and achieved SDG 13 Climate Action. In September 2020, Oman announced they will achieve carbon neutral in 2050[3].

4. As the gas generator(s) will be installed after the closure of cell 2 of Al Multaqa landfill (expected in 2025), electricity generated by the LFG will be supplied for onsite use (leachate treatment) and probably be exported to power grid, thus would achieve SDG 7 Affordable and Clean Energy. The amount of electricity generated will be monitored and reported for the future verification.

[3] https://www.omanobserver.om/article/1126819/oman/oman-sustainability-center-to-spearhead-carbon-neutrality

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7	Amount of electricity generated by utilizing recovered LFG	Implemented activities to increase	The gas generator(s) has not been installed in this monitoring period; thus no electricity has been generated.	The gas generator(s) has not been installed in this monitoring period; thus no electricity has been generated.
2)	8	Numbers of job opportunities provided by implementation of the project	Implemented activities to increase	The project has created 2 job opportunities by the end of this monitoring period.	2 people have been employed by the project for operation and maintenance by end of the reporting period.
3)	9	Volume of methane captured by adopting environmentally sound technologies	Implemented activities to increase	The project has captured 1962.48 tonnes of methane and avoid its direct release to atmosphere by adopting state-of-the-art environmentally sound technologies by the end of this monitoring period.	Captured 1962.48 tonnes of methane by adopting state-of-the-art environmentally sound technologies by the end of the reporting period
4)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	Prevented the release of 39,371 tonnes of CO_2e into the atmosphere during the monitoring period.	Prevented the release of 39,371 tonnes of CO_2e into the atmosphere by the end of the reporting period

1.18 Additional Information Relevant to the Project

Leakage Management

Not applicable.

Commercially Sensitive Information

Parameter CAPEX and OPEX, which is the total investment to implement the project and total cost to operate the project, sourcing from the contract between the Be'ah and the operator (Suez Al Bashaer LLC). The data of this parameter is considered as commercially sensitive information and has been excluded from the public version of the PD. The contract will be provided to the VVB at the verification for the 1st monitoring period.

Further Information

There is no additional relevant legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and/or temporal information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

The proposed project is to capture and utilize the LFG generated from Al Multaqa landfill, which would otherwise be released to the atmosphere. There are no harms identified from the proposed project.

2.2 Local Stakeholder Consultation

The residents, works and other stakeholders near the proposed project were invited to provide their opinions and understanding on this project. In May 2023, before the validation of the proposed project, the survey was distributed among the stakeholders which varied in age, gender and education, as shown in Table 2.

Table 2: Basic information of the stakeholders' survey

Item	Distribution	Number	Percentage
Gender	Male	26	55%
	Female	21	45%

Age	<20	30	64
	20-29	3	6
	30-39	7	15
	40-49	3	6
	>50	4	9
Education	Less than Primary School	2	4
	Primary School	2	4
	Highschool	35	74
	College or university	6	13
	Post-graduate	2	4

For the project to be completely comprehensive by the stakeholders, more data has been taken as general questions that characterized the project from various perspectives in table 3. The result showed that, 70% of stakeholders believe that the project is objective. According to 66% of the stakeholders, this project would have beneficial effects on the environment. Furthermore, a large majority of stakeholders demonstrated their belief in the project's good effect on climate change and ecosystem. In addition, they considered that the project would have a beneficial impact on local economies as well as create an employment opportunity for locals. In conclusion, 87% had a full support to the construction and operation of the project.

Table 3: Summary of the survey results

No.	Questions	Response	Number	Percentage
1	Through the provided introduction, are the objectives and the activities of the project activity and objectives?	Yes	33	70%
		A little bit	11	23%
		Not at all	3	6%
2		Good impact	31	66%

	Do you think that the landfill gas capture and use project will have a good impact on the environment?	No impact	5	11%
		Not sure	11	23%
3	Do you think that the project will have a good impact on the global worming?	Good impact	29	62%
		No impact	6	13%
		Not sure	12	26%
4	Do you think that the project will have a good impact on the local economy?	Good impact	33	70%
		No impact	8	17%
		Not sure	6	13%
5	Do you think that the project will have a good impact on the local ecosystem?	Good impact	31	66%
		No impact	8	17%
		Not sure	8	17%
6	Will the construction of the project bring employment opportunities to the local residents?	Good impact	31	66%
		No impact	8	17%
		Not sure	8	17%
7	In general, what is your attitude towards the project construction and operation?	Fully supportive	41	87%
		Not supportive	5	11%
		Not sure	1	2%

Local stakeholder consultation during the project operation:

During the project's execution, local stakeholders will be consulted through two channels: regular surveys done yearly by the Project Proposer, as well as interactions between residents and authorities. The project proponent notifies the local authorities of key project implementation events or changes; the local authorities then notify residents living near the project sites, and the local authorities collect the comments and suggestions from residents;

the local government agencies also conduct regular spot checks on project implementation and provide suggestions on potential issues.

2.3 Environmental Impact

The environmental impacts and associated mitigation measures are summarized as follows.

In order to mitigate groundwater contamination, a suitable basal sealing system was chosen based on various aspects, including effectiveness, resistance, construction feasibility, climate effects, quality assurance, and availability in Oman. An asphalt sealing system was selected. The installation of this sealing system effectively mitigates potential impacts on groundwater. Additionally, a final cover will be installed to prevent water infiltration into the waste body, reducing the generation of leachate. As each landfill section is filled, it will be covered with a layer of soil to minimize littering and odor issues.

To mitigate impacts on public health and worker safety, measures have been proposed. Residents located adjacent to the site will be resettled to a new location at a minimum distance of 2 km, as per national legislation, to avoid potential sanitary impacts from construction and operational activities. The waste body at the landfill produces landfill gas, which is combustible and potentially explosive due to its high methane content. It also contains trace gases, including H_2S, which is toxic and causes odors. To control and manage landfill gas, perforated pipes will be installed horizontally at intervals of 30 m to collect the gas. Drain pipes will be inserted vertically at intervals of 10 m, connecting to imperforated pipes and a ring pipe that leads the gas to a gas flare. Once a landfill section is filled, vertical gas wells will be installed and connected to a gas collecting station, redirecting the gas to the gas flare.

To mitigate impacts on surface water, measures will be taken to direct surface runoff, which may occur adjacent to the deposition area or along internal roads, into open trenches. This helps prevent contamination of surface water.

In terms of vegetation, acacia trees will be cut down after the construction of all landfill cells. To mitigate the loss of these trees, the responsible party will commit to replanting new trees at a ratio of 1:2 in the immediate vicinity of the site, using typical trees of the region. This helps maintain the ecological value and compensate for the loss of vegetation.

2.4 Public Comments

The proposed project will be listed on the Verra website for public comment.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The proposed project applies the large-scale consolidated methodology ACM0001: Flaring or use of landfill gas (version 19.0)

https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M

The methodology also refers to the latest approved tools:

Tool 04: Emissions from solid waste disposal sites (version 08.0)

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

Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)

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

Tool 06: Project emissions from flaring (version 04.0)

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

Tool 08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)

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

Tool 32: Positive lists of technologies (version 04.0)

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

3.2 Applicability of Methodology

The project fulfils the applicability of the applied baseline and monitoring methodology ACM0001 version 19.0 and associated tools, as shown in the following:

Table 3.2.1 Applicability of the proposed project to ACM0001

Applicability criteria	Justification
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	(a) Applicable. The proposed project involves the installation of a new LFG capture system in an existing SWDS.

(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.	(b) Not applicable. There was not an LFG capture system prior to the implementation of the proposed project. (c) Applicable. The proposed project flares the LFG and will use the captured LFG to generate electricity. (d) The implementation of the proposed project does not reduce the amount of organic waste that would be recycled in the absence of the project. All the solid waste is disposed in the Al Multaqa landfill site.
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:	The most plausible baseline scenario is : the LFG generated from Al Multaqa landfill was released into the atmosphere, the equivalent amount of electricity to be generated by the proposed project would be supplied by

(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 fossil-fuel dominated power grid.
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.	Not applicable.

Table 3.2.2 Applicability of the proposed project to associated tools

Tool	Applicability criteria	Justification
Tool 04: Emissions from solid waste disposal sites (version 08.0)	The tool can be used to determine emissions for the following types of applications: (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g.	(a) Applicable. The project captures the methane from Al Multaqa Landfill site and would use the LFG captured to generate electricity.

	"ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); (b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.	(b) Not applicable.
Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity	If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not	Scenario A is applicable. The proposed project purchased electricity during the operation. There is no captive poser plant at the site of the project.

generation (version 03.0)	operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	
	This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	The electricity to be generated in the project site would be supplied to consumers/electricity consuming facilities.

	This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	Not applicable.
Tool 06: Project emissions from flaring (version 04.0)	The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	Applicable. An enclosed flare is applied by the proposed project.
	This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	Applicable. Methane is the component with the highest concentration of LFG.
	The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. In the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare and these shall be followed by the project participant.	Not applicable.

Tool 08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)	Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions. The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N2).	Applicable. Volumetric flow of gaseous stream LFG and volumetric fraction of methane are measured for the determination of baseline emissions. The applied methodology ACM0001 specifies all the required information from (a) to (d).
Tool 32: Positive lists of technologies (version 04.0)	The use of this methodological tool is not mandatory for the project participants of a CDM project activity or CDM PoA for demonstrating their additionality.	Applicable.
	This methodological tool shall be applied in conjunction with a small-scale or large-scale methodology which refers to this tool.	The proposed project applies this methodological tool in conjunction with the large-scale methodology ACM0001 (version 19.0).
	The positive lists as contained in section 5 of this tool are valid up to 10 March 2025. Notwithstanding the provisions on the validity of new, revised and previous versions of methodologies and methodological tools in the "Procedure: Development, revision and	The positive lists are valid at time of compiling this Project Document.

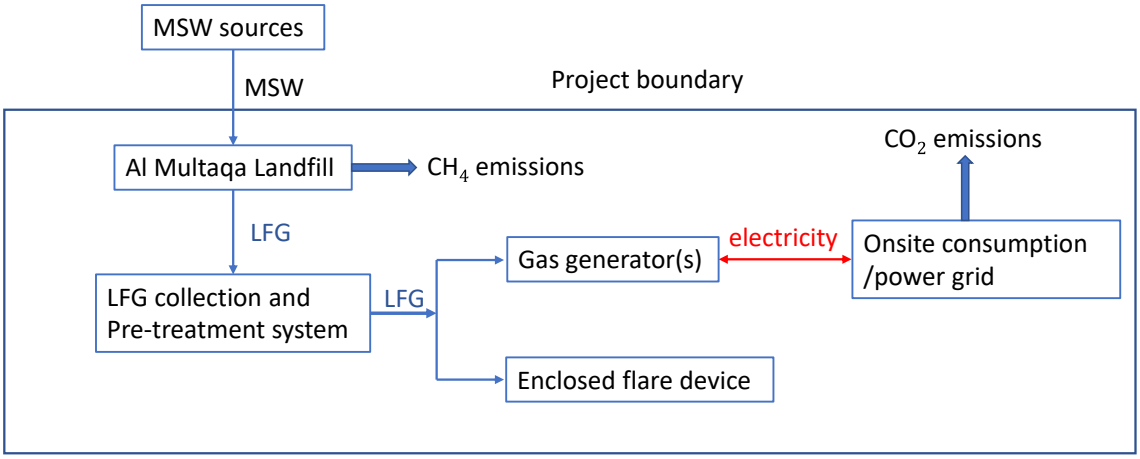
	clarification of baseline and monitoring methodologies and methodological tools", there will be no grace period for the application of this tool and the validity of the positive list after this date, including in cases where further technologies are added to the positive list through revisions of this tool before this date.	

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO2 is also released under the project activity.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. 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.
	Emissions from heat generation	CO_2	No	The proposed project does not involve heat generation.
		CH_4	No	The proposed project does not involve heat generation.
		N_2O	No	The proposed project does not involve heat generation.
	Emissions from the use of natural gas	CO_2	No	The proposed project does not involve the use of natural gas.
		CH_4	No	The proposed project does not involve the use of natural gas.

Source		Gas	Included?	Justification/Explanation
		N_2O	No	The proposed project does not involve the use of natural gas.
Project	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	The proposed project does not involve fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity.
		CH_4	No	The proposed project does not involve fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity.
		N_2O	No	The proposed project does not involve fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity.
	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.
	Emissions from flaring	CO_2	No	Emissions are considered negligible.
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible.
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO_2	No	The proposed project does not involve distribution of LFG using trucks and dedicated pipelines.
		CH_4	No	The proposed project does not involve distribution of LFG using trucks and dedicated pipelines.
		N_2O	No	The proposed project does not involve distribution of LFG using trucks and dedicated pipelines.

The project boundary is the site of the project activity- Al Multaqa landfill site, where the LFG is captured and to be used for electricity generation, and it will also include all power sources connected to the power grid.



3.4 Baseline Scenario

As per the Section 5.3 of the methodology applied, project participants may either apply the simplified procedure in section 5.3.1 or the procedures in section 5.3.2 to select the most plausible baseline scenario and demonstrate additionality.

The simplified procedure is applied for the proposed project, and the baseline is assumed to be the atmospheric release of the LFG; all the electricity to be generated by the project is assumed to be electricity generation in existing and/or new grid-connected power plants.

3.5 Additionality

To demonstrate additionality, simplified procedure in section 5.3.1 of the methodology ACM0001 (version 19.0) is applied, according to which the methodological tool "TOOL 32: Positive lists of technologies" (version 4.0) shall be referred to.

As the project applies the technology listed in the Section 5.1.1 (landfill gas recovery and its gainful fuse) of the tool, and the applicability of related conditions are:

The project activities and PoAs at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if it is demonstrated that prior to the implementation of the project activities and PoAs the landfill gas (LFG) was only vented and/or flared (in the case of brownfield projects) or would have been only vented and/or flared (in the case of greenfield projects) but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met:

(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;

(b) The LFG is used to generate heat for internal or external consumption;

(c) The LFG is flared.

According to the descriptions above, prior to the implementation of the proposed project, the LFG was only vented, and under the project activity, the LFG is captured and flared, and will be used to generate electricity in the future. The total installed capacity of the generator(s) is to be about 0.5MW, which is below 10MW.

Therefore, the proposed project is deemed automatically additional.

3.6 Methodology Deviations

There is no methodology deviation involved.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The proposed project aims to capture the landfill gas from Al Multaqa landfill and utilize the LFG to generate electricity, which will be used by onsite leachate facility and exported to the power grid.

As described in section 1.11, the Al Multaqa landfill includes two cells, and only Cell 1 was closed in 2021 when the cell reached its full capacity. Cell 2 closure is expected to be carried out in 2025. After the closure of Cell 2, the gas generator(s) will be installed.

By the end of 1st monitoring period (Dec 31, 2022), the landfill gas collection and control system has been installed in Cell 1 and the LFG flare device started operation in Nov 2021. LFG was extracted under negative pressure by blower and sent to flare device, and no electricity was generated. Hence in the 1st monitoring period, only the LFG from Cell 1 is captured and flared, which will impact the GHG emission reductions, and the actual emission reductions will be substantial less than the estimation as per ex-ante calculation.

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the methodology ACM0001 (version 19.0), the baseline emissions are determined according to equation (1) and comprise the following sources:

(a) Methane emissions from the SWDS in the absence of the project activity;

(b) Electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

(c) Heat generation using fossil fuels in the absence of the project activity; and

(d) Natural gas used from the natural gas network in the absence of the project activity

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

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

The proposed project does not involve in heat generation and natural gas use, therefore, the baseline emissions are calculated as follows:

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

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 taken into account:

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH4,BL,y}\right) \times GWP_{CH4} \quad \text{Equation (3)}$$

Where:

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/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 CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

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:

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

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 CH_4/yr)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year y (t CH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year y (t CH_4/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 CH_4/yr)

The proposed project does not involve in heat generation and natural gas use, therefore,

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} \quad \text{Equation (5)}$$

$F_{CH4,EL,y}$, 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 ($Op_{j,h,y}$). The following requirements apply:

(a) As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed;

(b) CH_4 is the greenhouse gas for which the mass flow should be determined;

(c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);

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

(e) The mass flow calculated for hour h is 0 if the equipment is not working in hour h ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare(s) and any methane emissions from the flare(s), as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}} \quad \text{Equation (6)}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$F_{CH4,sent\_flare,y}$ is determined directly using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the requirements described above where the gaseous stream the tool shall be applied to is the LFG delivery pipeline to the flare(s).

$PE_{flare,y}$ shall be determined using the methodological tool "Project emissions from flaring". If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

According to the Tool 06 "Project emissions from flaring" (Version 04.0), as an enclosed flare device was installed and according to the size of the equipment, the ratio of height and the diameter is between two and ten, thus it falls into the category of low height flare and the default value of 80% is applied for the flare efficiency.

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3} \quad \text{Equation (7)}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)
$F_{CH4,RG,m}$	=	Mass flow of methane in the residual gas in the minute m(kg)
$\eta_{flare,m}$	=	Flare efficiency in the minute m

Tool 08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) provides 6 options for measuring the mass flow of a greenhouse gas *i* in a gaseous stream ($F_{i,t}$), as shown in the table below:

Table 4.1 Measurement options

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow – dry basis	dry or wet basis
B	Volume flow – wet basis	dry basis
C	Volume flow – wet basis	wet basis
D	Mass flow – dry basis	dry or wet basis
E	Mass flow – wet basis	dry basis
F	Mass flow – wet basis	wet basis

The flow meter and gas analyzer are installed to monitor the volumetric flow of the LFG and the volumetric fraction of CH_4 in the LFG, with both parameters monitored on dry basis. Therefore, option A is applied. The mass flow of $F_{CH4,t}$ is determined as follows:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \quad \text{Equation (8)}$$

With:

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t} \quad \text{Equation (9)}$$

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 (m^3 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 (m^3 gas i/m^3 dry gas)

$\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m^3 gas i)

P_t = Absolute pressure of the gaseous stream in time interval t (101,325Pa)

MM_i = Molecular mass of greenhouse gas i (16.04kg/kmol)

R_u = Universal ideal gases constant (8,314 Pa.m3/kmol.K)

T_t = Temperature of the gaseous stream in time interval t (273.15K)

All parameters of LFG which is flared or fed into the gas engines are converted automatically to normal conditions during the monitoring process.

Ex ante determination 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 (according to equation (2)) in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$ Equation (10)

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 CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

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

(a) f_y 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.

As per Tool 04 (version 08.0), $BE_{CH4,SWDS,y}$ is calculated as follows:

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} w_{j,x} \cdot DOC_j \cdot e^{-k_j(y-x)} \cdot (1 - e^{-k_j})$$ Equation (11)

Where:

$BE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO_2e/yr)
φ_y	=	Model correction factor to account for model uncertainties for year y
f_y	=	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 CH_4 (t CO_2e/t CH_4)
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)

$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
MCF_y	=	Methane correction factor for year y
$w_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
DOC_j	=	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
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	=	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)

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

The methodology ACM0001 (version 19.0) 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 odor concerns, or for other reasons (collectively referred to as requirement in this section). The four cases in 4.2 are distinguished. The appropriate case should be identified, and the corresponding instructions followed.

Table 4.2 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

The was no regulation or standard enforces methane destruction in LFG when the Al Multaqa Landfill project started operation, and the landfill was not equipped with LFG capture and destruction system prior to the implement of the proposed project. Therefore, Case 1 is identified as the situation at the start of the project activity. Thus, $F_{CH4,BL,y}$=0.

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 the methodology tool 05 "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0),

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y}) \quad \text{Equation (12)}$$

Where:

$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year y (t CO_2 / yr)
$EC_{BL,k,y}$	=	Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/yr)
$EF_{EL,k,y}$	=	Emission factor for electricity generation for source k in year y (t CO_2/MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source k in year y
k	=	Sources of electricity consumption in the baseline

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

To determine the emission factor for electricity generation, according to the methodology tool 05, Scenario A applies as the baseline scenario of the project for electricity generation is the equivalent electricity generated by the proposed project was supplied from the grid. Option A2 is selected, and the value of 0.4 t CO_2/MWh is applied as for electricity grids in Oman where hydro power plants constitute less than the 50% of total grid generation.[4]

For the parameter $TDL_{k,y}$, default value of 3% for baseline emission is applied as per the methodology tool.

5.2 Project Emissions

As per ACM0001, project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad \text{Equation (13)}$$

Where:

PE_y	=	Project emissions in year y (t CO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year y (t CO_2/yr)

[4] IREC Country Report Oman (2021) https://www.irecstandard.org/documents/#

$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (t CO_2/yr)
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (t CO_2/yr)
$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (t CO_2/yr)

The proposed project does not involve consumption of fossil fuels, distribution of compressed/liquified LFG using trucks or supply of LFG to consumers through a dedicated pipeline, therefore, $PE_{FC,y}$=0, $PE_{DT,y}$=0, $PE_{SP,y}$=0.

Hence, $PE_y = PE_{EC,y}$

$PE_{EC,y}$ is determined by the methodology tool 05 "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0),

$$PE_{EC,y} = \sum_k EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y}) \quad \text{Equation (14)}$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (t CO_2 / yr)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EF_{EF,j,y}$	=	Emission factor for electricity generation for source j in year y (t CO_2/MWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y
j	=	Sources of electricity consumption in the project

When applying the tool 05 (version 03.0):

(a) $EC_{PJ,k,y}$ in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$); and

(b) If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y}$>0), then the electricity consumption in the tool ($EC_{PJ,j,y}$) 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 CDM-PDD.

To determine the emission factor for electricity consumption, as per the methodology tool 05, Scenario A applies as the electricity consumed by the proposed project was supplied from the grid. Option A2 is selected, and the value of 1.3 t CO_2/MWh is applied.

For the parameter $TDL_{j,y}$, default value of 20% for project emission is applied as per the methodology tool.

5.3 Leakage

No leakage effects are accounted for under the methodology ACM0001 (version 19.0).

5.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (15)}$$

Where:

ER_y	=	Emission reductions in year y (t CO_2e/yr)
BE_y	=	Baseline emissions in year y (t CO_2e/yr)
PE_y	=	Project emissions in year y (t CO_2/yr)

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)
01/11/2021-31/12/2021	14,598	27	0	14,571
01/01/2022-31/12/2022	95,803	164	0	95,639
01/01/2023-31/12/2023	104,472	164	0	104,308
01/01/2024-31/12/2024	113,690	164	0	113,526
01/01/2025-31/12/2025	122,548	164	0	122,384

01/01/2026-31/12/2026	115,824	164	0	115,660
01/01/2027-31/12/2027	110,100	164	0	109,936
01/01/2028-31/12/2028	104,688	164	0	104,524
01/01/2029-31/12/2029	99,026	164	0	98,862
01/01/2030-31/12/2030	93,695	164	0	93,531
01/01/2031-31/10/2031	74,259	137	0	74,122
Total	**1,034,105**	**1,612**	**0**	**1,032,493**

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	OX_{top_layer}
Data unit	-
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	Calculation of baseline emissions

Comments	-

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	IPCC Fifth Assessment report
Value applied:	28
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	The parameter will be updated according to the latest requirement of VCS standard and IPCC report or COP/CMP decisions.

Data / Parameter	η_{PJ}
Data unit	-
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	Al Amerat Landfill Biogas Potential Report
Value applied:	90%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions

Comments	-

Data / Parameter	$\rho_{i,t}$
Data unit	t/m^3
Description	Density of greenhouse gas i in the gaseous stream in time interval t
Source of data	Calculated as per Equation 8
Value applied:	0.000716 at normal conditions (273.15K, 101.325 kPa)
Justification of choice of data or description of measurement methods and procedures applied	As per Equation (7), $\rho_{i,t}$ (greenhouse gas i refers to methane) at normal conditions is calculated as follows: P_{CH4}= 101,325 Pa ×16.04 kg/kmol/(8,314 $Pa.m^3/kmol.K$×273.15 K) = 0.716 kg/m^3 =0.000716 t/m^3
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	Φ_y
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Default value from TOOL04: “Emissions from solid waste disposal sites” (version 08.0)
Value applied:	0.75
Justification of choice of data or description of measurement methods and procedures applied	Application A (the project activity mitigates methane emissions from a specific existing SWDS) is applied, and the default value of 0.75 is used.

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	OX
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2 This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS

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	Calculation of baseline emissions
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	Calculation of baseline emissions
Comments	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for: (a) Application A; or (b) Application B if the tool is applied to MSW.

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 SWDS does not have a water table above the bottom of the SWDS and Application A is applied. Therefore, a default value (MCF_y=$MCF_{default}$) 1.0 for anaerobic managed solid waste disposal sites is selected from TOOL04 (version 08.0) according to the management of the SWDS.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$W_{j,x}$
Data unit	t
Description	Amount of solid waste type j disposed in SWDS in the year x
Source of data	Records from landfill operator
Value applied:	

Year	Annual disposed MSW(tons)
2011	155,013
2012	254,231
2013	233,311
2014	205,097
2015	212,084
2016	351,586
2017	323,095
2018	321,244
2019	349,133
2020	355,019

	2021: 356,522 2022: 372,902 2023: 391,547 2024: 411,124 2025: 431,680

Waste type j	Weight fraction (% wet waste)
Wood and wood products	1.62
Pulp, paper and cardboard (other than sludge)	18.21
Food, food waste, beverages and tobacco (other than sludge)	13.30
Textiles	13.24
Garden, yard and park waste	3.62
Glass, plastic, metal, other inert waste	50.01

Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
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:	For MSW, the following values for the different waste types j should be applied:

Waste type j	DOC_j (% 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

Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	k_j
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:	

Waste type j	Tropical (MAT>20°C) and

			Dry (MAP<1000mm)
	Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.045
		Wood, wood products and straw	0.025
	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.065
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.085
Justification of choice of data or description of measurement methods and procedures applied	The climate condition of the location of the landfill[5]: Mean annual temperature: 28.3°C Mean annual precipitation: 105mm		
Purpose of Data	Calculation of baseline emissions		
Comments	-		

Data / Parameter	$EF_{EL,k,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation
Source of data	TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Value applied:	0.4

[5] https://www.climatestotravel.com/climate/oman

Justification of choice of data or description of measurement methods and procedures applied	According to Scenario A of the methodology tool 05, Scenario A applies as the baseline scenario of the project for electricity generation is the equivalent electricity generated by the proposed project was supplied from the grid. Option A2 is selected, and the value of 0.4 t CO2/MWh is applied as for electricity grids in Oman where hydro power plants constitute less than the 50% of total grid generation.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{EL,j,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity consumption
Source of data	TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Value applied:	1.3
Justification of choice of data or description of measurement methods and procedures applied	As per the methodology tool 05, Scenario A applies as the electricity consumed by the proposed project was supplied from the grid. Option A2 is selected, and the value of 1.3 t CO2/MWh is applied.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$TDL_{k,y}$ and $TDL_{j,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source k or source j in year y

Source of data	TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Value applied:	$TDL_{k,y}$ = 3% $TDL_{j,y}$ = 20%
Justification of choice of data or description of measurement methods and procedures applied	The Project is applicable to Scenario A defined in TOOL05 (version 03.0), which requires the default value of 20% for project emissions, and3% for baseline emissions.
Purpose of Data	Calculation of baseline emissions ($TDL_{k,y}$) and project emissions ($TDL_{j,y}$).
Comments	-

6.2 Data and Parameters Monitored

Data / Parameter	Management of SWDS
Data unit	-
Description	Management of SWDS
Source of data	Use different sources of data: (a) Original design of the landfill; (b) Technical specifications for the management of the SWDS; (c) Local or national regulations
Description of measurement methods and procedures applied	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications

Frequency of monitoring/recording	Annually
Value applied:	-
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	-
Calculation method	-
Comments	-

Data / Parameter	f_y
Data unit	-
Description	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
Source of data	TOOL04: "Emissions from solid waste disposal sites" (version 08.0)
Description of measurement methods and procedures applied	-
Frequency of monitoring/recording	For application A: once for the crediting period
Value applied:	0
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	Calculation of baseline emission

Calculation method	-
Comments	-

Data / Parameter	$V_{t,db}$
Data unit	m^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Flow meter(s)
Description of measurement methods and procedures applied	The flow meter continuously and simultaneously measures the volumetric flow, the temperature and the pressure of the LFG, and the equipment automatically converts into values at normal condition.
Frequency of monitoring/recording	Continuously measured and regularly recorded
Value applied:	-
Monitoring equipment	Flow meter(s)
QA/QC procedures applied	Flow meter(s) should be calibrated regularly in compliance with the national/industry standards.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$v_{i,t,db}$
Data unit	m^3 gas i/m^3 dry gas

Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Gas analyzer
Description of measurement methods and procedures applied	Continuous gas analyzer operating in dry-basis.
Frequency of monitoring/recording	Continuously monitored and regularly recorded
Value applied:	-
Monitoring equipment	Gas analyzer GA3000 plus
QA/QC procedures applied	Gas analyzer should be calibrated regularly in compliance with the national/industry standards.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$Op_{j,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Project participants
Description of measurement methods and procedures applied	The captured LFG is consumed by flare or to be consumed by gas generator(s). Operation of the flare/gas generator(s) are automatically monitored and recorded in the daily records. 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 PDD; (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. $Op_{j,h}$=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, $Op_{j,h}$=1
Frequency of monitoring/recording	hourly
Value applied:	-
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh

Description	Amount of electricity generated using LFG by the project activity in year y
Source of data	Electricity meter
Description of measurement methods and procedures applied	Monitor net electricity generation by the project activity using LFG
Frequency of monitoring/recording	Continuous
Value applied:	0
Monitoring equipment	Electricity meter
QA/QC procedures applied	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

Data / Parameter	$EG_{EC,y}$
Data unit	MWh
Description	Amount of electricity consumed by the project activity in year y
Source of data	Calculated by rated capacity of device used on site and length of working hours, as there are no separated electricity meter

	installed onsite for only the operation of LFG capture and utilization.
Description of measurement methods and procedures applied	Amount of annual electricity consumed =Rated capacity of device (MW) × 8760h/y Device including the operation of LFG capture system and processing and upgrading of the LFG to flare or other applications (boilers, power generators)
Frequency of monitoring/recording	Continuous
Value applied:	105MWh/y, Rated capacity of device is 12 kW
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process t $PE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data / Parameter	CAPEX and OPEX
Data unit	OMR/USD
Description	Total investment to implement the project and total cost to operate the project
Source of data	Engineering, procurement and construction contracts; and maintenance contracts

Description of measurement methods and procedures applied	-
Frequency of monitoring/recording	At the first issuance request after each phase of the project is fully implemented
Value applied:	-
Monitoring equipment	-
QA/QC procedures applied	Audited by professional, independent financial auditors. The VVB should only verify that the data provided corresponds to the data from independent financial auditors
Purpose of data	-
Calculation method	-
Comments	-

6.3 Monitoring Plan

Monitoring and management team will be set up by the project owner, aiming to make sure that the monitored data and parameters set out in section 6.2 are properly obtained and recorded.

1. Parameters to be monitored and the location of monitoring instruments.

Figure 6.1 shows the parameters to be monitored as well as the position of the monitoring instruments.

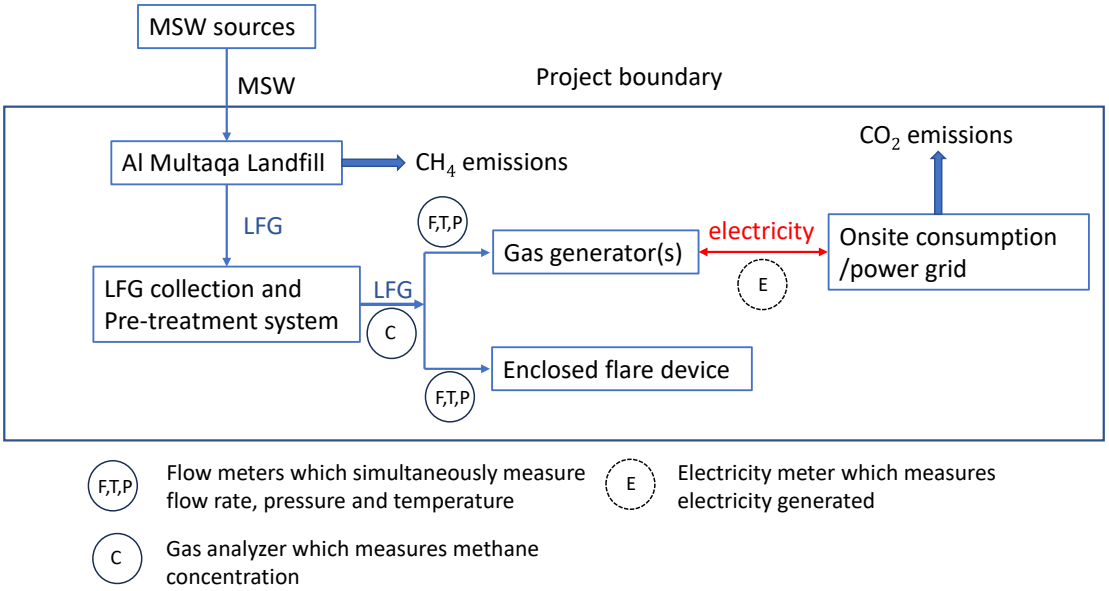


Figure 6.1 Diagram of the project boundary showing the monitored parameters

2. Operational and management structure for monitoring

Overall responsibility for daily monitoring and reporting lies with the project owner. A monitoring group will be established to carry out the monitoring activities. The detailed organizational structure is as follows:

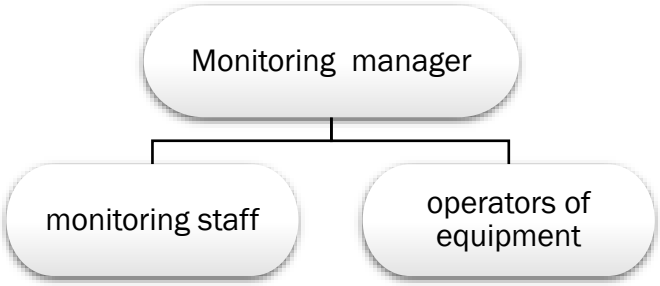


Figure 6.2 Monitoring and management structure

The responsibility of each role in the team structure are:

Monitoring manager will be appointed to supervise the implementation of monitoring plan. He/she will be responsible for training, and for internal check of the measurement, collection of relevant receipts and invoices, and the calculation of the mission reductions.

Monitoring staff is responsible for the daily operation and aggregating the monitored data monthly and yearly data, including the gas flow data, relevant receipts and invoices.

Operators of monitoring equipment is responsible for the monitoring and maintenance of key equipment such as gas analysers, flow meters and electric meters.

3. Quality control

All metering equipment for monitoring will be maintained in accordance with VCS requirements and will be calibrated regularly by qualified organizations as per the national or sectoral regulations. The calibration records should be kept along with the data files of project monitoring.

In case of a meter in fault, it shall be immediately repaired and replaced. The equipment supplier will provide technical support to engage the problem promptly and emission reduction during the corresponding period will be calculated conservatively.

4. Data management

All monitoring data and records should be archived in electronic format and hard copy. The project owner will also keep copies of related documents such as sales receipts and calibration records at least for 2 years after the end of crediting period.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	Management of SWDS
Data unit	-
Description	Management of SWDS Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications
Value applied:	Since the implementation of the project activity, no changes have taken place in the management of the landfill to increase the methane generation, and the provisions on methane recovery

	and utilization have not changed in the current laws and regulations in Oman.
Comments	-

Data / Parameter	f_y
Data unit	-
Description	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
Value applied:	0
Comments	-

Data / Parameter	$V_{t,db}$
Data unit	m^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis The parameter is measured by flow meter(s) continuously, which will be converted automatically into value under standard condition.
Value applied:	

Period	$V_{t,db}$ (Nm^3/h)
01/11/2021-30/11/2021	1,270.596
01/12/2021-31/12/2021	1,060.883
01/01/2022-31/01/2022	990.357
01/02/2022-28/02/2022	917.348
01/03/2022-31/03/2022	718.208
01/04/2022-30/04/2022	575.454
01/05/2022-31/05/2022	514.532
01/06/2022-30/06/2022	457.137

	01/07/2022-31/07/2022	576.046
	01/08/2022-31/08/2022	460.558
	01/09/2022-30/09/2022	430.603
	01/10/2022-31/10/2022	785.256
	01/11/2022-30/11/2022	898.059
	01/12/2022-31/12/2022	874.011
Comments	This parameter will be monitored in Options A.	

Data / Parameter	$v_{i,t,db}$
Data unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis The specification of the monitoring equipment is Gas analyzer GA3000 plus

Value applied:

Period	$v_{i,t,db}$ (%)
01/11/2021-30/11/2021	37.30
01/12/2021-31/12/2021	22.16
01/01/2022-31/01/2022	35.17
01/02/2022-28/02/2022	36.37
01/03/2022-31/03/2022	37.89
01/04/2022-30/04/2022	41.12
01/05/2022-31/05/2022	46.86
01/06/2022-30/06/2022	49.34
01/07/2022-31/07/2022	41.52
01/08/2022-31/08/2022	47.43
01/09/2022-30/09/2022	50.21
01/10/2022-31/10/2022	41.11
01/11/2022-30/11/2022	38.95

	01/12/2022-31/12/2022	41.73
Comments	-	

Data / Parameter	$Op_{j,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Value applied:	

Period	Number of hours ($Op_{j,h}$ =1)
01/11/2021-30/11/2021	609
01/12/2021-31/12/2021	668
01/01/2022-31/01/2022	693
01/02/2022-28/02/2022	611
01/03/2022-31/03/2022	689
01/04/2022-30/04/2022	718
01/05/2022-31/05/2022	744
01/06/2022-30/06/2022	417
01/07/2022-31/07/2022	691
01/08/2022-31/08/2022	738
01/09/2022-30/09/2022	594
01/10/2022-31/10/2022	750
01/11/2022-30/11/2022	717
01/12/2022-31/12/2022	744

Comments	-

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh

Description	Amount of electricity generated using LFG by the project activity in year y
Value applied:	0
Comments	-

Data / Parameter	$EG_{EC,y}$
Data unit	MWh
Description	Amount of electricity consumed by the project activity in year y
Value applied:	Calculated by rated capacity of device used on site and length of working hours, as there is no separated electricity meter installed onsite for only the operation of LFG capture and utilization. Rated capacity of device onsite is 12kW, working hour per day is 24/d and 8760h/year for conservative.

Period	Electricity consumed onsite
01/11/2021-30/11/2021	8.640
01/12/2021-31/12/2021	8.928
01/01/2022-31/01/2022	8.928
01/02/2022-28/02/2022	8.064
01/03/2022-31/03/2022	8.928
01/04/2022-30/04/2022	8.640
01/05/2022-31/05/2022	8.928
01/06/2022-30/06/2022	8.640
01/07/2022-31/07/2022	8.928
01/08/2022-31/08/2022	8.928
01/09/2022-30/09/2022	8.640
01/10/2022-31/10/2022	8.928
01/11/2022-30/11/2022	8.640

	01/12/2022-31/12/2022	8.928
	Total	122.688
Comments	-	

Data / Parameter	CAPEX and OPEX
Data unit	OMR/USD
Description	Total investment to implement the project and total cost to operate the project
Value applied:	The actual value is sourced from the contract between the Be'ah and the operator (Suez Al Bashaer LLC). The data of this parameter is considered as commercially sensitive information and has been excluded from the public version of the PD. The contract will be provided to the VVB at the verification for the 1st monitoring period.
Comments	-

7.2 Baseline Emissions

According to the methodology ACM0001(V19.0), baseline emissions are determined based on the section 5.1. The BE_y is ex-post determined as the following equations:

$$BE_y = BE_{CH4,y} + BE_{EC,y}$$

As the electricity generator has not been installed yet, the baseline emissions associated with electricity generation is zero.

$$BE_y = BE_{CH4,y} + BE_{EC,y} = BE_{CH4,y}$$

$$= \left(\left(1 - OX_{top_{layer}}\right) \times F_{CH4,PJ,y} - F_{CH4,BL,y}\right) \times GWP_{CH4}$$

$$= \left(\left(1 - OX_{top_{layer}}\right) \times F_{CH4,flared,y} - 0\right) \times GWP_{CH4}$$

$$= \left(\left(1 - OX_{top_{layer}}\right) \times (F_{CH4,sent_{flare},y} - \frac{PE_{flare,y}}{GWP_{CH4}})\right) \times GWP_{CH4}$$

$$= \left(1 - OX_{top_{layer}}\right) \times [(V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \times GWP_{CH4}) - PE_{flare,y}]$$

According to the TOOL06 (version 04.0),

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

Therefore, based on the monitored data and parameters of section 6.1 and 7.1, BE_{CH4} is ex post calculated as the following:

Table 7.1 The ex post calculation of $F_{CH4,flare,y}$

Period	$V_{t,db}$ (Nm^3/h)	$V_{i,t,db}$ (%)	$\rho_{i,t}$ (tCH_4/m^3CH_4)	$O_{p,j,h}$ (h)	$F_{CH4,sent\_flare}$ (tCH_4)	PE_{flare} (tCO_2e)	$F_{CH4,flare,y}$ (tCH_4)
01/11/2021-30/11/2021	1,270.596	37.30	0.000716	609	206.63	1157	165.30
01/12/2021-31/12/2021	1,060.883	22.16	0.000716	668	112.42	630	89.93
01/01/2022-31/01/2022	990.357	35.17	0.000716	693	172.80	968	138.24
01/02/2022-28/02/2022	917.348	36.37	0.000716	611	145.94	817	116.75
01/03/2022-31/03/2022	718.208	37.89	0.000716	689	134.25	752	107.40
01/04/2022-30/04/2022	575.454	41.12	0.000716	718	121.66	681	97.33
01/05/2022-31/05/2022	514.532	46.86	0.000716	744	128.44	719	102.75
01/06/2022-30/06/2022	457.137	49.34	0.000716	417	67.35	377	53.88
01/07/2022-31/07/2022	576.046	41.52	0.000716	691	118.34	663	94.68
01/08/2022-31/08/2022	460.558	47.43	0.000716	738	115.44	646	92.35

01/09/2022-30/09/2022	430.603	50.21	0.000716	594	91.95	515	73.56
01/10/2022-31/10/2022	785.256	41.11	0.000716	750	173.37	971	138.70
01/11/2022-30/11/2022	898.059	38.95	0.000716	717	179.60	1006	143.68
01/12/2022-31/12/2022	874.011	41.73	0.000716	744	194.29	1088	155.43
Total				**9,383**	**1,962.48**		**1569.99**

During this monitoring period, the methane captured was only flared and has not yet used for electricity generation, therefore $F_{CH4,flare,y}=F_{CH4,PJ,y}$,and BE_{CH4} is calculated as following:

Table 7.2 The ex post calculation of $BE_{CH4,y}$

Period	OX_{top_layer}	$F_{CH4,y}$ (tCH_4)	$F_{CH4,BL,y}$ (tCH_4)	GWP_{CH4}	BE_{CH4} (tCO_2e)
01/11/2021-30/11/2021	0.1	165.30	0	28	4,166
01/12/2021-31/12/2021	0.1	89.93	0	28	2,266
01/01/2022-31/01/2022	0.1	138.24	0	28	3,484
01/02/2022-28/02/2022	0.1	116.75	0	28	2,942
01/03/2022-31/03/2022	0.1	107.40	0	28	2,706
01/04/2022-30/04/2022	0.1	97.33	0	28	2,453
01/05/2022-31/05/2022	0.1	102.75	0	28	2,589
01/06/2022-30/06/2022	0.1	53.88	0	28	1,358

01/07/2022-31/07/2022	0.1	94.68	0	28	2,386
01/08/2022-31/08/2022	0.1	92.35	0	28	2,327
01/09/2022-30/09/2022	0.1	73.56	0	28	1,854
01/10/2022-31/10/2022	0.1	138.70	0	28	3,495
01/11/2022-30/11/2022	0.1	143.68	0	28	3,621
01/12/2022-31/12/2022	0.1	155.43	0	28	3,917
Total		**1,569.99**			**39,564**

7.3 Project Emissions

Quantity of project emissions are determined according to the methodology and based on section 5.2, the project emission determined as the following equation:

$PE_y = PE_{EC,y}$

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

Therefore, $PE_{EC,y}$ is ex post calculated as the following:

Table 7.3 Project emission calculation

Period	EC_{PJ} (MWh)	$EF_{EF,j,y}$ (tCO_2e/MWh)	$TDL_{j,y}$	PE_y (tCO_2e)
01-Nov-2021~ 31-Dec-2021	17.568	1.3	20%	27
01-Jan-2022~ 31-Dec-2022	105.120	1.3	20%	164
Total	**122.688**	**1.3**	**20%**	**191**

7.4 Leakage

No leakage effects are accounted for under the methodology ACM0001 (version 19.0).

7.5 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01-Nov-2021~ 31-Dec-2021	6,432	27	0	6,404
01-Jan-2022~ 31-Dec-2022	33,132	164	0	32,967
Total	**39,564**	**191**	**0**	**39,371**

Comparison of actual emission reductions with ex ante estimates:

Ex-ante emissions reductions /removals	Achieved emissions reductions /removals	Percent difference	Justification for the difference
110,210	39,371	-64.28%	As mentioned in section 1.11, the Al Multaqa landfill includes two cells, and only Cell 1 was closed in 2021 when the cell reached its full capacity. Cell 2 closure is expected to be carried out in 2025. Therefore, in the 1st monitoring period, only the LFG from Cell 1 is captured and flared. The Ex-ante emission reductions were calculated based on the model simulation, for both cell 1 and cell 2. Besides, the actual waste characteristics, amount of waste disposed, and other operational parameters may be different from the model assumptions. There are other operational factors that may impact the GHG emission reductions, for instance, the area between cell1&2 was not completely sealed, allowing gas to escape.

APPENDIX X

Not applicable.