



 Monitoring report form (Version 04.0)	
MONITORING REPORT	
Title of the project activity	Samsun Landfill Gas to Energy Project, Turkey
Reference number of the project activity	GS 935
Version number of the monitoring report	2.1
Completion date of the monitoring report	08.12.2014
Registration date of the project activity	24.06.2011
Monitoring period number and duration of this monitoring period	Monitoring Period Nr. 2 01.12.2012 – 31.08.2014
Project participant(s)	Samsun Avdan Enerji Üretim ve Tic. A.Ş. Mavi Consultants
Host Party(ies)	Turkey
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Waste Handling and Disposal; Energy Industries ACM0002 v.12.1, "Consolidated Baseline Methodology for Grid-Connected Electricity Generation From Renewable Sources" ACM0001 v.11, "Consolidated Baseline and Monitoring Methodology for Landfill Gas Project Activities"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	2012: 35,937 tCO ₂ 2013: 44,505 tCO ₂ 2014: 52,698 tCO ₂
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	192,201 tCO ₂
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	6,207 tCO ₂
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	185,994 tCO ₂

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The proposed activity involves the collection and utilization of the landfill gas that is generated at the Samsun landfill site, Turkey, to generate electricity with an installed capacity starting with 2.4 MW_e and reaching 4.8 MW_e throughout the investment.

- 1. Purpose of the project activity and the measures taken for greenhouse gas emission reductions:** The Project aims to generate electricity from landfill gas and feed it to the national electricity grid. The national electricity settlement centre manages supply of power plants such that the power generation of thermal power plant-dominated generation system is reduced at the same amount the Project activity exports power, ensuring that the emissions are decreased in practice. The Project activity effectively collects and destroys methane (a strong greenhouse gas) for power generation or by flaring, further diminishing the greenhouse gas effect caused by the landfill site.
- 2. Brief description of the installed technology and equipment:** The anaerobic fermentation of the municipal organic waste that is stored at the landfill site results in the formation of methane gas, which is collected by a piping system that is installed by the Project activity. The Project will use the LFG from both the already dumped solid waste and the waste that will be disposed in coming years. Therefore, the piping and capacity expansion work will be carried out in parallel to waste disposal amount during the Project lifetime. The Project mainly consists of a LFG collection system, a flaring unit, electricity generation sets, switchgear station and controlling / measurement equipment. The Project uses **3 internal combustion engines** that utilize landfill gas as fuel, destroy the methane content of the gas, thereby generating electricity.
- 3. Relevant dates for the project activity:** The gas collection and preliminary flaring on site has started on 09.02.2011. Following the installation of the first and second gas engines, official power generation has started on 09.03.2012. The third engine started operating officially on 27.09.2013.
- 4. Total GHG emission reductions achieved in this monitoring period:** 192,201 tCO₂.

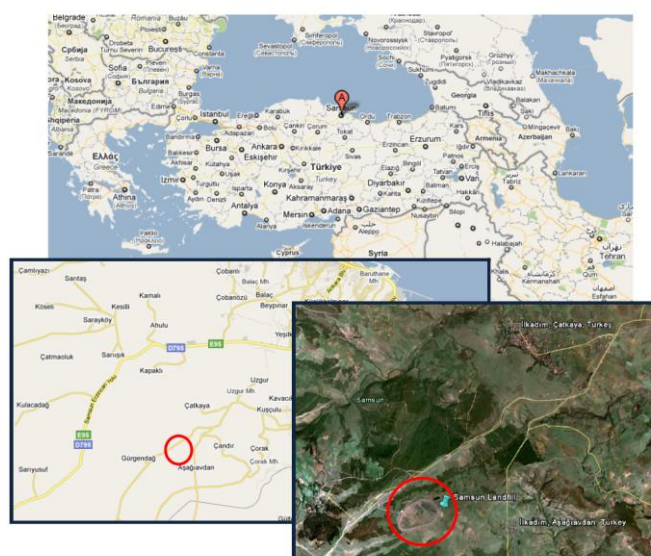
A.2. Location of project activity

Host country: Turkey

Region: Samsun Province.

Town: The closest neighbourhoods are Gurgendag and Asagiavdan.

Geographic location:
41°14'45"N, 36°13'16"E



A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Turkey (host)	Samsun Avdan Enerji Üretim ve Tic. A.Ş. (private entity)	No
Turkey (host)	Mavi Consultants (private entity)	No

A.4. Reference of applied methodology and standardized baseline

The following tools and methodologies are used for the Project activity:

- ACM0002, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”, v.12.1;
- ACM0001, “Consolidated baseline and monitoring methodology for landfill gas project activities”, v.11;
- “Tool to calculate the emission factor for an electricity system”, v.01.1;
- “Tool for the demonstration and assessment of additionality”, v.05.2;
- “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”; v.4;
- Methodological tool “Project emissions from flaring”; v.02.0.0, EB68, Annex 15.
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” v.02.0.0.

The Monitoring Report has been carried out in accordance with the UNFCCC methodologies and tools that have been used in the registered PDD. These tools and methodologies that are used are available at <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

A.5. Crediting period of project activity

Parameter	Crediting Period Information
Type of Crediting Period:	Renewable
Registered crediting period start date:	09.02.2011
Actual start date for emission reductions:	09.02.2011
Length:	7 years

A.6. Contact information of responsible persons/ entities

The name and contact information of responsible person(s) / entity(ies) are given below:

Name	Role and Responsibility	Contact Information
Mr. Erol Iren	Proper implementation of the monitoring plan and management of the	Samsun Avdan Enerji Üretim ve Tic. A.Ş. Suleyman Seba C., Besiktas, BJK



	monitoring and verification procedures in the name of the Project owner.	Plaza, A Blok, No:77, Istanbul – TURKEY Tel: +90 212 2581820 Fax: +90 212 2581240
Mr. Yagmur Karabulut	Mavi Consultants is assigned by the Project owner as carbon consultant for the completion of the monitoring report and support during verification.	Mavi Consultants Kalamis Fener C. Tevfik Paşa S. 12/1 D.9 Fenerbahçe Mah. Kadıköy, Istanbul – TURKEY Tel: +90 216 3370659 Fax: +90 216 3370662

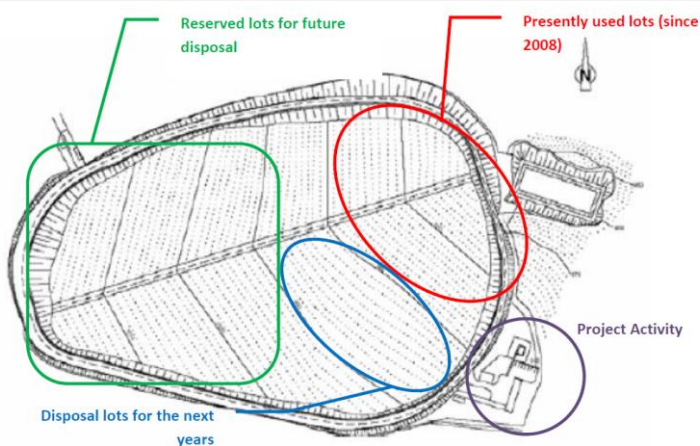
SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The Project has started reducing emission with flaring of the landfill gas on 09.02.2011. After 2 gas engines are installed, the power generation officially started on 09.03.2012 with a written approval of relevant authorities (Ministry of Energy and Natural Resources). The electricity generated is delivered to the national grid.

When the gas generation is low, the Project activity draws some electricity from the grid, which has to be produced partly by fossil fuel fired power plants. Although power augmentation in such situations may be necessary, these amounts are already accounted for by considering only the net electricity generation of the Project. When the yield of gas is insufficient to initiate the generators, or if there is maintenance, or if there is more LFG than the generators can combust, then LFG will be sent to an enclosed auto-ignition flare unit. Once the methane in the LFG is converted to carbon dioxide, its greenhouse effect is effectively reduced.

The LFG collection system consists of newly installed branch pipes, head pipes and extraction wells for the effective collection of the LFG. Following the gas collection, the LFG is pre-treated by first separating the leachate condensate, dewatering, removing solid impurities, drying and pressurization by a blower. Then the pre-treated LFG is fed into the gas engines. The Project does not store LFG.



As of the ending date of the monitoring period, the Project is in operation with **3 gas engines**, each having a capacity of 1.2 MW_e, reaching a total installed capacity of 3.6 MW_e. Waste tipping continues on site and new generators will be added in stages as the gas yield increases during the project activity due to more waste deposition. Between each new addition of gen-sets, the remaining gas which cannot be used by the existing generators will be flared. According to the PDD, the Project can expand up to 4.8 MW_e, using 4 gen-sets, depending on gas availability. Therefore, further installation of gas collection pipes and gas engines is planned. The main equipment used in the Project is gas engines with the following specifications;

Table 1. Technical details of installed methane destruction equipment

	Power Gen-Set	Flare Unit ¹
Manufacturer	MWM (Deutz)	Conveco
Type of Units	1.23 MW _m , 1.2 MW _e ,	Enclosed type, K-Type thermocouple
Number of units	3	1

¹ Source: Booster and flare unit fact sheet



Specifications	Internal combustion (gas) engine Efficiency at full capacity: 40.4%	Capacity: 200-1000 m ³ /h Temperature: 800-1200 °C Minimum methane: 25%
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Overall, the Project is in commercial operation in line with the description in the registered PDD. There are no significant overhaul times, downtimes of equipment, exchange of equipment or any other similar special event that could have an impact on the applicability of the UNFCCC tools and methodologies that have been used.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

For the **electricity generation** component of emission reductions, there are **the following** deviations from the validated monitoring plan:

In the registered monitoring plan in Section D.2, ID.1 corresponds to **EL_{LFG,y}** (“net electricity supplied to the grid”) and states that the exported electricity to the grid (“ISVM”) will be used for calculating emission reductions. However, during the monitoring period the PMUM records do not show this parameter anymore. Instead, only “UEVM”, the exported electricity recorded at the transformer station (not the total amount supplied to the grid, but deducted after line losses in the grid up to the transformer station) is included in the PMUM records. It is not known whether PMUM will in future include ISVM data again. However, due to data unavailability UEVM data are temporarily used instead of ISVM data for the power export. This is conservative, as UEVM is always lower than ISVM.

For temporary monitoring plan deviations of individual Gold Standard sustainable development indicators, please refer to the Appendix on *ANNEX I - GOLD STANDARD INFORMATION* of this report.

For the **methane destruction** component of emission reductions, there are **no temporary** deviations from the validated monitoring plan.

Forward Action Requests: The following issues have been raised during the Project validation, registration or verification phases;

By:	Forward Request	Explanation of the Project Proponent
Gold Standard	The verifying DOE shall check the official communications occurred between the PP and both national and local authorities and report accordingly in the verification report.	Although leachate management is beyond the scope of the Project activity, the Project owner has committed to monitor this indicator as long as there exists publicly available information for the leachate/ground water quality. The Municipality does not publicly report leachate/ground water quality. The Project owner has officially contacted the Municipality for the provision of leachate data. In response, the Samsun Greater Municipality has provided a letter confirming that there is no positive or negative change in the leachate quality.

Gold Standard	The applicable version “Tool to determine mass flow of a GHG in a gaseous stream”, require demonstration of the temperature of the gaseous stream (Tt) is less than 60°C at the flow measurement point. The confirmation of the temperature of the gaseous stream shall be based on actual measurement by instruments with recordable electronic signals (analogical or digital). The measurement is required to assure that the applicability conditions to apply option A (Volume Flow-dry basis) is met. The PP shall install appropriate measurement device and include the measurement of (Tt) to the monitoring plan in accordance with the requirements of “Tool to determine mass flow of a GHG in a gaseous stream” version 02.0.0. If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option will be used from Table one of the Tool shall be applied instead. The DOE shall verify during the verification accordingly.	The Project has not been able to install an additional automatic temperature measurement device that records data. It is to be noted that the calculation on wet basis, as suggested, also requires the moisture content measurements (Option 1) measurement or temperature measurement for H₂O's saturation pressure (Option 2) both of which are unavailable for the Project activity. Therefore, dry basis is used as it has previously been confirmed that the temperatures are below 60°C and the gas intake is on dry basis. The landfill gas temperature at the entering point to the booster has not been measured and recorded real time, however it has been recorded manually. The records show that the temperature has always been relatively stable, between 25 – 38 °C throughout the monitoring period. As these temperatures are consistently and conservatively below 60 °C, it is fair to suggest that the dry basis assumption holds true.
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B.2.2. Corrections

N/A

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

- For permanent monitoring plan deviations of individual Gold Standard **sustainable development indicators**, please refer to the *ANNEX I - GOLD STANDARD INFORMATION* of this report.
- For the **electricity generation** component of emission reductions, there are **no permanent** deviations from the validated monitoring plan.

- iii. For the **project emissions** generated by the flare, there are some **permanent deviations**² in this monitoring period. In the **previous** monitoring report, there had been the following permanent deviation:
- In the registered PDD, project emissions are estimated using the “Tool to determine project emissions from flaring gases containing methane”; EB28, Annex 13. In this monitoring report, the most recent version of this tool, the methodological tool “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15) is used. The scope and applicability of this new version complies with the Project. The tool is applicable, as the Project meets following applicability conditions:
 - Methane is the component with highest concentration in the flammable residual gas;
 - The source of residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas);
 - The flare is enclosed and there are operating specifications provided by the manufacturer of the flare.
 - Due to the use of the methodological tool “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15), the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” v.02.0.0 is also used in this monitoring report. The scope and applicability of this new version complies with the Project. The tool is applicable, as the Project meets following applicability conditions:
 - The tool is applied to the residual gas;
 - The flow of the gaseous stream is measured continuously;
 - CH₄ is the greenhouse gas for which the mass flow is determined;
 - The time interval t for which mass flow should be calculated is every minute m . However, the monitored data frequency is every 10 minutes. As a deviation, the $MD_{\text{flare},y}$ has been reduced by 1% to account for the error margin. Please refer to the monitoring parameter CF_{EM} in Section D.2 for details.
 - With the use of the methodological tool “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15), a new parameter $F_{\text{ch4,RG},m}$ has been added to the monitoring plan, instead of $LFG_{\text{flare},y}$. Although their unit is different ($F_{\text{ch4,RG},m}$ has the unit of kg, whereas $LFG_{\text{flare},y}$ has the unit of Nm³) they both measure the amount of the landfill gas that is flared. Since the formulae in the “Project emissions from flaring”, v.02.0.0 use $F_{\text{ch4,RG},m}$, this parameter is added to this monitoring report as a permanent deviation.
- iv. For the **methane destruction** component of emission reductions, there is one **permanent deviation** in this monitoring period². In the **previous** monitoring report, the following permanent deviations have been stated:

² The GWP of methane is considered to be 25 instead of 21 from 01.01.2013 onwards, according to the IPCC 4th Assessment Report. Details are provided in section D.1, GWP parameter. Another deviation is the addition of the monitoring parameter “Temperature of the gaseous stream (T_t)”, which is to ensure that the selection of “dry basis” assumption holds true.

- **Deviation regarding procedures for missing or corrupted data:** For the SCADA system data that are corrupted or missing, the following procedure had been presented in line with the registered monitoring plan: “The value of that parameter one hour before the error, one hour after the system restart, and the average from the previous 24 hours will be determined and the lowest figure of those will be used”. However, due to complicated nature of this procedure for missing or corrupted data, the Project Participants have simply omitted missing or corrupted data for the sake of conservativeness and higher data quality.
- In the registered PDD, one of the monitored parameters is $MG_{PR,y}$, which is the amount of methane generated during year y of the project activity that is to be *estimated* using the *actual* amount of waste disposed in the landfill. However, for verification purposes the Project Participants consider this parameter to be irrelevant and the methodologies and tools do not require projects to monitor this parameter. Therefore, this parameter has been removed from the monitoring plan permanently.

B.2.4. Changes to project design of registered project activity

There are **no changes** in this monitoring period. In the **previous** monitoring period, the following project design changes have been carried out;

In the registered monitoring plan, a flow meter device was supposed to be installed for each gas engine that measures flow rate of the landfill gas. However in the actual Project, there is only one flow meter installed at the inlet to the engines. There are 3 flow meter devices present in the Project implementation. One of these flow meters (denoted as FM 1) is installed after the booster (main pipe), another flow meter measures the LFG that goes into the flare (denoted as FM 2), and a third flow meter measures the LFG that goes to the engines (denoted as FM 3).

Another measurement instrument deviation is the use of a K-type thermocouple in the flare unit, instead of an N-type thermocouple as was suggested in the registered PDD.

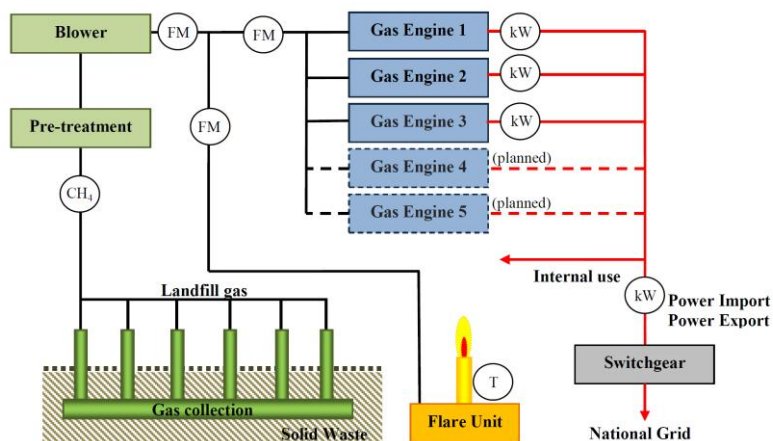


Figure 1. Flow chart of the implemented Project

Another design deviation from the registered PDD is the operating temperature of the flare unit. The installed flare is capable of efficiently flaring landfill gas with an exhaust gas temperature range of 800-1200 °C, instead of 900-1200 °C as stated in the PDD.

These deviations do not compromise the applicability of the methodologies and tools that are used for registration. The summary overview of the monitoring system is provided in *Table 2*.

Table 2. Summary of actual monitoring parameters in the implemented Project activity

Parameter	Measured Data	Data Source
$EL_{LFG,y}$	Net amount of electricity supplied to the grid by the Project	Primary and secondary electricity measurement devices (PMUM)
$PE_{FC,i,y}$	Project emissions from fossil fuel combustion	Calculation
$F_{CH_4,RG,m}$	Mass flow of methane in the residual gaseous in the minute m	Calculation
$LFG_{flare,y}$	Total amount of landfill gas flared in year y	Flow meter device
$LFG_{electricity,y}$	Amount of landfill gas combusted in generators	Flow meter device
$LFG_{total,y}$	Total amount of landfill gas captured in year y	Flow meter device
w_{CH_4}	Methane fraction in the landfill gas	Gas analyzer
$PE_{flare,y}$	Project Emissions from flaring	Calculation
h	Operational hours of the power plant	Power generation of engines
AF	Regulatory LFG destruction requirements	Qualitative
$T_{EG,m}$	Temperature in the exhaust gas of the enclosed flare in minute m	Thermocouple

Please refer to *Section D.2* for details of the instruments and QA/QC procedures.

B.2.5. Changes to start date of crediting period

As stated in the previous monitoring report; “The start date of the crediting period has been registered as 01.06.2011. Flaring has been initiated on 09.02.2011 and official electrical power generation has started on 09.03.2012. Therefore, the actual crediting period deviates from the validated crediting period. Considering this change, the crediting period start date of the Project has been shifted to 09.02.2011 as a **permanent deviation**.”

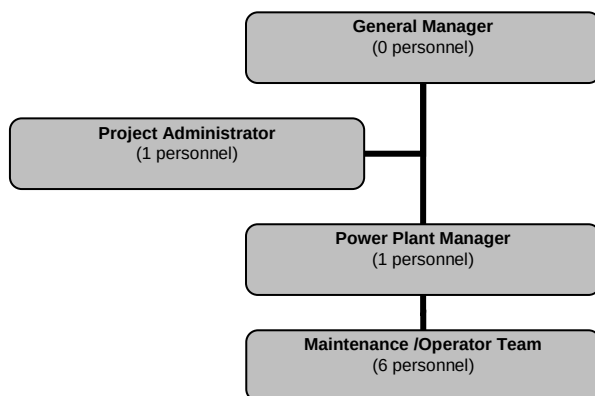
B.2.6. Types of changes specific to afforestation or reforestation project activity

N/A

SECTION C. Description of monitoring system

The monitoring plan involves the determination of the baseline emissions occurring within the project boundary during the crediting period. As the project boundary is defined as the national grid of Turkey, the baseline emissions from electricity generation activities in Turkey are calculated and monitored based on national official data.

Organizational structure:



The tasks of the General Manager are being carried out by one of the board members. The General Manager is responsible for the information flow and monitoring procedures in the name of the Project owner.

Project Administrator is responsible for information flow, document management and project administration.

Power Plant Manager is responsible for overseeing and managing daily operations and local relationships.

Maintenance / Operator team is responsible for carrying out operational and maintenance tasks.

The responsibilities of the General Manager include:

- Ensuring the information flow between the Project owner company and the DOE,
- Managing data collection, record keeping, data handling and processing, filing and reporting,
- Ensuring that project personnel have the necessary skills to carry out these tasks properly,
- Overseeing the proper implementation of the monitoring procedure,
- Emission reduction calculations and the preparation of necessary documents for verification,
- Management of the monitoring and verification procedures,
- Management and organization of trainings and carrying out data handling,
- Activities related to invoicing and human resources.

Other Responsibilities:

Mavi Consultants supports the Project owner in the preparation of this monitoring report and its verification.

For maintenance and repairs of the plant, the Project Participant has assigned different 3rd parties as subcontractors (three separate companies are assigned for generator units, for the booster system, and for the electricity and transformer station).

Information flow and Procedures:

- i. Electricity Generation Component:

The power generation data are stored by PMUM, the financial settlement centre of TEIAS (the national grid operator). The website of PMUM (<http://dgpys.teias.gov.tr/dgpys>) is accessible by the Project owner with their unique user ID and password. Once accessed, the Project owners are able to call electricity generation and consumption reports of their own projects. The same reports are used by the Project owner for invoicing purposes. The electricity generation data are reported on a monthly basis. The procedure involves the following tasks:

- Accessing the website of PMUM (<http://dgpys.teias.gov.tr/dgpys>) using the user ID and password assigned to the Project owner,
- Obtaining the electricity generation and consumption reports, for each month in the monitoring period,
- Storing these monthly reports in electronic format and in printed hardcopies.

ii. Methane Destruction Component:

Landfill gas flow is measured by flow meters, including the flow into the flare, generators and the total flow. These parameters are required to be normalized at 0°C and 1 atm, using actual gas temperature and pressure data to be measured with temperature and pressure transmitters. These in-built transmitters are integrated in each of the flow meters and equipped with a flow computer so that the values sent to the SCADA system are already been normalized (converted to normal cubic meters). Therefore, temperature and pressure data at each flow meter do not need to be separately monitored.

Methane content in the landfill gas is measured by a gas analyser that is connected to the PLC-SCADA system.

Measured data will be cross checked to ensure data quality and in case of mismatches necessary procedures will be conservatively taken. Flow rates from different flow meter measurements will be compared to each other and checked for correctness (e.g. sum of gas fractions, gas flow rate into engines vs. total power generation of engines etc.) to ensure that data is dependable and of high quality.

The monitoring plan mainly involves preparation of a spreadsheet for reporting and verification purposes, supported by evidential documents. All data used for the monitoring plan will be archived electronically and backed up regularly. These data will be kept for the full crediting period and a further two years after the end of the crediting period or the last issuance of carbon credits, whichever occurs later.

The monitoring equipment and other equipment of the plant are connected to a Programmable Logic Controller (PLC), which collects all the monitoring data and sends them to the SCADA system so that the operator can read main parameters in real time. The PLC archives reading values in a database which is accessible through the SCADA interface. Monitored data can be read and downloaded with the SCADA system for reporting purposes. Moreover, these electronic records are backed-up in a separate computer.

The main source for landfill gas data is the Project activity's PLC-SCADA system. The system automatically reads measurement devices and records data on hard drives. The PLC system records meter readings at pre-determined intervals, as specified in the CDM monitoring manual. These data will be used to calculate the total emission reductions.

- **Methane destruction by gas engines:** The amount of LFG combusted in the gas engines will be monitored by effectively and conservatively monitoring the methane amount supplied into engine units. The readings will be taken and recorded internally by compatible and proper measurement devices automatically with high data quality. The actual emission reductions from the destruction of methane in the combustion units will be calculated such that the risk of overestimation is minimised, and according

to the ACM0001 v.11, “Consolidated baseline and monitoring methodology for landfill gas project activities”.

- **Methane destruction by flare units:** An enclosed flare unit is installed that has an inbuilt flame detection unit. The project emissions from flaring and emission reductions from the destruction of LFG will be monitored at this point. The readings will be taken and recorded internally by compatible and proper measurement devices automatically with high data quality. The measured parameters are automatically converted to dry-basis and normal conditions by the PLC system. The instruments monitor parameters continuously but records readings every 10 minutes due to system memory limitations. This recording frequency has been updated to 30 minutes in this monitoring period. The emissions are calculated using the methodological tool “Project emissions from flaring” (v. 02.0.0), which is the newest version of the tool at the time of the preparation date of this monitoring report.

Data recording and aggregation and procedures for extraordinary events:

i. Electricity Generation Component:

There are two measurement devices; a primary measurement device and a secondary (i.e. back-up or check-meter) measurement device for quality assurance, to be used if the primary meter fails. Both the primary and back-up measurement devices measure and store the aggregate total electricity import and export for the whole Project in real-time. The PLC system also stores various data electronically.

The invoices are kept by the Project owner as hardcopies. Furthermore, the PMUM system stores the reports electronically, which is accessible to the Project owner whenever necessary. After the monthly reports are obtained from PMUM, data are aggregated using a separate spreadsheet. The monthly generation and consumption data are entered to the spreadsheet, which calculates the emission reductions during the monitoring period. This spreadsheet file is attached in the *ANNEX III – EMISSIONS REDUCTIONS TABLE* of this report.

In case of a fire, earthquake or other similar emergency situation, the electricity data after the settlement with TEIAS will be valid, i.e. the electricity generation and consumption figures used for invoicing purposes during or after the emergency will be used for the calculation of emission reductions.

In case the PMUM report cannot be reached online, the monthly generation protocols signed by both the Project owner and TEIAS will be used. These protocols are the source of the PMUM data and provide the same values, under normal circumstances, in hardcopy format. Although SCADA data are not used for monitoring purposes, they are of high quality and can principally be used for monitoring purposes in case of emergencies conservatively.

ii. Methane Destruction Component:

Data Storage: The electronic monitoring system will periodically archive the readings data. Written documents (e.g. equipment replacement protocols, accident logs, maintenance records, back-ups etc.) will be kept safely.

Data handling: For the PLC system data that are corrupted or missing, a deviation from the registered monitoring plan is presented in *Section B.2.3*. Accordingly, for erroneous data the emission reductions are assumed to be simply zero. In case the installed flow meters do not measure flow rates in normalized units (for 0°C and 1 atm) or if the PLC system does not calculate the LFG amount in normalized cubic meters, then this will be done using appropriate formulae, using the temperature and pressure data for the flowing gas.



Maintenance and calibration of measurement devices: All measurement devices will be purchased and maintained as specified in the CDM monitoring manual according to manufacturer specifications. All measurement devices that are used in monitoring will be subject to a quality control procedure that will include regular maintenance and calibration in agreement with legal and/or manufacturer requirements. According to the relevant regulation³, periodical inspections are required every 10 years. For every calibration, a separate calibration record will be kept that shows the identification number of each measurement device, calibration date, due date for next calibration, calibration service provider etc. Calibration certificates will be kept for every measurement device until two years after the end of the crediting period.

If any equipment has a malfunction or breakdown, corrective actions will be carried out in a timely manner to minimize the risk of emissions that are not intended. To ensure data quality, operational staff will be trained appropriately so that they can effectively take actions in such cases. The plant operator will periodically inspect the plant to check visually if there are any obvious problems. In case of any findings, these will be documented.

In case of an organisational change within the Project owner, a qualified person will be assigned for carrying out and management of the monitoring and verification procedures. In case of fire, earthquake or another similar emergency situation, the data that are stored by the Project owner as back-up will be used, whereby conservativeness will be maintained with specific procedures. For extraordinary events where such back-up data are not available, the amount of landfill gas consumed will be calculated by using the power generation figures and engines' full load electrical efficiencies, by using conservative values and other assumptions to maintain conservativeness, as necessary.

Regarding the project emissions from flaring, data recording and aggregation and procedures for extraordinary events are the same as described above (i.e. the methane destruction component).

³ "Measurement and Measuring Tools Inspection Regulation", Date: 24/07/1994, Official Gazette Number: 22000

SECTION D. Data and parameters

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

i. Electricity Generation Component:

Data / Parameter:	Combined Margin Emission Factor
Unit:	tCO₂/MWh
Description:	The combined margin emission factor is the weighted average of the operating and build margins and describes the emission factor of the baseline scenario.
Source of data:	Baseline calculations in the PDD
Value(s) applied :	0.559
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The GHG emission reductions of the Project will be calculated by multiplying the ex-ante combined margin emission factor with the net electricity exported.

Data / Parameter:	Leakage
Unit:	tCO₂
Description:	Leakage is emissions arising due to activities such as power plant construction, fuel handling and land inundation.
Source of data:	The baseline methodology suggests not considering the leakage for this technology.
Value(s) applied :	0
Purpose of data:	Calculation of leakage
Additional comment:	

ii. Methane Destruction Component:

Data / Parameter:	ρ_{CH_4}
Data unit:	t/m ³
Description:	Density of methane at normal conditions
Source of data used:	“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methane density under normal conditions (0° C and 1,013 bar) is constant.
Any comment:	

Data / Parameter:	GWP_{CH₄}
Data unit:	t _{CO2eq} t _{CH₄}
Description:	Global Warming Potential of methane valid for the commitment period
Source of data used:	Methodological tool “Project emissions from flaring” v.02.0.0
Value applied:	21 until 31.12.2012



	25 from 01.01.2013 onwards
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default GWP value of 21 is used as suggested by the UNFCCC tool. Since 1.1.2013 the GWP of Methane is considered to be 25 instead of 21. The revised value is confirmed to be correct based on the IPCC 4th Assessment Report: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).
Any comment:	

The following information is added to the Monitoring Report as a fixed parameter **ex post** as a result of the use of a newer version of the methodological tool “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15). In the next monitoring periods, this information will be taken as ex ante.

Data / Parameter:	SPEC_{flare}
Data unit:	Temperature: °C Flow rate: m ³ /h
Description:	Manufacturer’s flare specifications for temperature and flow rate
Source of data used:	Flare manufacturer
Value applied:	Flare specifications set by the manufacturer for the correct operation of the flare are the following parameters: a) Minimum and maximum inlet flow rate: 200 - 1000 m ³ /h b) Minimum and maximum operating temperature: 800 - 1200°C c) Minimum methane content: 25%
Justification of the choice of data or description of measurement methods and procedures actually applied :	This parameter is only applicable in case of enclosed flares. The maintenance schedule is not required if flare efficiency is fixed (Option A in the methodological tool “Project emissions from flaring”, v.02.0.0).
Any comment:	These manufacturer requirements are used to determine the flare efficiency at any given time. The flow meter that measures the flow to the flare unit (FM 2) has an accurate measurement range. Only the landfill gas amount that is flared according to manufacturer’s specifications and that can effectively be measured by FM 2 will be taken into account.

D.2. Data and parameters monitored

i. Electricity Generation Component:

Data / Parameter:	EL_{LFG,y} (Net amount of electricity supplied to the grid by the Project)
Unit:	MWh
Description:	Power export and power import by the Project during the monitoring period
Measured /Calculated /Default:	Measured
Source of data:	The PMUM website (http://dgpys.teias.gov.tr/dgpys). The data imported from this website are read from the primary measurement device (or the back-up device in case the primary device is inaccurate, malfunctioning etc.)



Value(s) of monitored parameter:	Net electricity generation ⁴ of the Project activity is as the following:					
	Year	Start date	End date	Net power generation [kWh]		
	2012	01.12.2012	31.12.2012	1,309,887 kWh		
	2013	01.01.2013	31.12.2013	18,798,626 kWh		
	2014	01.01.2014	31.08.2014	16,071,347 kWh		
	Total	01.12.2012	31.08.2014	36,179,860 kWh		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The measurement devices have the following specifications:					
	Table 3. Specifications of measurement devices used					
	Serial Number	Device Model	Manufacturer	Installation	Date of initial calibration ⁵	Accuracy
	436730	A1500 Alpha	ELSTER (backup)	2011	22.02.2011	0.5 S
	*436731	A1500 Alpha	ELSTER (main)	2011 replaced	22.02.2011	0.5 S
	*210000 08	AEL.T F11	Köhler (main)	2014 replaced	Prior installation	0.5 S
	130008 93	AEL.TF11	Köhler (main)	2014	Prior installation	0.5 S
	*These two meters are replaced. Please see Table 4 for details.					
	Calibration frequency: According to the Article 9 of the relevant regulation ⁸ , periodical inspections of “gauges for electric, water, coal gas, natural gas and, current and voltage measuring transformers will be made once in 10 years”. This is in line with the monitoring plan and national requirements. TEIAS will decide when to carry out the next calibration. The Project owner has no control over or access to the measurement devices and is <i>not</i> entitled to perform any type of maintenance or calibration.					
	Date of last calibration: The measurement devices have not been calibrated again since their first installation. Please see Table 3 for details.					
Responsible personnel: TEIAS is responsible for monitoring and ensuring that the measurement devices satisfy the requirements. TEIAS is also responsible for the calibration of the measurement devices. In case of any detected problem (e.g. failure of one of the measurement devices, inconsistency between the readings of the primary and the back-up meter etc.), the plant manager in the name of the Project owner is responsible for coordinating the necessary maintenance and calibration procedure with TEIAS.						
Validity: The technical specifications and the calibration procedure are in agreement with the national regulations ⁹ and the monitoring plan.						

⁴ Difference between ID.1 (Gross electricity generation by the Project) and ID.2 (Electricity consumption by the Project).

⁵ Calibration documents are provided to the DOE.

⁸ “Measurement and Measuring Tools Inspection Regulation”, Date: 24/07/1994, Official Gazette Number: 22000

⁹ According to the “Communiqué for Measurement Devices used in the Electricity Market”, Article 11, the measurement devices used for power plants are subject to the following requirements:

Capacity of the circuit, where the meter is connected	Larger than 100 MVA	Between 100 and 10 MVA (inclusive)	Less than 10 MVA
Active energy meters	IEC-EN 60687 0.2S class	IEC-EN 60687 0.5S class	IEC-EN 60687 0.5 class

	The list of the incidents occurred during the monitoring period which might have an impact on the measurement devices is given below;		
	Table 4. Extraordinary Events (during monitoring period)		
	Potential Risks of Inaccuracy	Occurrence?	Information
	Calibration of the measurement devices (carried out by TEIAS)	None	This is in line with the monitoring plan.
	Malfunction, replacement, resetting, repair service or any other relevant activity regarding the measurement devices	Elster 436731 is replaced by the grid operator with Köhler 21000008 (05.05.2014), which is later replaced with Köhler 13000893 (27.08.2014).	The replaced devices are calibrated and sealed.
	Accident (fire, technical equipment failure, theft of equipment etc.) which could compromise the accuracy	None	This is in line with the monitoring plan.
	As seen from the <i>Table 4</i> , there is not any extraordinary event which could be critical in assessing the accuracy of this monitoring parameter.		
Measuring/ Reading/ Recording frequency:	The primary and back-up measurement devices measure, read and record various data such as electricity generated and consumed, in real-time. The measurements and recordings are made continuously. The readings are performed in monthly intervals. There is no sampling involved.		
Calculation method (if applicable):	The PMUM (TEIAS) Market Balancing Center website ¹⁰ is accessed and the monthly reports are recorded, using the Project Owner's own user ID and password. These reports do not show the net electricity generation, but Power Export and Power Import data. Therefore, their difference is calculated to obtain the net electricity generation of the Project. These data in the PMUM interface are copied and pasted to a prepared spreadsheet, which will perform the calculations. For each month, the <i>Power Export</i> and the <i>Power Import</i> values are extracted from the PMUM monthly reports. The <i>Power Export</i> is denoted as "İletim Sistemine Veris Miktarı" (ISVM) and the <i>Power Import</i> is denoted as "Uzlaşmaya Esas Cekis Miktarı" (UECM) in the monthly report in Turkish language.		

Reactive energy meters	**IEC-EN 61268 0.2S class	**IEC-EN 61268 0.2S class	**IEC-EN 61268 0.2S class
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The Project capacity falls into the second category. Sources:

Turkish: <http://www.epdk.gov.tr/mevzuat/teblig/elektrik/sayac/sayacson.doc>

English: <http://www.epdk.gov.tr/english/regulations/electric/meters.doc>

¹⁰ <http://dqpys.teias.gov.tr/dqpys>



	Net Electricity Generated = Power Export – Power Import This difference (which is equal to monthly net electricity generation) is added to each other for each month of the monitoring period to find the total net electricity generation of the Project. The monitoring spreadsheet, together with the scans of the PMUM reports, is submitted to the DOE. The calculation and formulae are clearly visible in the spreadsheet.
QA/QC procedures:	The initial values of the measurement devices are recorded with a protocol (submitted to the DOE) with TEIAS. This prevents any over-calculation of GHG emission reductions. There are two measurement devices continuously measuring and recording electricity generation and consumption of the Project activity. The primary measurement device is used for invoicing, and the secondary measurement device is used for quality control and back-up purposes. Both measurement devices comply with industry standards, UNFCCC and national requirements. This ensures the quality and continuity of monitored data. TEIAS reads monthly recorded values that were measured until 24:00 of the last day of the preceding month. Based on this reading, the invoices are prepared by the Project owner. The monthly measurement device readings are transferred and stored in the web server of PMUM (the financial settlement agency of TEIAS). Since 01.02.2012, the reading of the measurement devices are remotely made by TEIAS, with the system called OSOS (Automatic Meter Reading System) via GPRS technology. This is done through an external modem which has no impact on the quality and quantity of data reading. With the introduction of OSOS system, TEIAS personnel do not go to project site to perform the reading of the measurement devices. The meters are also read by the Project personnel at the end of each month (after 24.00 in the last day). The monthly reading protocols are filled by the Project personnel and sent to TEIAS. In this way, it is checked if there are inconsistencies between the values read by OSOS and the reading protocols. In case of malfunction of OSOS, TEIAS personnel will make the reading by going to the project site. The monthly measurement device reading protocols are stored as hardcopy by the Project owner. The electronic reports are stored by TEIAS and are accessible by the Project owner by any time. This ensures that the monitored data are stored both by the Project owner and the TEIAS PMUM system, both as hardcopy and softcopy, ensuring security and quality. Independent from PMUM, the Project owner stores the hardcopies of the monthly protocols until at least 2 years after the end of the crediting period. The baseline calculations are carried out electronically with a spreadsheet; therefore the calculations are transparent, easily reproducible and of high quality. A SCADA system enables real time monitoring and analysis of data and provides support for maintenance. This system automatically records all electricity generation data for each unit 7/24. This ensures that extraordinary situations can be identified quickly. This system improves quality control and reduces operational risks. The Project owner is able to monitor the electricity generation data by the use of a SCADA system, however it has no control over, or access to the measurement devices and cannot perform any type of maintenance or calibration.



	Involvement of other parties: The management of the landfill is done by the Municipality, without any intervention of the Project owner. In order to enhance landfill gas generation on site, cooperation is maintained between the Project owner and Municipality in terms of waste terracing. The Municipality (or third parties assigned by the Municipality) manages the leachate on site, without any kind of control or interaction by the Project owner.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

ii. Methane Destruction Component:

Data / Parameter:	$PE_{FC,i,y}$
Unit:	tCO _{2e}
Description:	Project emissions from fossil fuel combustion in process <i>j</i> during the year <i>y</i>
Measured /Calculated /Default:	Calculated
Source of data:	Fuel invoices
Value(s) of monitored parameter:	N/A
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Project emissions involve direct emissions (such as fossil fuel consumption of construction equipment, co-firing for power generation or vehicles for on-going operations and maintenance) by the Project activity.
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	If the amount is not negligible, then the following methods will be used: - AMS I.F, Table 1.F.1; and/or, “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”.
QA/QC procedures:	The consumption of fossil fuel will be monitored based on the fuel invoices and is therefore of high quality.
Purpose of data:	
Additional comment:	In case of blackouts, the diesel generator owned by the Municipality at the landfill site provides power to the landfill and also to the offices of the Project for daily use purposes. This parameter does not include project emissions from flaring.

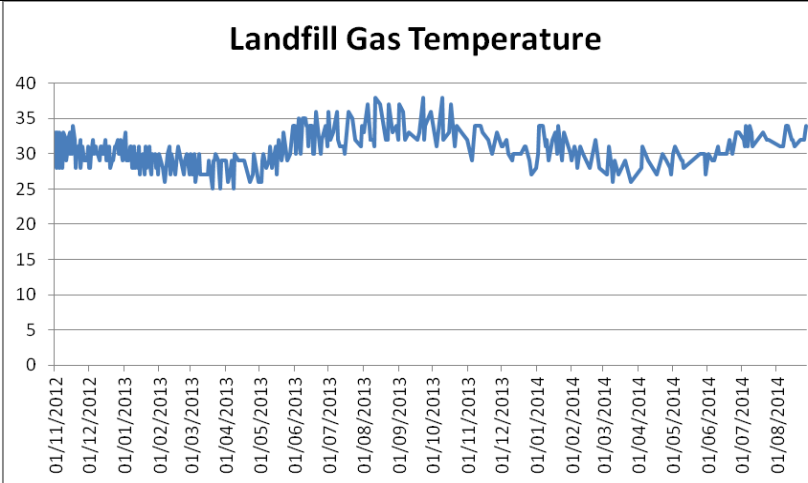
Data / Parameter:	$F_{CH_4,RG,m}$
Unit:	kg
Description:	Mass flow of methane in the residual gas in the minute <i>m</i>
Measured /Calculated /Default:	Calculated
Source of data:	This parameter is added after the Project registration as a deviation from the monitoring plan, as the tool requires that the methane amount



	is monitored as mass (kg), instead of volume (m ³). For conversion, volumetric flow rate data is collected from the flow meter Nr.2 (FM 2).												
Value(s) of monitored parameter:	Total methane mass flow in the residual gas over the crediting period is 79,253 kg of CH ₄ .												
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Table 5. Equipment Specifications <table><tr><td>Type</td><td>Accuracy</td><td>Serial Nr.</td><td>Cal. Frequency</td><td>Dates of relevant calibrations</td><td>Cal. validity</td></tr><tr><td>Orifice Plate - Technova HT</td><td>2%</td><td>AAM5322 F</td><td>Up to 10 years (no periodic calibration required by manufacturer)</td><td>24.11.2010 10.05.2012</td><td>10.05.2022</td></tr></table> Measurement range: 0-600 Nm³/h Flowmeter consistency is checked on 11.04.2013 to confirm that no calibration is necessary.	Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity	Orifice Plate - Technova HT	2%	AAM5322 F	Up to 10 years (no periodic calibration required by manufacturer)	24.11.2010 10.05.2012	10.05.2022
Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity								
Orifice Plate - Technova HT	2%	AAM5322 F	Up to 10 years (no periodic calibration required by manufacturer)	24.11.2010 10.05.2012	10.05.2022								
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed on 10.09.2013 so that the interval is increased to every 30 minutes.												
Calculation method (if applicable):	The flow rate of the residual landfill gas is automatically converted to dry basis and normal conditions by the PLC system without any intervention by the Project owner. This parameter is calculated by multiplying LFG _{flare} , density of methane and w _{CH4} (percentage of methane measured by the gas analyzer). This is in compliance with the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, v.02.0.0, EB61, Annex 11.												
QA/QC procedures:	A separate flow meter is installed for the flare unit. Data is measured continuously with a flow meter by the Project owner. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. This will ensure that the accuracy of the measurement instrument is maintained. The measurement frequency is equal to or more than one sampling each hour.												
Purpose of data:	This parameter will be used to check with the SPEC _{flare} parameter. This parameter will be used to calculate PE _{flare,y} .												
Additional comment:													

Data / Parameter:	Tt
Unit:	K
Description:	Temperature of the gaseous stream
Measured /Calculated /Default:	Measured
Source of data:	Measurement device
Value(s) of monitored parameter:	Fluctuating between 25-38 °C (Nov 2012 – Aug 2014)



	Landfill Gas Temperature 												
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Table 6. Equipment Specifications <table><tr><th>Type</th><th>Accuracy</th><th>Serial Nr.</th><th>Cal. Frequency</th><th>Dates of relevant calibrations</th><th>Cal. validity</th></tr><tr><td>Gentek temperature gauge</td><td></td><td>12--1900</td><td>no periodic calibration required by manufacturer</td><td>30.06.2014</td><td>N/A</td></tr></table> Calibration results: Uncertainty 1.05°C, standard deviation < 1°C.	Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity	Gentek temperature gauge		12--1900	no periodic calibration required by manufacturer	30.06.2014	N/A
Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity								
Gentek temperature gauge		12--1900	no periodic calibration required by manufacturer	30.06.2014	N/A								
Measuring/ Reading/ Recording frequency:	Manual reading and recording, every ca. 2 days on average.												
Calculation method (if applicable):													
QA/QC procedures:	The data is manually read and recorded. The temperature measurement device is calibrated, indicating a small error margin and small fluctuations.												
Purpose of data:	$F_{CH_4, RG, m}$, mass flow of methane in the residual gas in the minute m , is calculated based on the dry basis assumption, which requires the temperature of the landfill gas to be below 60 °C. This data is used to verify that this requirement is fulfilled. It should also be noted that the landfill gas is dehumidified before the booster intake.												
Additional comment:													

Data / Parameter:	$LFG_{electricity, y}$
Unit:	Nm ³
Description:	Total amount of landfill gas (under normal conditions of 0° and 1 Atm) combusted in the generator unit in year y
Measured /Calculated /Default:	Measured
Source of data:	Flow meter Nr.3 (FM 3)



Value(s) of monitored parameter:	17,606,682 m ³																		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th colspan="6">Table 7. Equipment Specifications</th></tr><tr><th>Type</th><th>Accuracy</th><th>Serial Nr.</th><th>Cal. Frequency</th><th>Dates of relevant calibrations</th><th>Cal. validity</th></tr><tr><td>Orifice Plate - Technova HT</td><td>2%</td><td>AAE9255F</td><td>Up to 10 years (no periodic calibration required by manufacturer)</td><td>24.11.2010 10.05.2012</td><td>10.05.2022</td></tr></table> Measurement Range: 0-2200 Nm³/h. Flowmeter consistency is checked on 11.04.2013 to confirm that no calibration is necessary.	Table 7. Equipment Specifications						Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity	Orifice Plate - Technova HT	2%	AAE9255F	Up to 10 years (no periodic calibration required by manufacturer)	24.11.2010 10.05.2012	10.05.2022
Table 7. Equipment Specifications																			
Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity														
Orifice Plate - Technova HT	2%	AAE9255F	Up to 10 years (no periodic calibration required by manufacturer)	24.11.2010 10.05.2012	10.05.2022														
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.																		
Calculation method (if applicable):	N/A																		
QA/QC procedures:	Data is measured continuously with a flow meter by the Project owner. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. This will ensure that the accuracy of the measurement instrument is maintained. The measurement frequency is equal to or more than one sampling each hour. One flow meter is installed for all of the gen-sets.																		
Purpose of data:																			
Additional comment:	The flow meter that measures the flow to the gas engine units (FM 3) has an accurate measurement range. Only the landfill gas amount that is used for power generation and that can effectively be measured by FM 3 will be taken into account.																		

Data / Parameter:	LFG _{flare,y}
Unit:	Nm ³
Description:	Total amount of landfill gas (under normal conditions of 0° and 1 Atm) flared in year y
Measured /Calculated /Default:	Measured
Source of data:	Flow meter Nr.2 (FM 2)
Value(s) of monitored parameter:	189,052 m ³
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Please see details of the parameter F _{CH4,RG,m} .
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is



	increased to every 30 minutes.
Calculation method (if applicable):	N/A
QA/QC procedures:	Please see details of the parameter $F_{CH4, RG, m}$.
Purpose of data:	This indicator has been included in the monitoring plan of the registered PDD. As the “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15) does <i>not</i> include this parameter, it is only used for double checking purposes by comparing it with $LFG_{electricity, y}$ and $LFG_{total, y}$.
Additional comment:	

Data / Parameter:	LFG _{total,y}					
Unit:	Nm ³					
Description:	Total amount of landfill gas (under normal pressure and temperature) captured in year y					
Measured /Calculated /Default:	Measured					
Source of data:	Flow meter Nr.1 (FM 1)					
Value(s) of monitored parameter:	17,795,734 m ³					
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Table 8. Equipment Specifications					
	Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity
	Orifice Plate - Technova HT	2%	AAE9253 F	Up to 10 years (no periodic calibration required by manufacturer)	24.11.2010 10.05.2012	10.05.2022
	Measurement Range: 0-2200 Nm ³ /h					
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.					
Calculation method (if applicable):	N/A					
QA/QC procedures:	Data is measured continuously with a flow meter by the Project owner. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. This will ensure that the accuracy of the measurement instrument is maintained. The measurement frequency is equal to or more than one sampling each hour.					
Purpose of data:	This parameter is used for double checking purposes for comparing it with the sum of LFG _{electricity,y} and LFG _{flare,y} .					
Additional comment:						

Data / Parameter:	W_{CH4}
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Unit:	%																							
Description:	Methane fraction in the landfill gas																							
Measured /Calculated /Default:	Measured																							
Source of data:	Gas analyzer (at the main booster pipe)																							
Value(s) of monitored parameter:	54% (Average)																							
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th colspan="6">Table 9. Equipment specifications</th></tr><tr><th>Type</th><th>Accuracy</th><th>Serial Nr.</th><th>Cal. Frequency</th><th>Dates of relevant calibrations</th><th>Cal. validity</th></tr><tr><td>Pronova SSM-6000-LT</td><td>2%</td><td>8002000 0-1435</td><td>Annually (manufacturer specification)</td><td>11.04.2013 10.09.2013</td><td>10.09.2014</td></tr></table>						Table 9. Equipment specifications						Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity	Pronova SSM-6000-LT	2%	8002000 0-1435	Annually (manufacturer specification)	11.04.2013 10.09.2013	10.09.2014
Table 9. Equipment specifications																								
Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity																			
Pronova SSM-6000-LT	2%	8002000 0-1435	Annually (manufacturer specification)	11.04.2013 10.09.2013	10.09.2014																			
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.																							
Calculation method (if applicable):	N/A																							
QA/QC procedures:	Methane content is measured directly and continuously with a gas analyzer. The gas analyzer will be maintained and calibrated regularly according to the manufacturer's requirements in order to ensure that required level of accuracy is maintained. The gas analyzer is subject to a regular maintenance and testing regime to ensure accuracy, therefore the analyzer will be calibrated according to the manufacturer's recommendations. The measurement interval is equal to or more than one sampling each hour.																							
Purpose of data:	The percentage of methane in the landfill gas is used to calculated the amount of methane destroyed in the gas engine and flare units. It is also used to check whether it satisfies the minimum methane content threshold for the flare unit to ensure the gas is flared efficiently.																							
Additional comment:																								

Data / Parameter:	$PE_{\text{flare},y}$
Unit:	$t_{\text{CO}_2\text{-eq}}$
Description:	Project emissions from flaring of the residual gas in year y
Measured /Calculated /Default:	Calculated
Source of data:	N/A
Value(s) of monitored parameter:	1,583 $t_{\text{CO}_2\text{-eq}}$
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	N/A



Calculation method (if applicable):	$PE_{\text{flare},y} = \sum_{m=1}^{\text{mon. period}} F_{\text{CH}_4, \text{RG}, m} * (1 - \eta_{\text{flare}, m}) * GWP_{\text{CH}_4} * 10^{-3}$ $F_{\text{CH}_4, \text{RG}, m}$ and $\eta_{\text{flare}, m}$ parameters are read continuously but recorded at regular intervals. Therefore, the formula above has been applied to 10-minutes and 30-minutes data, instead of 1-minute data. GWP_{CH_4} is a fixed ex ante parameter.
QA/QC procedures:	Calculations are carried out with a spreadsheet to minimize the risk errors.
Purpose of data:	
Additional comment:	

Data / Parameter:	Operation of the power plant					
Unit:	h					
Description:	Operational hours of the power plant					
Measured /Calculated /Default:	Measured					
Source of data:	Power generation of engines					
Value(s) of monitored parameter:	13,372 hours					
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Table 10. Equipment specifications					
	Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity
	Genset Control EASYGEN-3200-5	N/A	17856564	N/A	02.12.2011	N/A
	Genset Control EASYGEN-3200-5	N/A	17609634	N/A	11.07.2011	N/A
	Genset Control EASYGEN-3200-5	N/A	18336534	N/A	27.09.2013	N/A
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.					
Calculation method (if applicable):	The Project is considered to be operating when the total power generation of the engines is higher than 0 kW.					
QA/QC procedures:	The PLC provides data on engines' supplied amount of power (kW). Operational hours are calculated based on engine operation (i.e. at least of one of the engines generates power).					
Purpose of data:						
Additional comment:						

Data / Parameter:	AF
Unit:	%



Description:	Regulatory requirements relating landfill gas projects
Measured /Calculated /Default:	Default
Source of data:	National laws and regulations
Value(s) of monitored parameter:	0
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures:	There has not been any legal development concerning Article 27 of the “Control of Solid Waste Regulation” in the host country for obligatory landfill gas destruction.
Purpose of data:	
Additional comment:	

Data / Parameter:	T _{EG,m}																		
Unit:	°C																		
Description:	Temperature in the exhaust gas of the enclosed flare in minute <i>m</i>																		
Measured /Calculated /Default:	Measured																		
Source of data:	Thermocouple																		
Value(s) of monitored parameter:	The average exhaust gas temperature during the monitoring period is 897°C for the data that are used for calculations of emission reduction from flaring. Exhaust gas temperatures below and above the flare efficiency range are discarded from calculations.																		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th colspan="6">Table 11. Equipment specifications</th></tr><tr><th>Type</th><th>Accuracy</th><th>Serial Nr.</th><th>Cal. Frequency</th><th>Dates of relevant calibrations</th><th>Cal. validity</th></tr><tr><td>K-Type Thermocouple - Isocontrolli</td><td>N/A</td><td>N/A</td><td>Annual replacement</td><td>February 2012</td><td>N/A</td></tr></table>	Table 11. Equipment specifications						Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity	K-Type Thermocouple - Isocontrolli	N/A	N/A	Annual replacement	February 2012	N/A
Table 11. Equipment specifications																			
Type	Accuracy	Serial Nr.	Cal. Frequency	Dates of relevant calibrations	Cal. validity														
K-Type Thermocouple - Isocontrolli	N/A	N/A	Annual replacement	February 2012	N/A														
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.																		
Calculation method (if applicable):	N/A																		
QA/QC procedures:	If more than one temperature port is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature.																		



	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule. Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue.
Purpose of data:	This parameter will be used to check with the $SPEC_{flare}$ parameter.
Additional comment:	

Data / Parameter:	$\eta_{flare,m}$
Unit:	%
Description:	Flare efficiency in minute m
Measured /Calculated /Default:	Default. Option A in the methodological tool “Project emissions from flaring”, v.02.0.0 is selected, as the flare is of enclosed type.
Source of data:	$T_{EG,m}$, $F_{CH4,RG,m}$, and $SPEC_{flare}$
Value(s) of monitored parameter:	The flare efficiency for the minute m ($\eta_{flare,m}$) is 90% when the following conditions are met to demonstrate that the flare is operating: The temperature of the flare ($T_{EG,m}$), minimum methane content and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer’s specification for the flare ($SPEC_{flare}$) in minute m; and Otherwise $\eta_{flare,m}$ is 0%.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Measured continuously in real-time and recorded every 10 minutes. Data recording system is changed in 2013 so that the interval is increased to every 30 minutes.
Calculation method (if applicable):	A calculation spreadsheet is used to check the requirements defined above, which minimizes the risk of manual errors.
QA/QC procedures:	
Purpose of data:	
Additional comment:	

Data / Parameter:	$Flame_m$
Unit:	N/A
Description:	Flame detection of flare in the minute m
Measured /Calculated /Default:	Measured
Source of data:	Flame detector unit
Value(s) of monitored parameter:	Time series



Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Table 9. Equipment specifications					
	<u>Type</u>	<u>Accuracy</u>	<u>Serial Nr.</u>	<u>Cal. Frequency</u>	<u>Date of last cal.</u>	<u>Cal. validity</u>
	Optical flame detector	N/A	N/A	N/A	N/A	N/A
Measuring/ Reading/ Recording frequency:	Measured continuously.					
Calculation method (if applicable):	N/A					
QA/QC procedures:	The flare unit installed for the project activity includes the flame detector as an integral safety component. This detector coupled with the electronic module installed in the control panel continuously detect flame presence by UV sensor. If the detector cannot see the flame (and cogeneration engine are in OFF), the main valve automatically closes and a flame is tried to be created with only pilot line. If this operation fails, the system automatically shuts down and an alarm appears on the system. Therefore, the data availability also implies flame detection.					
Purpose of data:	This parameter is added to comply with the methodological tool "Project emissions from flaring", v.02.0.0 and there is no direct use for these data in calculations.					
Additional comment:						

Data / Parameter:	CF_{EM}
Unit:	N/A
Description:	Correction factor for error margin (resulting from the deviation of LFG _{flare,y} monitoring frequency) used for conservatively adjusting emission reduction claimed from flared methane.
Measured /Calculated /Default:	Calculated.
Source of data:	Flow meter Nr.2 (FM 2)
Value(s) of monitored parameter:	The error margin is calculated to be 0.86% ¹¹ . However, for conservativeness, it is has been rounded up to 1%. Therefore, the emission reductions calculated from flared methane have been decreased by 1% as an adjustment measure to account for uncertainty risk.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Please see details of the parameter F_{CH4,RG,m} .
Measuring/ Reading/ Recording frequency:	According to the methodological tool "Project emissions from flaring", v.02.0.0, the monitoring frequency of the LFG _{flare,y} is required to be every 1 minute. However, the Project has been registered in agreement with the "Tool to determine project emissions from flaring gases containing methane" v.01, which the Project has complied with a LFG _{flare,y} monitoring frequency of 30 minutes (10 minutes at the beginning of the monitoring period).

¹¹ Assuming a confidence level of 99.9%, population size of 653,760 (number of minutes during the first monitoring period), response distribution of 50% (which is the most conservative option). Formulae and details: <http://www.raosoft.com/samplesize.html>



	As a deviation (please see Section B.2.3), this monitoring report is using "Project emissions from flaring", v.02.0.0. Because of the difference between monitoring frequencies, a correction factor, CF_{EM} , has been introduced by the Project Participant to account for the use of measurement interval of 30 (and 10) minutes, instead of 1 minute interval.
Calculation method (if applicable):	Statistically, a higher frequency of monitored data provides more accurate results. Therefore, the 1 minute frequency requirement is more accurate than the 10 and 30 minutes monitoring frequency. The difference between the two monitoring scenarios has been compared with each other with statistical methods. Accordingly, measuring the $LFG_{flare,y}$ every 10 and 30 minutes (total data points 34,700) instead of 1 minute (total data points 653,760) results in a maximum error margin of 0.86% with 99.9% confidence.
QA/QC procedures:	The calculation methodology of the error margin assumes a confidence level of 99.9%, which is statistically quite high and in agreement with the CDM requirements. Therefore, to account for this error margin, the emission reductions resulting from $LFG_{flare,y}$ should be adjusted by deducting 0.86% of $MD_{flare,y}$. However, to be on the safe side and to prevent any over-calculation, the Project Participant has rounded up this correction factor to 1%, which has been used in the formula 7.
Purpose of data:	This parameter has been used for the calculation of $MD_{flare,y}$.
Additional comment:	

D.3. Implementation of sampling plan

No sampling is done. All data are measured continuously but recorded at intervals due to memory limits of the system. Considering the overall length of the monitoring period, rate or recording sufficiently provides adequate accuracy.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

i. Electricity Generation Component:

The Project mainly involves electricity capacity addition, which reduces CO₂ through the substitution of grid electricity generation with fossil fuel fired power plants by renewable electricity. According to the baseline methodology, the emission reduction ER_y by the project activity during a given year y is found as;

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

where BE_y is calculated as;

$$BE_y = (EG_y - EG_{\text{baseline}}) * EF_{\text{grid,CM,y}} \quad (2)$$

Baseline emissions are calculated using formula (2);

$$BE_y = 36,179,860 \text{ kWh} * 0.559 \text{ tCO}_2/\text{MWh} = \mathbf{20,216 \text{ tCO}_2}$$

Data used for calculations and further details are available in the PDD. Definitions can be found in *Table 15*. The screenshot of the electronic spreadsheet presenting monthly calculations can be found in *ANNEX III – EMISSIONS REDUCTIONS TABLE* of this report.

ii. Methane Destruction Component:

The baseline emissions prior to the Project implementation consist of the methane emitted to the atmosphere from the landfill and the grid emissions due to electricity generation;

$$BE_y = (MD_{\text{project,y}} - MD_{\text{BL,y}}) * GWP_{\text{CH}_4} \quad (3)$$

The regulatory methane destruction is calculated as;

$$MD_{\text{BL,y}} = MD_{\text{project,y}} * AF \quad (4)$$

As the Project does *not* involve thermal power generation or gas-supply to any pipeline, according to ACM0001 the methane destruction by the Project is calculated as;

$$MD_{\text{project,y}} = MD_{\text{flared,y}} + MD_{\text{electricity,y}} \quad (5)$$

Methane destroyed by the gen-sets is found as;

$$MD_{\text{electricity,y}} = (LFG_{\text{electricity,y}} * w_{\text{CH}_4,y} * D_{\text{CH}_4}) \quad (6)$$

Methane destroyed by flaring is found as;

$$MD_{\text{flared,y}} = CF_{\text{EM}} * (LFG_{\text{flare,y}} * w_{\text{CH}_4,y} * D_{\text{CH}_4}) - (PE_{\text{flare,y}} / GWP_{\text{CH}_4}) \quad (7)$$

where CF_{EM} is the correction factor for error margin included by the Project Participant to account for the use of measurement interval of 10 or 30 minutes instead of 1 minute interval

suggested in the methodological tool “Project emissions from flaring”, v.02.0.0. Please refer to the monitoring parameter CF_{EM} in Section D.2 for details.

The project emissions due to flaring will be calculated by using the methodological tool “Project emissions from flaring”, v.02.0.0 (EB68, Annex 15);

$$PE_{flare,y} = \sum_{m=1}^{\text{mon. period}} F_{CH_4,RG,m} * (1 - \eta_{flare,m}) * GWP_{CH_4} * 10^{-3} \quad (8)$$

where $F_{CH_4,RG,m}$ is calculated by using the Option A in the methodological “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” v.02.0.0. Option A is selected due to volumetric and dry basis flow of gaseous stream and dry basis in the analysis of volumetric fraction. The relevant formula is:

$$F_{CH_4,RG,m} = LFG_{flare} * W_{CH_4} * \rho_{CH_4} \quad (9)$$

$MD_{project,y}$ is calculated from formula (5) by adding up $MD_{flared,y}$ and $MD_{electricity,y}$ respectively;

$$MD_{project,y} = 15.8 \text{ tCH}_4 + 6,905.3 \text{ tCH}_4 = 6,921.1 \text{ tCH}_4$$

Baseline emissions from methane destruction are calculated using formula (3) using two GWP values (21 and 25 for December 2012 and onwards, respectively);

$$BE_y = 171,985 \text{ tCO}_2$$

For verification purposes, the LFG consumption in the flare and gen-sets ($F_{CH_4,RG,m}$ and $LFG_{electricity,y}$) throughout the monitoring period is obtained from measurement devices.

E.2. Calculation of project emissions or actual net GHG removals by sinks

- i. Electricity Generation Component: As described in section D.1, project emissions are considered as ex-ante and to be zero.
- ii. Methane Destruction Component: As described in section D.1, CO₂ project emissions from the gen-sets and flare units are already accounted for in the applicable methodologies.

E.3. Calculation of leakage

- i. Electricity Generation Component: As described in section D.1, leakage is considered as ex-ante and to be zero.
- ii. Methane Destruction Component: According to the methodology ACM0001, leakage does not need to be accounted.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
01.12.2012 31.12.2012	6,207	0	0	6,207
01.01.2013 31.12.2013	107,036	0	0	107,036
01.01.2014 31.08.2014	78,958	0	0	78,958
Total	192,201			192,201

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	Annual estimation in the PDD: 2012: 35,937 2013: 44,505 2014: 52,698 Date-adjusted estimations: 2012: 2,995 2013: 44,505 2014: 34,939	Actual achieved reductions: 2012: 6,207 2013: 107,036 2014: 78,958

E.6. Remarks on difference from estimated value in registered PDD

The actual emission reductions achieved during the monitoring period exceed the estimated values. It is believed that this over-production is due to the following possible reasons;

- The actual landfill gas amount is higher than the calculated values: This is the result of high quality and efficient piping system laid in the waste, professional engineering design and operation, careful waste terracing and low percentage of repairs. Another reason can be the UNFCCC methodologies and formulae, which lead to different results than PP's own calculations. The PP believes that the gas is being collected very efficiently, with minimal escape to the atmosphere.
- Installation of the third engine: The 3rd engine is installed and started operating in 2013, increasing power generation and methane destruction. Therefore, flaring (which leads to a lower emission reduction, compared to power generation) was not needed extensively (in contrast to the previous monitoring period).



E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO ₂ e)	6,207	185,994

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Samsun Avdan Enerji Üretim ve Tic. A.Ş.
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Contact person	Erol Iren
Title	General Manager
Salutation	Mr.
Last name	
Middle name	
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Department	
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Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
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Title	Manager
Salutation	Mr.
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Department	
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Direct tel.	
Personal e-mail	

Document information

Version	Date	Description
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report

ANNEX I - GOLD STANDARD INFORMATION

According to the PDD, two types of parameters are monitored for this Gold Standard project;

- i. GHG Emission Reductions: GHG Emission reductions are monitored in accordance with the UNFCCC requirements and the additional conservative approach of the Gold Standard.
- ii. Sustainable Development Screen: As required by the rules of the Gold Standard, the choice of indicators is based on the issues that have been highlighted to be important during the sustainable development assessment. These indicators are monitored to ensure the sustainable development contribution of the Project. During the sustainable development assessment, no issues have been highlighted as having a negative impact on sustainable development. The project provides power from a renewable resource and thereby contributes to local economy in various ways. It also creates positive environmental and social impacts, compared to the baseline of energy generation from fossil fuel resources.

Table 12. Summary of monitored parameters

ID number	Data variable	Source data	of	Data unit	Way obtaining data	of
01	Air quality: SO ₂ and NO _x emissions reduced	TEIAS, Turkstat		metric tons	Calculation	
02	Water quality and quantity: cooling water	TEIAS, Turkstat		metric tons	Calculation	
	Water quality and quantity: leachate management	Municipality		N/A	Estimation	
03	Soil condition: waste terraces	Municipality		N/A	Estimation	
	Soil condition: hazardous waste	Municipality		N/A	Estimation	
04	Other pollutants: VOC	Flow meters		metric tons	Calculation	
05	Quality of employment	Project Owner		N/A	Estimation	
06	Access to affordable and clean energy services: avoided fossil fuels	TEIAS		metric tons	Calculation	
07	Employment (numbers)	Project Owner		N/A	Measurement	
08	Balance of payments: reduction of natural gas import	TEIAS		metric tons	Calculation	
09	Technology transfer	Project Owner		N/A	Estimation	

1. Sustainable Development Indicator: 01

No	01
Indicator	Air Quality
Mitigation measure	Reduction of baseline SO ₂ and NO _x emissions: The Project, by replacing electricity from fossil fuel combustion and the related fuel consumption, reduces the baseline SO ₂ and NO _x emissions from electricity generation. The reductions of SO ₂ and NO _x emissions will be calculated by multiplying net electricity generation of the Project activity with the SO ₂ and NO _x intensities referred above.
Repeat for each parameter	
Chosen parameter	a) SO ₂ reductions b) NO _x reductions
Current situation of parameter	a) SO₂ emissions: The Project's net electricity generation is 36,179,860 kWh, therefore the Project has resulted in a SO ₂ reduction of: 36,179,860 kWh * 5.31 kg/MWh = 192.1 tons SO ₂ b) NO_x emissions: The Project's net electricity generation is 36,179,860 kWh, therefore the Project has resulted in an NO _x reduction of: 36,179,860 kWh * 1.65 kg/MWh = 59.7 tons NO _x Information about the calculation of emission intensities for SO ₂ and NO _x are provided below. Conclusion: The Project contributes positively to air quality.
Future target for parameter	The Project is expected to reduce the following emission amounts annually: SO ₂ : 5.31 kg/MWh * 7,920 MWh = 42 t SO ₂ NO _x : 1.65 kg/MWh * 7,920 MWh = 13 t NO _x
Way of monitoring	How Calculation. By multiplying the net electricity generation of the Project with the NO _x and SO ₂ emission intensities calculated above.
	When Every monitoring period.
	By who Project owner

Deviation from the monitoring plan:

N/A

QA/QC:

SO₂ and NO_x intensities are used for the calculation. These intensities are based on publicly available official data from the 2008 national inventory report of Turkey that has been submitted to UNFCCC in 2010¹². This report's Annex 7 does not specifically report the SO₂ and NO_x emission uncertainties; therefore an accurate uncertainty percentage is unavailable. However, considering Turkey's 2008 overall emission uncertainty (including sinks) of 11.9%, it can be concluded that the uncertainty of this indicator is within acceptable limits.

For QA/QC details of the net electricity generation, which is one of the input parameters of the calculations of SO₂ and NO_x reductions, please refer to the relevant section of the D.2.

¹² Source: UNFCCC, National Inventory Submission 2010. http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/tur-2010-crf-15april.zip, Workbook TUR-2010-2008-v1.2, Worksheet: Table1s1

Results:

The outcomes of the calculations suggest that the actual performance did not fully reach the targets since the monitoring period is shorter than one full year, but that the Project positively contributes to air quality by substituting fossil-fuel based power and thus effectively reducing SO₂ and NO_x emissions.

2. Sustainable Development Indicator: 02

No	02	
Indicator	Water quality and quantity	
Mitigation measure	Reduction of discharged cooling water in the baseline and Leachate quality: The Project, by replacing electricity from fossil fuel combustion and the related fuel consumption, reduces the baseline cooling water emissions generated by thermal power plants. The reductions of cooling water emissions will be calculated by multiplying net electricity generation of the Project activity with the ex-ante calculated cooling water intensities.	
Repeat for each parameter		
Chosen parameter	Reduction of discharged cooling water	
Current situation of parameter	The Project's net electricity generation is 36,179,860 kWh, therefore the Project has resulted in a cooling water reduction of: $23.5 \text{ m}^3/\text{MWh} * 36,179,860 \text{ kWh} = 848,433 \text{ m}^3$ Information about the calculation of cooling water emission intensities: In 2008, 4.45 billion m^3 cooling water was discharged by thermal power plants in Turkey¹³. Net electricity generation in 2008 was 189,762¹⁴ MWh, corresponding to 23.5 m^3/MWh discharged cooling water intensity¹⁵. Conclusion: The Project contributes positively to water quality.	
Future target for parameter	Estimated discharged cooling water reduction of in the second operational year is: $23.5 \text{ m}^3/\text{MWh} * 7,920 \text{ MWh} = 186,120 \text{ m}^3$ This amount is expected to increase in forthcoming years.	
Way of monitoring	How	Calculation. By multiplying the net electricity generation of the Project with the ex-ante cooling water emission intensities.
	When	Every monitoring period.
	By who	Project owner
Repeat for each parameter		
Chosen parameter	Leachate management	

¹³ Source: Turkish Statistical Institute (<http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=6171>)

¹⁴ Source: TEIAS, [http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/30\(84-08\).xls](http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/30(84-08).xls)

¹⁵ This is a conservative approach because most of the cooling water discharge stems from thermal and nuclear (not existing) power plants. The average share of thermal power is estimated to continue in coming years (see PDD for details) and the used technologies or fuel types do not indicate a clear changing trend. There is not any expected change in environmental legislation or technological requirement to limit cooling water discharges.



Current situation of parameter		Leachate is successfully collected and treated. The Municipality has assigned a third party on site, who is responsible of treating leachate properly. The Municipality has provided a letter confirming that the leachate quality has improved after the Project start.
Future target for parameter		Leachate is successfully collected and treated.
Way of monitoring	How	By collecting information from the Municipality.
	When	Every monitoring period.
	By who	Project owner

Deviation from the monitoring plan:

N/A

Revision of the monitoring plan for this Gold Standard indicator:

N/A

QA/QC:

The Project owner has no liability or responsibility regarding leachate management. The Municipality is the information source for the leachate management performance.

Conclusion:

The outcomes suggest that the leachate management is properly done and there is no negative impact caused by the Project in terms of water quality.

3. Sustainable Development Indicator: 03

No	03	
Indicator	Soil Condition	
Mitigation measure	Waste terracing and prevention of hazardous waste dumping on site	
<i>Repeat for each parameter</i>		
Chosen parameter	Waste terracing: Setting up capping layers in terraces	
Current situation of parameter	Waste terracing is properly done with capping layers.	
Future target for parameter	Waste terracing will be properly done with capping layers.	
Way of monitoring	How	Visual inspection
	When	Every monitoring period.
	By who	Project owner
<i>Repeat for each parameter</i>		
Chosen parameter	Hazardous waste processing	
Current situation of parameter	No hazardous waste is accepted or processed at the landfill site.	
Future target for parameter	The Project will <i>not</i> function as a hazardous waste disposal or processing facility (i.e. as a hazardous waste gasification or incineration facility).	

Way of monitoring	How	Visual inspection and interviews with stakeholders
	When	Every monitoring period
	By who	Project owner

Deviation from the monitoring plan:

N/A

Revision of the monitoring plan for this Gold Standard indicator:

N/A

QA/QC:

The landfill area only accepts municipal (household) solid waste. Industrial waste is not accepted at the gate of the landfill, which is operated by the Municipality. The Municipality collects an industrial waste collection fee, therefore it effectively minimizes the hazardous waste amount in the solid waste that is stored at the Project site. There is no incineration or gasification plant on site.

Conclusion:

The outcomes suggest that the Project does *not* operate as a hazardous waste processing facility.

4. Sustainable Development Indicator: 04

No	04	
Indicator	Other Pollutants	
Mitigation measure	LFG collection and destruction.	
<i>Repeat for each parameter</i>		
Chosen parameter	Reduction of Volatile Organic Compounds	
Current situation of parameter	The non-methane VOCs are typically roughly 2% of methane emissions ¹⁶ . The VOC destruction by combustion or flaring can be expected to be greater than 98% ¹⁷ . This leads to the following reductions of VOCs: VOCs Reduced = $9,655,556 \text{ m}^3 \times 2\% \times 98\% = 189,249 \text{ m}^3$	
Future target for parameter	Estimated amount of VOC reduction in the second operational year is: $2,490,958 \text{ m}^3 \times 2\% \times 98\% = 48,823 \text{ m}^3$ The amount of methane destroyed is expected to rise in forthcoming years, increasing also the amount of VOCs reduced.	
Way of monitoring	How	Calculation. By multiplying the total methane amount that is destroyed with the ex-ante constants for VOC fraction (2%) and combustion VOC destruction percentage (98%).
	When	Every monitoring period.
	By who	Project owner

¹⁶ "Estimating Landfill Greenhouse Gas Emissions from Measured Ambient Methane Concentrations and Dispersion Modeling", Figueroa, Cooper, and Mackie, Link: http://cee.ucf.edu/odormodeling/publications/Final_Paper_-_Figueroa_et_al_-_AWMA_2008.pdf

¹⁷ "Gas Recovery and Utilization From Municipal Solid Waste Landfills", Todd Potas. Link: http://www.anl.gov/PCS/acsfuel/preprint%20archive/Files/38_3_CHICAGO_08-93_0895.pdf

Deviation from the monitoring plan:

N/A

QA/QC:

The ex-ante constants are conservative generic values that aim to roughly approximate the VOC reduction. The amount of methane gas that is destroyed is measured and recorded with flow meters that meet the accuracy and calibration criteria of UNFCCC. All calculations are carried out using spreadsheets, minimizing the risk of errors and typo.

Results:

The outcomes of the calculations suggest that the actual performance is in agreement with previous estimations and that the Project positively contributes to air quality by effectively reducing VOC emissions.

5. Sustainable Development Indicator: 05

No	05						
Indicator	Quality of employment						
Mitigation measure	Safe and healthy working conditions						
Repeat for each parameter							
Chosen parameter	a) Relevant health and safety precautions taken, b) Compliance of tasks of the personnel with regulations, and, c) Social security provided to the personnel.						
Current situation of parameter	All safety equipment is available and used by personnel. No work accident has happened during the monitoring period. Necessary trainings are given to the personnel regarding safety and emergency procedures. The working environment of the personnel on the site do not present health risks or hazardous tasks. The tasks carried out by personnel are in compliance with legal employment and EHS requirements. All of the personnel have social security and they are paid in a timely manner. Conclusion: The Project contributes positively.						
Future target for parameter	a) All necessary health and safety precautions will be taken, b) Tasks carried out by the personnel will comply with regulations, and, c) All employees will have social security and will be paid timely.						
Way of monitoring	<table border="1"> <tr> <td>How</td><td>Estimated. Qualitative Assessment: By checking training certificates, attendance records and social security records.</td></tr> <tr> <td>When</td><td>Continuously. Details are summarized in <i>Table 16</i> and <i>Table 17</i>.</td></tr> <tr> <td>By who</td><td>Project owner</td></tr> </table>	How	Estimated. Qualitative Assessment: By checking training certificates, attendance records and social security records.	When	Continuously. Details are summarized in <i>Table 16</i> and <i>Table 17</i> .	By who	Project owner
How	Estimated. Qualitative Assessment: By checking training certificates, attendance records and social security records.						
When	Continuously. Details are summarized in <i>Table 16</i> and <i>Table 17</i> .						
By who	Project owner						

Deviation from the monitoring plan:

N/A

QA/QC:



The Project is in accordance with the TEIAS's Technical Specification Document ("ITM") that contains the necessary precautions to ensure Occupational Health and Safety. Health and safety precautions and equipment are legal necessities and have to be complied with to be in line with national regulations.

The trainings instructed by public institutions, such as first aid and high voltage, are mandatory trainings. This ensures that the employees are trained properly according to national standards and requirements. TEIAS requires the Project personnel to be adequately trained to ensure that the Project is properly maintained, operated and managed.

Conclusion:

The targets in the monitoring plan have been reached and the Project has contributed positively to employment quality in the region.

6. Sustainable Development Indicator: 06

No	06																								
Indicator	Access to affordable and clean energy services																								
Mitigation measure	N/A																								
Repeat for each parameter																									
Chosen parameter	Avoided fossil fuel consumption: The Project will generate and supply clean energy to the national grid, improving the carbon intensity of the power mix.																								
Current situation of parameter	Using ex-ante (2008) fuel intensity figures in the host country, the following amounts of fuel consumption are avoided: Table 13. Amounts of fuels saved by the Project <table><tr><th>Fuel Type</th><th>Fuel Consumption Intensity [t/GWh, 1000 m3/GWh]</th><th>Avoided Fuel Amount (t, 1000 m³)</th></tr><tr><td>Coal</td><td>395</td><td>1,447</td></tr><tr><td>Lignite</td><td>1,586</td><td>15,318</td></tr><tr><td>Fuel Oil</td><td>301</td><td>502</td></tr><tr><td>Diesel Oil</td><td>493</td><td>30</td></tr><tr><td>LPG</td><td>0</td><td>0</td></tr><tr><td>Naphtha</td><td>243</td><td>2</td></tr><tr><td>Natural Gas</td><td>219</td><td>4,987</td></tr></table> Conclusion: The Project contributes positively.	Fuel Type	Fuel Consumption Intensity [t/GWh, 1000 m3/GWh]	Avoided Fuel Amount (t, 1000 m³)	Coal	395	1,447	Lignite	1,586	15,318	Fuel Oil	301	502	Diesel Oil	493	30	LPG	0	0	Naphtha	243	2	Natural Gas	219	4,987
Fuel Type	Fuel Consumption Intensity [t/GWh, 1000 m3/GWh]	Avoided Fuel Amount (t, 1000 m³)																							
Coal	395	1,447																							
Lignite	1,586	15,318																							
Fuel Oil	301	502																							
Diesel Oil	493	30																							
LPG	0	0																							
Naphtha	243	2																							
Natural Gas	219	4,987																							
Future target for parameter	The Project is expected to substitute 13,358 MWh in 2015. This corresponds to the following expected fuel avoidance:																								

		Table 14. Expected fuel avoidance due to the Project	
		Fuel Type	Avoided Consumption [t, 1000m3]
		Coal	534
		Lignite	5,656
		Fuel Oil	185
		Diesel Oil	11
		LPG	0
		Naphtha	1
		Natural Gas	1,841
Way of monitoring	How	It is assumed that the net electricity generation during the monitoring period will be distributed among fossil fuels with the same weight as the fossil fuels. These values will be multiplied with the ex-ante fuel consumption intensities given above to find the respective reduction of fossil fuel consumption.	
	When	Monthly, by recording PMUM reports.	
	By who	Project owner.	

Deviation from the monitoring plan:

N/A

Revision of the monitoring plan for this Gold Standard indicator:

N/A

QA/QC:

The aim with this sustainability indicator is providing a representative metric for the fossil fuels saved, instead of exactly calculating actual reductions related to fossil fuel consumption by thermal power plants in the power grid. All ex-ante numbers are based on TEIAS data, which has a high quality. The amount of power generation is based on the PMUM system, which is used for invoicing and is therefore highly reliable.

Conclusion:

This indicator shows that the Project has contributed to affordable and clean energy services by indirectly reducing the consumption amounts of fossil fuels in the host country.

7. Sustainable Development Indicator: 07

No	07
Indicator	Quantitative employment and income generation
Mitigation measure	New job creation
Repeat for each parameter	
Chosen parameter	Number of local employees of the Project (last month)
Current situation of parameter	7



Future target for parameter		4
Way of monitoring	How	By checking the social security and residence records of the personnel.
	When	Continuously.
	By who	Project owner.

Deviation from the monitoring plan:

N/A

Revision of the monitoring plan for this Gold Standard indicator:

N/A

QA/QC:

The data obtained has high accuracy because it is based on documentary evidence.

Conclusion:

This indicator shows that the Project Owner has implemented the mitigation measures according to the monitoring plan and that it successfully contributes to job creation in the area.

8. Sustainable Development Indicator: 08

No	08	
Indicator	Balance of payments and investment	
Mitigation measure	Reduction in fossil fuel imports	
Repeat for each parameter		
Chosen parameter	Value of the imported natural gas avoided	
Current situation of parameter	Using the ex-ante natural gas price of 3.7 USD/MMBtu ¹⁸ and the actual electricity generation of 36,179,860 kWh, the Project has indirectly caused a natural gas import savings of 640,205 USD.	
Future target for parameter	Using the ex-ante natural gas price of 3.7 USD/MMBtu and the expected electricity generation of 13,358 MWh in 2015, the Project is expected to indirectly cause a natural gas import savings of 236,371 USD.	
Way of monitoring	How	The avoided natural gas amount will be taken from the indicator “Access to affordable and clean energy services”. The energy content of this amount will then be multiplied by the ex-ante natural gas price.
	When	Monthly, by recording PMUM reports.
	By who	Project owner.

Deviation from the monitoring plan:

N/A

¹⁸ Source: <http://www.bloomberg.com/energy/>

**Revision of the monitoring plan for this Gold Standard indicator:**

N/A

QA/QC:

The amount of natural gas savings is taken from the the indicator “Access to affordable and clean energy services”. The ex-ante natural gas price is taken from a credible source and is therefore of high quality. The amount of electricity generated is taken from PMUM, which is used for invoicing and is therefore highly reliable. For calculations, spreadsheet is used to minimize calculation errors or typo.

Conclusion:

This indicator shows that the Project indirectly contributes to the balance of payments by reducing natural gas imports.

9. Sustainable Development Indicator: 09

No		09
Indicator		Technology transfer and technological self-reliance
Mitigation measure		Continuous know how sharing with the local team
<i>Repeat for each parameter</i>		
Chosen parameter		
Current situation of parameter		Local and international experts have provided technical trainings.
Future target for parameter		Local stakeholders and the Municipality will gain information and best practice applications through site visits, training sessions and/or know how contributions made by international experts.
Way of monitoring	How	Interviews with stakeholders.
	When	Continuously.
	By who	Project owner.

Deviation from the monitoring plan:

N/A

Revision of the monitoring plan for this Gold Standard indicator:

N/A

QA/QC:

The data obtained has high quality because it depends on interviews with stakeholders who are the focus of this indicator.

Conclusion:

This indicator shows that the Project successfully contributes to technology and knowhow transfer in the area.

ANNEX II – INFORMATION ABOUT MONITORING PARAMETERS

Table 15. Definitions of the parameters

Parameter	Definition
$EM_{grid,y}$	Emissions resulting from electricity generation in year y
EG_y	Net electricity delivered to the grid in year y , excluding low cost-must run generation units
ER_y	Emission reductions in year y (tCO_2e/yr)
PE_y	Project emissions in year y (tCO_2/yr)
BE_y	Baseline emissions in year y (tCO_{2e})
$MD_{project,y}$	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario
$MD_{BL,y}$	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4)
$MD_{flared,y}$	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity (tCH_4)
$F_{CH_4,RG,m}$	Mass flow of methane in the residual gas on a dry basis at reference conditions in the minute m (kg)
$w_{CH_4,y}$	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in $m^3 CH_4 / m^3 LFG$)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream y
$SPEC_{flare}$	Manufacturer's flare specifications for temperature and flow rate
$T_{EG,m}$	Temperature in the exhaust gas of the enclosed flare in minute m
x	Year during the crediting period: x runs from the first year of the first crediting period ($x = 1$) to the year y for which avoided emissions are calculated ($x = y$)
y	Year for which methane emissions are calculated
$LFG_{flare,y}$	Total amount of landfill gas (under normal conditions of 0° and 1 Atm) flared in year y
$LFG_{electricity,y}$	Total amount of landfill gas (under normal conditions of 0° and 1 Atm) combusted in the generator unit in year y
$LFG_{total,y}$	Total amount of landfill gas (under normal pressure and temperature) captured in year y
CF_{EM}	Correction factor for error margin

Table 16. Health and safety precautions

Checklist	Assessment
Safety equipment is available and sufficient.	Positive. The available safety equipment include safety rope, rescue rope, working clothes, safety shoes, helmets, safety gloves, protective glasses, ear plugs, dust and gas masks, medicine box and fire extinguishers.
Personnel use safety equipment continuously and correctly.	Positive. The personnel on site effectively use the required equipment such as the working clothes, safety shoes and helmets, depending on their roles and responsibilities.
The project does not	Positive.



involve hazardous work.	The Project does not involve any activity that is hazardous.
No accident has happened during monitoring period.	Positive. There has not been any work accident (i.e. personal injury, first aid etc.) on site during the monitoring period.
Compliance with national health and safety regulations.	Positive. There has not been any incompliance with relevant regulations in the host country.

Table 17. Trainings

Description	Managed / Given By	Participants	Date / Duration	Certificate
Occupational Health and Safety Training	ATAC	7 staff	2014 Half-day training	Yes

Table 18. Employment Information

Position	Task	Number of Staff	Employer	How many of them are local people?
Power Plant Manager	Responsible from operational and maintenance activities and management of the plant on site.	1	Project Owner	0
Project Administrator	Information flow, document management and project administration.	1	Project Owner	0
Maintenance Operator	Routine controls, intervention in case of breakdowns, daily operations.	6	Project Owner	6
Total	8 full-time	8		6

ANNEX III – EMISSIONS REDUCTIONS TABLE

Project Name: Samsun Landfill Gas to Energy Project, Turkey
 Period start: 01/12/2012
 Period end: 31/08/2014

Year	Period Start	Period End	Emission Reduction from Methane Destruction (t CO ₂ e)	Emission Reduction from Electricity Generation (t CO ₂ e)	Overall Emission Reduction (t CO ₂ e)
2012	01/12/2012	31/12/2012	5,474.68	731.91	6206.6
2013	01/01/2013	31/01/2013	6,558.68	734.19	7292.9
2013	01/02/2013	28/02/2013	6,124.93	668.83	6793.8
2013	01/03/2013	31/03/2013	6,721.40	701.94	7423.3
2013	01/04/2013	30/04/2013	5,615.73	705.13	6320.9
2013	01/05/2013	31/05/2013	7,408.12	813.15	8221.3
2013	01/06/2013	30/06/2013	8,027.38	871.73	8899.1
2013	01/07/2013	31/07/2013	7,686.54	881.71	8568.2
2013	01/08/2013	31/08/2013	8,470.21	901.62	9371.8
2013	01/09/2013	30/09/2013	7,221.84	777.65	7999.5
2013	01/10/2013	31/10/2013	10,882.47	980.69	11863.2
2013	01/11/2013	30/11/2013	11,301.83	1,236.24	12538.1
2013	01/12/2013	31/12/2013	10,513.37	1,231.02	11744.4
2014	01/01/2014	31/01/2014	10,156.59	1,153.57	11310.2
2014	01/02/2014	28/02/2014	9,800.41	1,021.69	10822.1
2014	01/03/2014	31/03/2014	9,124.78	1,084.08	10208.9
2014	01/04/2014	30/04/2014	10,186.54	1,116.08	11302.6
2014	01/05/2014	31/05/2014	10,849.36	1,152.37	12001.7
2014	01/06/2014	30/06/2014	8,046.48	1,008.57	9055.1
2014	01/07/2014	31/07/2014	6,899.05	1,168.74	8067.8
2014	01/08/2014	31/08/2014	4,914.36	1,274.92	6189.3
TOTAL			171,984.8	20,215.8	192,200.6