



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

CONTENTS

- A. General description of project activity
- B. Application of a baseline and monitoring methodology
- C. Duration of the project activity / crediting period
- D. Environmental impacts
- E. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

**SECTION A. General description of project activity****A.1. Title of the project activity:**

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Kocaeli Landfill Gas to Electricity Project – Turkey

Version number of the document: 3

Date: 13.08.2012

A.2. Description of the project activity:

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Summary:

Kocaeli Landfill Gas to Electricity Project (hereafter referred to as “the Proposed Project”) developed by Körfez Enerji A.Ş. (hereafter referred to as the “Project Participant”), is a landfill gas recovery and utilization project at the site of Solaklar Landfill Area in Solaklar District, Kocaeli Province, Turkey.

Solaklar Landfill Area has been built in 1997 as a sanitary landfill area under the responsibility of İZAYDAŞ¹ and is the biggest landfill area in Kocaeli Municipality. With a total area of approximately 3 million square meters, the landfill accepts municipal wastes since operated. The landfill area has received an average of 630 ton/day² MSW, with an accumulated waste storage of approximately 3 million ton. The landfill gas (LFG) is released into the atmosphere without any collection, flaring or utilization till the project activity. On 13.07.2010, İZAYDAŞ has transferred the right of use of the closed lots to the Project Participant. Based on the agreement with İZAYDAŞ, the Project Participant has the right to recover the landfill gas and generate electricity by utilization of the LFG from the closed lots.

The proposed project activity involves, preparing the landfill area for collection of LFG, recovery of LFG gas and utilization of the recovered LFG through gas engines to generate electricity. The generated electricity will be delivered to the national electricity system. It is estimated that the LFG will support approximately 2MW of installed capacity, which will be covered by installing two gas engines with a nominal capacity of 1.2 MW each. Any excess of LFG gas will be flared in an enclosed flare system. It is expected that the electricity generation will reach approximately to 15,000 MWh/year³ and will be delivered to the national electricity system through a transformer substation.

The baseline scenario is the same as the existing scenario, which the municipal waste is deposited and left for decay at the landfill site, leading to generate and release of large amounts of landfill gas. Landfill gas is one of the largest sources of methane emissions to the atmosphere and typically contains 50% of methane, a potent greenhouse gas. GHG emission reductions will be achieved by two means.

- By collection and destruction of methane by power generation, and;
- Displacing an equal amount of electricity generated by power plants connected to the electricity system.

¹ İZAYDAŞ (Kocaeli Waste Incineration and Waste Management CO) is an affiliated company of Kocaeli Metropolitan Municipality. <http://www.izaydas.com.tr/default.asp>

² Currently receiving approximately 1000 ton/day MSW.

³ This value is the estimated maximum amount of electricity generation in year 2015.



The total estimated GHG emission reductions of the proposed project activity are estimated to reach a total of 635,221 tCO₂eq within the first crediting period.

Contribution to Sustainable Development:

The proposed project activity will also contribute significantly to the region's sustainable development:

- The project activity will significantly improve local air quality by reducing the amount of pollutants emissions contained in the LFG. Landfill areas cause odour nuisance and have a high risk of explosion and fire. By properly covering the landfill and extracting the landfill gas, the odour nuisance and risk of explosion and fire will be significantly reduced.
- The project activity will result in creation of local employment.
- The project activity will contribute to reduce global warming by reducing CH₄, which has a global warming potential 21 times of CO₂.
- The project results in the transfer of knowledge on waste management principles.

Additionally, no major negative impacts are expected as confirmed by the Local Stakeholders Consultation Meeting.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Turkey (host country)	Körfez Enerji A.Ş.	No

Körfez Enerji A.Ş. is a special purpose company established for the proposed project activity under Ortadogu Group of Companies⁴.

OakDanışmanlık is the carbon consultant for this project⁵.

Full contact information for the project participants are provided in Annex 1.

⁴ Reference: www.ortadogugrup.com.tr

⁵ OakDanışmanlık is not a project participant

**A.4. Technical description of the project activity:****A.4.1. Location of the project activity:**

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A.4.1.1. Host Party(ies):

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Republic of Turkey

A.4.1.2. Region/State/Province etc.:

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Marmara Region, Kocaeli/İzmit Province

A.4.1.3. City/Town/Community etc.:

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Kocaeli, the province is located at the Gulf of İzmit in the Sea of Marmara, about 100 km east of Istanbul, on the northwestern part of Anatolia. The city center has a population of 294,875 (2009 census). The population of the province (including rural areas) is about 1,500,000. The Solaklar landfill is the largest landfill area within Kocaeli Province and is located within the headquarter facilities area of İZAYDAŞ.



A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

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Coordinates of the project: Latitude: 40°47'14.83"N, Longitude: 30° 1'33.60"E

**A.4.2. Category(ies) of project activity:**

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Table 1. Categories of the project activity

Applicable rules and definitions	Category	Justification
UNFCCC	Sectoral scope 13, Waste Handling and Disposal	The proposed project involves waste management and treatment through LFG extraction and Utilization.
Gold Standard	Large scale Renewable Energy Supply ⁶ .	Although the installed capacity of the proposed project activity is below the threshold of 15MW, there is a possibility that the emission reductions will exceed the 60k threshold set under the CDM⁷ rules for the small scale project activities. Therefore the project activity will be developed as a large scale project activity. The system is designed in a way to make use of the biogas recovered for the delivery of electricity. The project activity involves generation and delivery of energy services from non-fossil and non-deplatable energy sources⁸.

A.4.3. Technology to be employed by the project activity:

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The purpose of the project activity is to recover the LFG gas accumulated in the landfill area and generate electricity via gas engines to generate electricity. In order to recover the LFG, the closed lots of the landfill will be covered by an appropriate layer to maximize the collection efficiency. The LFG will be collected actively via vertical wells drilled into the landfill area and will be transferred to the engines through horizontal pipes laid down through the landfill area.

2 sets of gas engines with a 1.2 MW capacity each will be installed within the scope of the project activity⁹. The gas engines are TCG2020 type engine manufactured by the Berman Company MWM GmbH, specifically used for electricity generation from landfill gas. The output of each engine is 1.2

⁶ Gold Standard Toolkit, Chapter 1.2, p 23: http://www.cdmgoldstandard.org/wp-content/uploads/2011/10/GSv2.1_Toolkit_Clean-11.pdf

⁷ The term CDM (Clean Development Mechanism) should be also interpreted as VER (Voluntary Emission Reductions) through out the PDD.

⁸ Although making use of deplatable source, landfill gas projects are eligible under the Gold Standard according to Gold Standard Requirements.

⁹ Depending on the availability of the LFG a third engine might be installed.



MWe with V type 12 cylinders¹⁰. An enclosed flare system will be installed to burn the excess LFG in a controlled environment and disposal of it safely to the atmosphere.

The generated electricity will be exported to the national grid, through a transformer via Medium Voltage Level.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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Table 2. Estimated amount of emission reductions over the first crediting period

Years	Annual estimation of emission reductions (tCO ₂ e)
2012	74,058 ¹¹
2013	94,269
2014	99,196
2015	103,692
2016	93,056
2017	83,799
2018	75,713
2019	11,438 ¹²
Total emission reductions (tCO₂e)	635,221
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tCO₂e)	90,746

A.4.5. Public funding of the project activity:

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No public funding is obtained for the project.¹³

¹⁰ For more details on the engines please refer to www.mwm.net/en/products/gas-engines-power-generators/tcg-2020-tcg-2020-k/

¹¹ The figure for 2012 has been adjusted according to the starting date of the crediting period 01.03.2012

¹² The figure for 2019 has been adjusted according to the end of first crediting period 28.02.2019

¹³ The ODA declaration form is available to the DOE.

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

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Applied approved baseline and monitoring methodologies:

- Approved consolidated baseline methodology ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0;

Used tools:

- “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1;
- “Tool to determine project emissions from flaring gases containing methane “version 01;
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0
- “Emissions from solid waste disposal sites” version 06.0.0;
- “Tool to calculate the emission factor for an electricity system” Version 02.2.1,
- “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 01.

For more information regarding the methodology please refer to

<http://cdm.unfccc.int/methodologies/DB/RNAKK7JRFWIKCFT3YSNKGPC1FR2DVA>

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The project activity involves LFG extraction and utilization and ACM0001 approved consolidated methodology “Flaring or Use of Landfill Gas” version 12.0.0 is considered applicable to the project activity. The applicability of the methodology and referred tools has been discussed in detail as follows:

Applicability of ACM0001 v12.0.0:

The emission reductions resulting from the capture and utilization of landfill gas are calculated using ACM0001 “Flaring or Use of Landfill Gas”. The applicability of ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0 is discussed as follows:

Ref.	Applicability Criteria	Justification
The methodology is applicable to project activities which:		
a	Install a new LFG capture system in a new or existing SWDS	The proposed project activity involves installation of a new LFG capture system.
b	Make an investment into an existing LFG capture system to increase the recovery rate or change the use of captured LFG, providing that; i) The captured LFG was only vented or flared and not used prior to the implementation of the project activity; and	Although there are a couple of wells for basic fire control are observed in the landfill area, these wells are heavily damaged and none of these wells are suitable for gas extraction. Therefore the proposed project activity will not be able to benefit from any of these wells and could not be considered as “an investment into an existing LFG capture system”.



	ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flare is available.	
c	Flare the LFG and/or use the captured LFG in any (combination) of the following ways: i) Generating electricity ii) Generating heat in a boiler, air heater or kiln (brick firing only); and/or iii) Supplying the LFG to consumers through a natural gas distribution network.	The proposed project activity is designed in a way to make use of the LFG recovered for the delivery of electricity, where the excess LFG will be flared for emergencies. There will be no heat generation or supply of LFG to consumers.
d	Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	There are no recycling activities within the project activity.
The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is		
a	Partial or total release of the LFG from the SWDS; and	The most plausible baseline scenario is the total release of the LFG from the SWDS. Please refer to section B.4 of this PDD for more detailed description on the baseline scenarios.
b	In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heat, or kiln; i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or ii) For heat generation: that heat would be generated using fossil fuels in on-site equipment.	The most plausible baseline scenario for electricity generation is that electricity would be generated in the grid. Please refer to section B.4 of this PDD for more detailed description on the baseline scenarios.
The methodology is not applicable:		
a	In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln, where the purpose of the CDM project activity is to implement energy efficiency measures at kiln;	This methodology is not used in a combination of other approved methodologies.
b	If the management of the SWDS in the project activity is deliberately changed in order to increase methane generation	No changes or intervene has been made deliberately to increase generation compared to situation prior to the implementation of the



	compared to the situation prior to the implementation of the project activity (e.g. other to meet a technical or regulatory requirement). For example this may apply to the addition of liquids to a SWDS, pre-treating waste to seed it with bacteria for the purpose of increasing the anaerobic degradation environment of the SWDS or changing the shape of SWDS to increase the Methane Correction Factor.	project activity.
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ACM0001 version 12.0.0 “Flaring or Use of Landfill Gas” is applicable to the proposed project activity since, the project activity involves the installation of a new LFG capture system in order to generate electricity, which otherwise the total LFG will be released to the atmosphere and the same amount of electricity will be generated by the national grid.

Applicability of “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1:

The combined tool to identify the baseline scenario and demonstrate the additionality provides a step-wise approach to identify the baseline scenario and simultaneously demonstrate additionality. As referred in methodology ACM0001, the “Combined tool to identify the baseline scenario and demonstrate the additionality” is applicable for the proposed project activity.

Applicability of “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0:

This tool provides procedures to determine the mass flow of CH₄ in the LFG in time interval t. As referred in methodology ACM0001, the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0 is applicable for the proposed project activity.

Applicability of “Tool to determine project emissions from flaring gases containing methane” v 01:

The tool provides procedures to calculate project emissions from flaring of a residual gas stream containing methane. Applicability of “Tool to determine project emissions from flaring gases containing methane” is discussed below:

Ref	Applicability Criteria	Justification
a	The residual gas stream to be flared contains no other combustible gases than methane, carbon dioxide and hydrogen.	In the proposed project activity only the captured LFG, which contains no other combustible gases than methane is flared in case of emergency or unavailability of the project equipment for electricity production.
b	The residual gas stream to be flared shall be obtained from decomposition of organic material (through landfills, biogasifiers or anaerobic lagoons, among others) or from	In the proposed project activity, the residual gas stream to be flared is obtained from decomposition of organic material through a landfill.



	gases vented in coal mines (coal mine methane and coal bed methane).	
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Based on the above arguments it can be concluded that the Tool to determine project emissions from flaring gases containing methane” v 01 is applicable to the project activity.

Applicability of “Emissions from solid waste disposal sites” version 06.0.0:

This tool provides procedures to calculate baseline, project or leakage emissions of the methane from solid waste disposed or prevented from disposal at a SWDS. The applicability of the tool “Emissions from solid waste disposal sites” version 06.0.0 is discussed as follows:

Ref	Applicability Criteria	Justification
The tool can be used to determine emissions for the following types of applications:		
Application A	The CDM project activity mitigates methane emissions from a specific existing SWDS.	Since the methane emissions are mitigated by capturing and flaring or combusting the methane, “Application A” implies to the proposed project activity. The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In line with the requirements, this tool is only applied for an <i>ex-ante</i> estimation of emissions in the CDM-PDD. The emissions will be monitored during the crediting period using the applicable approaches in the relevant methodologies (ACM0001 in this case).
Application B	The CDM project activity avoids or involves the disposal of waste at a SWDS.	Since the MSW is not treated with an alternative option such as composting or anaerobic digestion, “Application B” is not relevant to the proposed project activity.

The tool “Emissions from solid waste disposal sites” version 06.0.0 is applicable since the proposed project activity mitigates methane emissions from a specific existing SWDS.

Applicability of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” v 01:

This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity. The tool is only applicable if certain scenario applies to the sources of electricity consumption. Three possible scenarios have been discussed as follows:



Ref	Applicability Criteria	Justification
a	Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exists, it is not operating or it can physically not provide electricity to the source of electricity consumption.	In the proposed project activity, the electricity is purchased from the grid only and no captive power plant is installed at the site of electricity consumption.
b	Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.	Not relevant to the project activity since there are no captive power plants installed at the site of electricity consumption source.
c	Electricity consumption from the grid and (a) fossil fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumption source can be provided with electricity from the captive power plant(s) and the grid.	Not relevant to the project activity since there are no captive power plants installed at the site of electricity consumption source.

Based on the above arguments it can be concluded that the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption’ v 01 is applicable to the project activity.

Applicability of “Tool to calculate the emission factor for an electricity system” v 02.2.1:

This methodological tool determines the CO₂ emission factor for displacement of electricity generated by power plants in an electricity system, by calculating the “combined margin” emission factor (CM) of the electricity system. This tool maybe applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity. As the proposed project activity supplies electricity to the national grid, the “Tool to calculate the emission factor for an electricity system” v 02.2.1 is applicable to the project activity.

**B.3. Description of the sources and gases included in the project boundary:**

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Project boundary:

In line with the requirements of ACM0001 ‘Flaring or Use of Landfill Gas’ (version 12.0.0), the project boundary of the project activity includes the following:

- Site where LFG is captured;
- Site where the LFG is flared and used;
- Power generation sources connected to the grid, which are supplying electricity to the project activity
- Power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity;

The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available as required by the “Tool to calculate the emission factor for an electricity system” (version 02.2.1). The electricity produced on-site will be delivered to the Turkish national grid¹⁴.

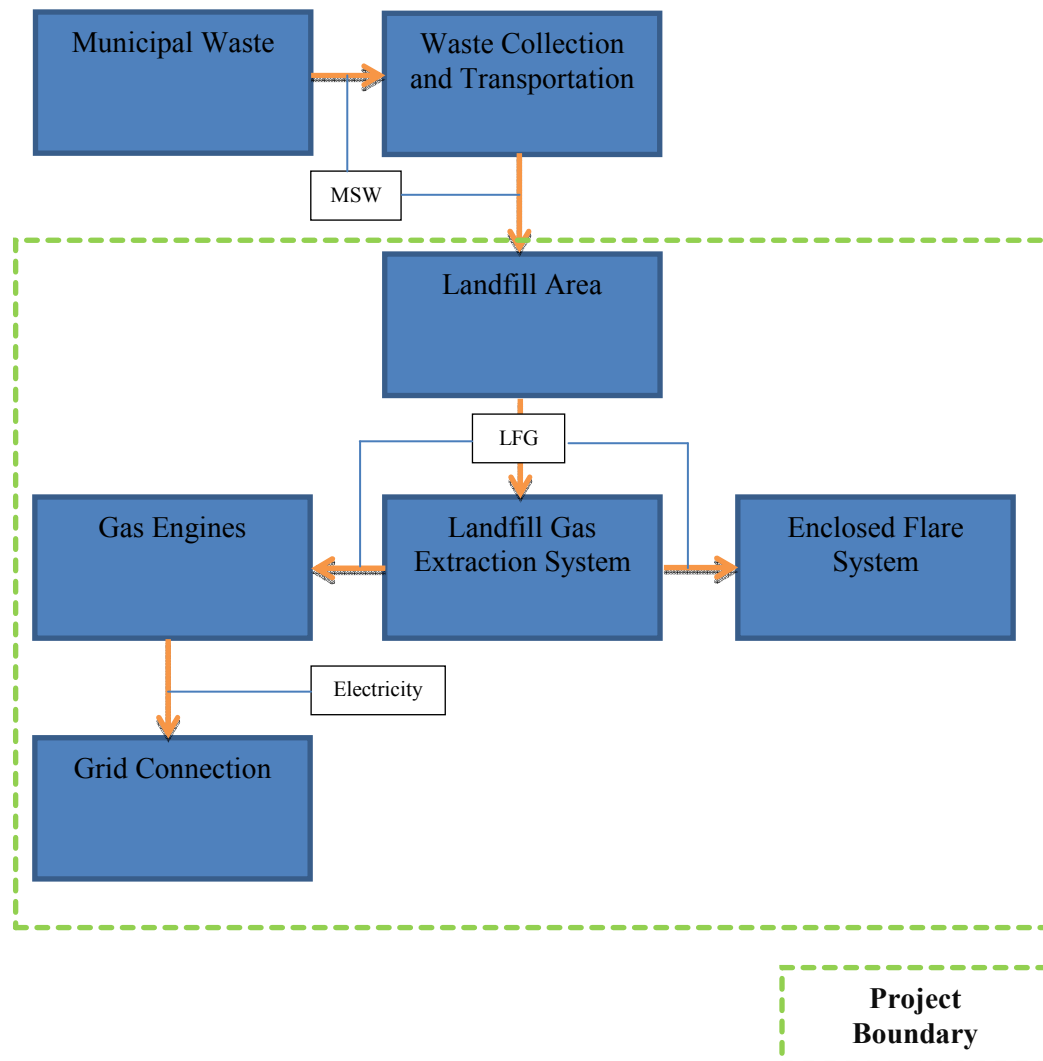
The gases and sources relevant to the proposed project activity are listed in the below table.

Table 3 Summary of greenhouse gases and sources included in and excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH ₄	Yes	The major source of emissions in the baseline.
		N ₂ O	No	N ₂ O emissions are small compared to CH ₄ emissions from SWDS. This gas is conservative.
		CO ₂	No	CO ₂ emissions from the decomposition of organic waste are not accounted.
	Emissions from electricity consumption	CO ₂	Yes	Main emission source.
		CH ₄	No	Excluded for simplification. This is conservative.
		N ₂ O	No	Excluded for simplification. This is conservative.
Project Activity	Emissions from on-site electricity use	CO ₂	Yes	May be an important emission source
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small

¹⁴ Reference: Turkish National Grid Line Diagram <http://www.teias.gov.tr/4grupmd/atcharita.htm>

As presented by the below figure, the physical boundary of the proposed project are the components of the proposed project activity in which the gas will be captured and utilized/destroyed (including gas collection system, electric generators and flaring system) and their connection to the Turkish National Grid.



**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

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Procedures for the selection of most plausible baseline scenario

According to ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, the baseline scenario is identified using the “Combined tool to identify the baseline scenario and demonstrate additionality”¹⁵.

Step 1: Identification of alternative scenarios

This step serves to identify all alternative scenarios to the proposed project activity which can be the baseline scenario following the sub-steps:

Step 1a: Define alternative scenarios to the proposed project activity:

In line with ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, alternative scenarios that a) are available to the project participant, b) cannot be implemented in parallel to the proposed project activity, and c) provide outputs and with comparable quality, properties and application areas as the proposed project activity. In line with the requirements of ACM0001, these alternatives are defined as follows:

- LFG 1:** The project activity implemented without being registered as a VER project activity;
- LFG 2:** Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and odor concerns;
- LFG 3:** LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;
- LFG 4:** LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;
- LFG 5:** LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

Since LFG is used for generating electricity for export to the grid, the following alternatives have been also analyzed:

- E1:** Power generated from LFG undertaken without being registered as a VER project activity;
- E2:** Electricity generation in existing or new on-site or off-site renewable based captive power plant;
- E3:** Electricity generation in existing and/or new grid connected power plants;

As the proposed project does not involve thermal energy generation, all the alternatives for heat generation are not included in the analysis.

¹⁵ This tool provides a step wise approach to identify the baseline scenario and simultaneously demonstrate additionality. Therefore step 1, which is the identification of alternative scenarios, will be discussed under section B.4 of this PDD and step 2, 3 and 4 will be discussed under section B.5 of the PDD.



Alternatives LFG 3, 4 and 5 as well as E 2 has been excluded from further consideration as a realistic alternative, which is explained as follows:

Table 4 Alternative scenarios excluded from further consideration

Reference	Alternative	Justification
LFG 3	LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS.	It is not realistic to consider recycling of solid waste which has been subject to decomposition for over 10 years as a realistic and credible alternative. Alternative LFG 3 has been excluded from further evaluation.
LFG 4	LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS.	It is not realistic to consider aerobic treatment of solid waste which has been subject to decomposition for over 10 years as a realistic and credible alternative. Alternative LFG 4 has been excluded from further evaluation.
LFG 5	LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.	It is not realistic to consider aerobic treatment of solid waste which has been subject to decomposition for over 10 years as a realistic and credible alternative. Alternative LFG 4 has been excluded from further evaluation.
E 2	Electricity generation in existing or new on-site or off-site renewable based captive power plant.	There is no existing electricity generation in the SWDS. Also there are no available renewable energy resources (hydro, geothermal, wind etc) in or close to the vicinity of the SWDS. Alternative E 2 has been excluded from further evaluation.

Outcome of Step 1a:

Based on the above arguments, two alternatives scenarios could be identified:

Table 5 Alternative scenario combinations applicable to the project activity

Scenario	Alternatives			Description of situation
	Landfill Gas	Electricity	Heat	
1	LFG 1	E 1	n.a.	Project activity including power generation from LFG without being registered as a VER project activity.
2	LFG 2	E 3	n.a.	Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity.

**Step 1.b: Consistency with mandatory laws and regulations**

Related laws and regulations to the proposed project activity are as followed:

- Electricity Market Law¹⁶ [Law Number: 4628 Ratification Date: 20.02.2001 Enactment Date: 03.03.2001]
- Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy¹⁷ [Law Number: 5346 Ratification Date: 10.05.2005 Enactment Date: 18.05.2005]
- Environmental Law¹⁸ [Law Number: 2827 Ratification Date: 09.08.1983 Enactment Date: 11.08.1983]
 - Regulation on Solid Waste Control¹⁹ [Last updated on 05.04.2005]
 - Regulation on Managed Waste Land Filling²⁰ [Regulation number 27533 Enactment Date: 26.03.2010]

Relevance of mentioned Laws and Regulations

Electricity Market Law: The purpose of this Law is to ensure the development of financially sound and transparent electricity market operating in a competitive environment under provisions of civil law and the delivery of sufficient, good quality, low cost and environment-friendly electricity to consumers and to ensure the autonomous regulation and supervision of this market. Among others, the scope of the law also covers generation of electricity. As one of the important aspects of the proposed project activity is electricity generation, the Electricity Market Law is one of the regulating legislations regarding the project activity.

Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy: The purpose of this Law is to expand the utilization of renewable energy resources for generating electrical energy, to benefit from these resources in secure, economic and qualified manner, to increase the diversification of energy resources, to reduce greenhouse gas emissions, to assess waste products, to protect the environment and to develop the related manufacturing sector for realizing these objectives. At the time of the investment decision, the law guaranteed a tariff range of 5 – 5.5 ¢cent/kWh for 10 years. On 29.12.2010 the Law has been revised and the guaranteed tariff has been amended as 13.3 ¢cent/kWh for electricity production based on biogas²¹. As one of the important aspects of the proposed

¹⁶ Reference: The official web page of EMRA; <http://www.epdk.gov.tr/documents/10157/351a7a0c-52a9-40d5-8e12-f8e61afe7247>

¹⁷ Reference: The official web page of EMRA; <http://www.epdk.gov.tr/documents/10157/4b360128-53aa-4174-8104-a6c10434ac9c>

¹⁸ Reference: The official web page of the Ministry of Environment and Forestry; <http://www2.cevreorman.gov.tr/yasa/k/2872.doc>

¹⁹ Reference: The official web page of the Ministry of Environment and Forestry; <http://www.cygm.gov.tr/CYGM/Files/mevzuat/yonetmelik/kaky.doc>

²⁰ Reference: The official web page of the Ministry of Environment and Forestry; http://www.cygm.gov.tr/CYGM/Files/mevzuat/yonetmelik/Duzenli_Depolama.doc

²¹ Reference: “Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity” (18/04/2007), Article 6;



project activity is electricity generation from renewable energy sources the “Renewable Energy Law” is one of the regulating legislations regarding the project activity.

Environmental Law: This law outlines Turkey’s environmental policy in general terms. It aims to protect the environment and Turkey’s natural resources for the benefit of future generations. It includes the polluter pays principle. Regulations have been issued on air quality protection, water pollution control, environmental impact assessment, waste control, noise control, and the control of hazardous materials. The Environmental Law is one of the main legislations regarding the project activity as it relates to waste management activities. The following two sub regulations of this law are specifically related to the Project Activity:

- Regulation on Solid Waste Control: Summarizing, the regulation mentions the obligation of the party undertaking the solid waste management to respect the human health and welfare of the society. However it doesn’t prescribe any technology to achieve this (article 5 and article 27) nor does it mention any sanction or penalty if solid waste management projects are implemented otherwise. As such the regulation is instructive on the issue of solid waste management rather than normative. It does not mandate the destruction of methane. Although semi-controlled release of landfill gas to the air (a.k.a. ‘venting’) occurs at several landfills (also see B.5 step 4), the law does not mandate the destruction of methane.

- Regulation on Sanitary Landfilling: The newly enacted regulation (26.03.2010) on sanitary waste landfilling aims to (1) minimize the impact of leachate and LFG on soil, air and water quality; (2) regulate waste acceptance to the landfill area; and (3) provide procedures for opening and closure of a landfill area.

In summary: although solid waste management regulation is being implemented in Turkey, it is neither compiled to nor enforced. The regulations don’t define sanctions or penalties. In practice none of the landfill areas comply with these regulations, as indicated in statistics on landfill areas²². The majority of landfill areas in Turkey are actually ‘waste dumps’ where no waste management (including covering of the landfill) implemented.

Outcome of Step 1b:

Both *Scenario 1* and *Scenario 2* as defined under table 5 “Alternative scenario combinations applicable to the project activity” are in consistency with mandatory laws and regulations and remain as credible and realistic alternative scenarios to the proposed project activity for further evaluation on identification of the baseline scenario.

http://www.ibb.gov.tr/sites/aydinlatmaenerji/Documents/Enerji%20Mevzuat%C4%B1/1_YEKKanun_Temmuz2008.pdf

²² Please refer to section B.5 Step 4, Common Practice for further details.

**Step 2: Barrier Analysis**

Since the “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1 is used to identify the baseline scenario, a barrier analysis has to be conducted to assess which alternative scenarios are prevented by defined barriers. When applying this step “Guidelines for objective demonstration of and assessment of barriers” version 01 has been taken into account.

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

This step has been explained in detail under section B.5 “Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality)” of this PDD. Only the outcome of this step has been presented in order to identify the baseline scenario.

Outcome of Step 2a:

Realistic and credible barriers that would prevent alternative scenarios to occur have been identified under the generic topic “Investment Barriers”.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

This step has been explained in detail under section B.5 “Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality)” of this PDD. Only the outcome of this step has been presented in order to identify the baseline scenario.

Table 6 Assessment of alternative scenarios against the impact of identified barriers

Scenario	Identified Barriers
	Investment Barrier
	One of the major barriers related with project activity is defined as “limited access to finance”.
Scenario 1: Project activity including power generation from LFG without being registered as a VER project activity.	Waste management projects need a high level of financing and limited access to finance represents a real and credible barrier that would prevent the project activity invested without the VER revenues.
Scenario 2: Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity.	Since this scenario is the continuation of the current practice, it does not require any investment and therefore is not affected by the identified barrier.

Outcome of Step 2a:



Based on the above arguments, the following scenarios are not prevented by any identified barriers.

Table 7 Alternative scenario combinations that are not prevented by barriers

Scenario	Alternatives			Description of situation
	Landfill Gas	Electricity	Heat	
2 (Identified as the baseline scenario)	I	E 3	n.a.	Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity. This scenario also represents the continuation of the situation before the implementation of the proposed project activity.

Outcome of Step 2:

There is only one alternative scenario that is not prevented by any barrier, which is Scenario 2; Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity. In line with the requirements of “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1, Scenario 2 has been identified as the baseline scenario.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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Approved consolidated baseline methodology ACM0001 “Flaring or use of landfill gas” version 12.0.0, requires the use of the latest “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1 to demonstrate and assess the additionality of the proposed project.

The tool provides for a step-wise approach to demonstrate and assess additionality. These steps include:

- STEP 1. Identification of alternative scenarios;
- STEP 2. Barrier analysis;
- STEP 3. Investment analysis (if applicable)
- STEP 4. Common practice analysis

Step 1. Identification of alternative scenarios

This step has been covered extensively under section B.4. Credible and realistic alternative scenarios consistent with mandatory laws and regulations are identified as follows:

**Table 8** Alternative scenarios to the project activity

Scenario	Alternatives			Description of situation
	Landfill Gas	Electricity	Heat	
1	LFG 1	E 1	n.a.	Project activity including power generation from LFG without being registered as a VER project activity.
2	LFG 2	E 3	n.a.	Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity.

Step 2: Barrier Analysis

In line with the requirements of “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1, a barrier analysis has been conducted to identify barriers and to assess which alternative scenarios are prevented by these barriers. When applying this step “Guidelines for objective demonstration of and assessment of barriers” version 01 has been taken into account.

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

The major barriers could be mainly categorized under “investment barrier”, which is presented in detail as followed:

Investment Barrier:

According to “Metropolitan Municipalities Law”, Metropolitan Municipalities are responsible for management and disposal of the municipal waste and building and operating the necessary facilities. However, taking into account that the modern waste management technologies such as LFG extraction and utilization require specific know-how and a high level of investment, municipalities in Turkey are reluctant to undertake such investments and associated risks. Also the lack of legislation that enforces municipalities and/or private companies to implement emission reduction measures result in landfills being only managed as “sanitary” landfill areas where no methane destruction or avoidance take place such as landfill areas in Turkey. Furthermore the statistics in Turkey show that even sanitary landfills do have a minority share among the total, with only 37 sanitary landfill out from 3129 municipalities (%1.1) receiving solid waste²³.

On 13.07.2010, IZAYDAŞ (an affiliated company under Kocaeli Metropolitan Municipality) has transferred the right of use of two landfill areas, namely “Solaklar” and “Dilovası”²⁴ to Ortadoğu Enerji. The process was significantly based on availability of the expected carbon revenues.

²³ Reference: Turkish Statistics Institute official website / Main solid waste indicators of municipalities
http://www.turkstat.gov.tr/PreIstatistikTablo.do?istab_id=496

²⁴ Since Dilovası landfill area is very small, it is not suitable for LFG utilization and therefore not eligible under Gold Standard Rules and therefore it has not been included in the Project Boundary and no emission reductions will be claimed.



According to the contract between Ortadoğu Enerji and IZAYDAŞ, Ortadoğu Enerji is entitled to invest in LFG extraction and utilization technology and to benefit both from electricity sales and carbon revenues, while a certain share on both electricity and carbon revenues are distributed among two parties. Carbon revenues have been the major element for;

- IZAYDAŞ to transfer the right of use of the landfill area for LFG extraction and utilization, and;
- Ortadoğu Enerji to undertake the risks associated with the investment and enabled to secure finance to the proposed project activity.

Article 24 of the contract²⁵ states that 40% of the carbon revenues belong to IZAYDAŞ while 60% of the carbon revenues belong to Ortadoğu Enerji.

To summarize the above statements; the investment decision of the Project Participant on the proposed project activity was majorly assured due to the benefit of the carbon revenues. From the beginning, availability of the carbon revenues was the bases of this investment both for IZAYDAŞ and Ortadoğu Enerji. The landfill areas were transferred to Ortadoğu Enerji by IZAYDAS on the condition of a carbon revenue stream.

Limited Access to Financing:

Waste management projects need a high level of financing. However waste management investments are still perceived as investments with high risks by the creditors/financing institutions.

The proposed project activity is among the first projects to introduce modern waste management treatment technologies to Turkey. As stated by a report on waste management in Turkey: *“The most frequent method for the disposal of wastes in Turkey is the irregular land filling (‘dumping’), and the methods of regular landfilling, composting, incineration or recycling are not common... significant part of the waste, namely 70%, is disposed into seas through rivers or disposed in nature.”*²⁶

Although similar types of project activities are observed, mainly in larger cities, all of these projects are developed with VER revenue streams taken into account²⁷ and it still very early to state that the waste management technologies are well known to, and accepted by, creditors as well as investors, who still have to overcome barriers.

Another important risk factor is the complexity of determining the amount of landfill gas generated and hence the level of income from electricity generation. There are considerable margins of error connected to the estimation of gas generation, relying not only on the experience of the investigator, but also on the unpredictable behaviour of landfill gas.²⁸ A World Bank LFG workshop, investigating the performance

²⁵ The contract between IZAYDAS and Ortadoğu Enerji is available for the DOE.

²⁶ Köse, Ayaz, Köruglu 2007: Waste Management in Turkey – National Regulations and Evaluation of Implementation Results: http://www.environmental-auditing.org/Portals/0/AuditFiles/Turkey_f_eng_07Waste_Management_Report.pdf (Accessed 17/02/2010)

²⁷ Please refer to Common Practice Analysis for more detailed information on similar project activities.

²⁸ UKPS 1994: Technical Guidance Note CPE 07/94: Combined Landfill Gas and Leachate Extraction Systems <http://www.environmental-expert.com/Files%5C6283%5Carticles%5C4814%5Ccombinedlandfillgasandleachateextractionsystems.pdf> (Accessed 15/02/2010)



of LFG projects in developing countries, confirms the difficulty of correctly modelling LFG generation, due to lack in local know-how, the limited information required for the planning of a site and flaws in engineering.²⁹

Adding to the difficulty in estimating landfill gas generation is the complexity of rehabilitating an uncontrolled waste dump; the installing of the gas extraction system is marked by uncertainty; the composition of the waste beneath is often unknown, hence decomposition behaviour may strongly vary over time thus adding a lot of uncertainty to the ex-ante calculated gas generation potential.

The amount of electricity generated and sold to the grid is a major source of company income and the project's cash flow. A high level of uncertainty is connected to the prediction of landfill gas generation. The resulting uncertainty in electricity generation increases the risk of the investment from the creditors' perception.

The availability of carbon revenues plays a significant role in decreasing the risk perception of the creditors and attracting financing. The project participant was only able to obtain debt funding by demonstrating the additional revenues from VERs³⁰.

Sub-step 2b: Eliminate alternative scenarios which are prevented by identified barriers

As defined under Step 1a, two alternative scenarios to the project activity were identified as follows:

Scenario 1: Project activity including power generation from LFG without being registered as a VER project activity.

And;

Scenario 2: Atmospheric release of the LFG and electricity would have been generated by the existing grid connected power plants as continuation of the situation before the project activity.

Scenario 1 is prevented from the identified barriers as described in detail under section sub-step 2a, while Scenario 2 is not prevented since this scenario is the continuation of the current practice, and it does not require any investment.

Step 3. Investment analysis

According to the “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1, Step 3 “Investment Analysis” is only applicable if there are still several alternative scenarios remaining, including the proposed project activity undertaken without being registered as a VER project activity after step 2. Since there is only one alternative scenario left (Scenario 2) after Step 2, the investment analysis has not been conducted.

²⁹ World Bank 2007: Landfill Gas Capture; Design and Actual Performance and the Future for CDM Projects <http://siteresources.worldbank.org/INTLACREGTOPURBDEV/Resources/840343-1178120035287/EditedLFGWorkshopReportAugust14.pdf>

³⁰ Reference: Written statement from the creditor bank for the proposed project activity. The letter is available for the DOE.

Step 4: Common practice analysis

According to “Combined tool to identify the baseline scenario and demonstrate the additionality” version 03.0.1, the previous steps has to be complemented with an analysis of the extent to which the proposed project type has already diffused in the relevant sector and geographical area.

The “Guidelines on Common Practice” version 01.0 has been followed for the analysis. In line with Annex 12 of EB 63, the following definitions are applicable to the common practice analysis:

Applicable geographical area: The applicable geographical area covers the entire host country as default.

Measure: Methane destruction

Output: Electricity generation

Different technologies: different technologies are defined as technologies that deliver the same output (electricity generation to the national grid) and differ at least one of the following:

- Energy source/fuel;
- Feedstock;
- Size of installation (power capacity);
- Investment climate;
- Other features.

In line with the “Guidelines on Common Practice”, the following steps have been applied:

Step 1: The Project activity has a total licensed capacity of 2.4 MW. The applicable output range of +/- 50% is calculated as 3.6 MW and 1.2 MW.

Step 2: Within Turkey, there are 52 power plants in total that are connected to the national grid system which falls between 3.6 MW – 1.2 MW capacity range that are operational³¹. N_{all} has been defined as 52.

Step 3: Among 52 plants that represent N_{all} , there are no power plants that could be identified as similar. 51 power plants generate electricity based on non-biogas technologies such as Natural Gas, Hydro, Wind or Fuel Oil and only one power plant is based on biogas which is known as “Bel-ka”. However the “Bel-ka” facility is an auto-producer owned and operated by a municipality, which represents a different investment climate and generates electricity from the utilization of wastewater. Therefore N_{diff} has been defined as 52.

Step 4: In accordance with the “Guidelines on Common Practice”, the factor “ $F=1-N_{diff}/N_{all}$ ” has to be calculated representing the share of plants using the technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity. The factor F has been calculated as 0.

³¹ Reference: Turkish Electricity System, 10 Year Projection on Electricity Generation 2011-2020, Annex 1: Current System (by the end of 2010). <http://www.teias.gov.tr/projeksiyon/KAPASITEPROJEKSIYONU2011.pdf>



According to “Guidelines on Common Practice”, the proposed project activity is a “common practice” within the sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3. Since F is calculated as 0 and $N_{all} - N_{diff}$ is 0, it could be concluded that the proposed project activity is not common practice in Turkey.

Outcome of Step 4:

Based on the above information it is clear that there are no similar project activities in Turkey to the proposed project activity, and LFG extraction and utilization projects are not common practice or the technology is diffused in Turkey, and therefore the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The emission reductions resulting from the proposed project are calculated according to ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0.

According to the referred methodology the emission reductions are calculated with the following equation:

$$ER_y = BE_y - PE_y \quad (1)^{32}$$

Where:

ER_y	Emission reductions in year y (tCO ₂ e/year)
BE_y	Baseline emissions in year y (tCO ₂ e/year)
PE_y	Project emissions in year y (tCO ₂ e/year)

Baseline emissions

In accordance with ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, baseline emissions should comprise the following sources:

- A) Methane emissions from the SWDS in the absence of the project activity;
- B) Electricity generation using fossil fuels or supplied by the grid in the absence of project activity;
- C) Heat generation using fossil fuels in the absence of project activity; and
- D) Natural gas used from the natural gas network in the absence of the project activity.

Since there are no heat generation or natural gas usage in the baseline scenario, only baseline emissions from methane emissions from SWDS (A) and electricity generation (B) will be taken into account³³. The baseline emissions are calculated as follows:

$$BE_y = BE_{CH_4,y} + BE_{EC,y} \quad (2)^{34}$$

³² This equation is referred as (#22) under ACM0001

³³ This approach will be applied to each equation applicable.



Where:

BE_y	Baseline emissions in year y (tCO ₂ e/yr)
$BE_{CH_4,y}$	Baseline emissions of methane from SWDS in year y (tCO ₂ e/yr)
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year y (tCO ₂ eq/yr)

Step (A): Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$)

Baseline emissions of methane from the SWDS are determined as follows, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline. In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account.

$$BE_{CH_4,y} = (1 - OX_{top-layer}) * (F_{CH_4,PJ,y} - F_{CH_4,BL,y}) * GWP_{CH_4} \quad (3)^{35}$$

Where:

$BE_{CH_4,y}$	Baseline emissions of LFG from SWDS in year y (tCO ₂ e/yr)
$OX_{top-layer}$	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH_4,PJ,y}$	Amount of methane in the LFG that which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y (tCH ₄ /yr)

Step A.1: Ex-post determination of $F_{CH_4,PJ,y}$

During the crediting period $F_{CH_4,PJ,y}$ is determined as the sum of quantities of methane flared and used in power plant(s) as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y} \quad (4)^{36}$$

Where:

$F_{CH_4,PJ,y}$	Amount of methane in the LFG that which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,flared,y}$	Amount of methane in the LFG which is destroyed by flaring in year y (tCH ₄ /yr)
$F_{CH_4,EL,y}$	Amount of methane in the LFG which is used for electricity generation in year y (tCH ₄ /yr)

The working hours of the power plant(s) will be monitored.

³⁴ This equation is referred as (#1) under ACM0001

³⁵ This equation is referred as (#2) under ACM0001

³⁶ This equation is referred as (#3) under ACM0001



The amount of methane destroyed by electricity generation ($F_{CH_4,EL,y}$)

$F_{CH_4,PJ,y}$ is determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0.

The tool provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$F_{i,t}$ ³⁷	kg/h	Mass flow of greenhouse gas i (CO ₂ , CH ₄ , N ₂ O, SF ₆ or a PFC) in the gaseous stream in time interval t.

The mass flow of CH₄ in LFG is determined through measurement of the flow and volumetric fraction of the gaseous stream (LFG). The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0 provides 6 different ways to make these measurements and the corresponding calculation option for $F_{i,t}$.

Table 12 Measurement options for $F_{i,t}$

Option	Flow of Gaseous Stream	Volumetric Fraction
A	Volume flow-dry basis	Dry or wet basis
B	Volume flow-wet basis	Dry basis
C	Volume flow-wet basis	Wet basis
D	Mass flow-dry basis	Dry or wet basis
E	Mass flow-wet basis	Dry basis
F	Mass flow-wet basis	Wet basis

Option A is applied in the proposed project activity. Since option B and E have not been selected as an option, the absolute humidity of the gaseous stream will not be determined.

Option A:

According to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0, flow measurement on a dry measurement is not doable for a wet gaseous stream. Therefore it will be demonstrated that the temperature of the gaseous stream (T_1) is less than 60°C (333.15 K) at the flow measurement point.

The mass flow of CH₄ ($F_{CH_4,t}$)³⁸ is determined as follows:

$$F_{CH_4,t} = V_{t,db} * v_{CH_4,t,db} * \rho_{CH_4,t} \quad (5)^{39}$$

With

³⁷ The parameter ($F_{i,t}$) under the “Tool to determine the mass flow of a greenhouse gas in gaseous stream” corresponds to the parameter ($F_{CH_4,EL,y}$) under ACM0001.

³⁸ $F_{CH_4,t}$ described under the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” corresponds to $F_{CH_4,EL,y}$ described under ACM0001 “Flaring or use of a landfill gas”.

³⁹ This equation is referred as (#5) under the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”



$$\rho_{CH_4,t} = \frac{P_t * MM_{CH_4}}{R_u * T_t} \quad (6)^{4041}$$

Where:

$F_{CH_4,t}$	Mass flow of CH ₄ in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m ³ dry gas/h)
$V_{CH_4,t,db}$	Volumetric fraction of CH ₄ in the gaseous stream in a time interval t on a dry basis (m ³ gas CH ₄ /m ³ dry gas)
$p_{CH_4,t}$	Density of CH ₄ in the gaseous stream in time interval t (kg gas CH ₄ / m ³ gas CH ₄)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_{CH_4}	Molecular Mass of CH ₄ (kg/kmol)
R_u	Universal ideal gases content (Pa.m ³ /kmol.K)
T_t	Temperature of gaseous stream in time interval t (K)

The amount of methane destroyed by flaring ($F_{CH_4,flared,y}$)

According to ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, $F_{CH_4,flared,y}$ is determined as the difference between the amount of methane emissions from flare(s), as follows:

$$F_{CH_4,flared,y} = F_{CH_4,sent_flare,y} - \frac{PE_{flare,y}}{GWP_{CH_4}} \quad (7)^{42}$$

Where:

$F_{CH_4,flared,y}$	Amount of methane in the LFG which is destroyed by flaring in year y (tCH ₄ /yr)
$F_{CH_4,sent_flare,y}$	Amount of methane in the LFG which is sent to the flare in year y (tCH ₄ /yr)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y (tCO ₂ e/yr)
GWP_{CH_4}	Global Warming potential of CH ₄ (tCO ₂ e/tCH ₄)

In line with the requirements of ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, $F_{CH_4,sent_flare,y}$ is determined directly using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” using option A as described under the relevant tool⁴³.

In accordance with the requirements of ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, $PE_{flare,y}$ will be determined using the “Tool to determine project emissions from flaring gases containing

⁴⁰ This equation is referred as (#6) under the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”

⁴¹ Since all the parameters are converted to normal conditions during the monitoring process, $p_{CH_4,n}$ which is equal to 0.716 kg/m³ will be used for equation (5) for ex-post calculation of mass flow of CH₄ in the gaseous stream.

⁴² This equation is referred as (#4) under the ACM0001

⁴³ Since the method and equations to determine the amount of methane in the LFG which is sent to flare is the same to determine the amount of methane in the LFG which is sent to electricity generation, the procedures are not re-explained here however will be applicable. $F_{CH_4,sent_flare}$ is calculated in the same manner as parameter F_{CH_4} ,



methane”. If the LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

In line with the requirements of the “Tool to determine project emissions from flaring gases containing methane”, $PE_{flare,y}$ will be calculated as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * (GWP_{CH_4} / 1000) \quad (8)^{44}$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y (tCO ₂ e)
$TM_{RG,y}$	Mass flow rate of methane in the residual gas in hour h (kg/h)
$\eta_{flare,h}$	Flare efficiency in hour h. In line with the “Tool to determine project emissions from flaring gases containing methane” v 01, a default value of 90% will be used for the flare efficiency ⁴⁵ .
GWP_{CH_4}	Global Warming Potential of methane valid for commitment period

$TM_{RG,h}$ will be calculated as follows:

$$TM_{RG,h} = FV_{RG,h} * fv_{CH_4,RG,h} * \rho_{CH_4,n} \quad (9)^{46}$$

Where:

$TM_{RG,y}$	Mass flow rate of methane in the residual gas in hour h (kg/h)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m ³ /h).
$fv_{CH_4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour h (fraction)
$\rho_{CH_4,n}$	Density of methane at normal conditions (0.716 kg/m ³)

Step A.1.1: Ex-ante estimation of $F_{CH_4,PJ,y}$

An ex-ante estimate of $F_{CH_4,PJ,y}$ is required to estimate baseline emissions of methane from the SWDS (according to equation 3) in order to estimate the emission reductions of the proposed project activity. In accordance with ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, it is determined as follows:

$$F_{CH_4,PJ,y} = \eta_{PJ} * BE_{CH_4,SWDS,y} / GWP_{CH_4} \quad (10)^{47}$$

⁴⁴ This equation is referred as (#15) under the “Tool to determine project emissions from flaring gases containing methane”

⁴⁵ An enclosed system is used in the Project Activity.

⁴⁶ This equation is referred as (#13) under the “Tool to determine project emissions from flaring gases containing methane”

⁴⁷ This equation is referred as (#5) under ACM0001



Where:

$F_{CH_4, PJ, y}$	Amount of methane in the LFG which is flared and or used in the project activity in year y (tCH ₄ /yr)
$BE_{CH_4, SWDS, y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO ₂ e/yr)
n_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH_4}	Global Warming Potential of CH ₄ (tCO ₂ e/tCH ₄)

$BE_{CH_4, SWDS, y}$ is determined using the methodological tool “Emissions from solid disposal sites” version 06.0.0. The amount of methane generated from disposal of waste at the SWDS is calculated based on a first order decay (FOD) model. The amount of methane generated from disposal of waste at the SWDS is calculated for year y as follows⁴⁸:

$$BE_{CH_4, SWDS, y} = \varphi \cdot (1 - f) \cdot GWP_{CH_4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^y \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j}) \quad (11)^{49}$$

Where:

$BE_{CH_4, SWDS, y}$	Baseline methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (tCO ₂ e/yr)
x	Years in time period in which waste is disposed at the SWDS, extending from the first year in time period (x=1) to year y (x=y)
y	Year of the crediting period for which methane emissions are calculated
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
φ_y	Model correction factor to account for model uncertainties for year y
f_y	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH_4}	Global Warming Potential of methane
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction)
MCF_y	Methane correction factor for year y
DOC_j	Fraction of degradable organic carbon in the waste type j (weight fraction)
k_j	Decay rate for the waste type j (1/yr)
j	Type of residual waste or types of waste in the MSW

⁴⁸ The time period for the calculation starts from x=1997, when the SWDS starts receiving waste till 2019, which is the end of the first crediting period.

⁴⁹ This equation is referred as (#1) under the methodological tool “Emissions from solid waste disposal sites”

**Parameters required to apply the FOD model**

The parameters required to apply the FOD model is listed under table 13 below. The parameters are selected according to Application A as defined under the tool “Emissions from solid disposal sites” version 06.0.0, and under section B.2 “Applicability of the tool” in the PDD.

Table 13 Parameters required to apply FOD model

Parameter	Value		
φ_y	A default value of 0.75		
OX	A default value of 0.1		
F	A default value of 0.5		
$\text{DOC}_{f,y}$	A default value of 0.5		
MCF_y	A default value of 1.0		
k_j	The following values for the different waste types have been applied as a default value:		
	Waste type j		Boreal and Temperate (MAT < 20°C)
			WET(MAP/PET >1)
	Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.06
		Wood, wood products and straw	0.03
	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.10
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185
$W_{j,x}$	Estimated once. Please refer to table 14		
DOC_j	The following values for the different waste types have been applied as a default value:		
	Waste type j		DOC_i (% wet waste)
	Wood and wood products		43
	Pulp, paper and cardboard		40
	Food, food waste, beverages and tobacco		15
	Textiles		24
	Garden, yard and park waste		20
	Glass, plastic, metal, other inert		0
f_y	A default value of 0		

Determining the model correction factor (φ_y)

In line with the requirements of the tool “Emissions from solid disposal sites” version 06.0.0, a default value: $\varphi_y = \varphi_{\text{default}}$ will be used. φ_{default} is set as 0.75.

Determining the amounts of waste types j disposed in the SWDS ($W_{j,x}$)

In line with the requirements of the tool “Emissions from solid disposal sites” version 06.0.0, W_x is based on the waste characterization of Kocaeli Province⁵⁰.

Table 14 The amount of waste type j disposed in the SWDS⁵¹.

Waste Type	Fraction of the waste type
Pulp, paper, cardboard (other than sludge)	30.92%
Wood, wood products and straw	0%
Textiles	0%
Other (non-food) organic putrescible garden and park waste	2.24%
Food, food waste, sewage sludge, beverages and tobacco	38.87%
Glass, plastic, metal, other inert	27.97%

Determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$)

In line with the requirements of the tool “Emissions from solid disposal sites” version 06.0.0, a default value: $DOC_{f,y} = DOC_{f,default}$ will be used. $DOC_{f,default}$ is set as 0.5.

Procedure to determine the methane correction factor (MCF_y)

In line with the requirements of the tool “Emissions from solid disposal sites” version 06.0.0, a default value: $MCF_y = MCF_{default}$ will be used. $DOC_{f,default}$ is set as 1.0, which corresponds to anaerobic managed solid waste disposal site.

Step A.2: Determination of $F_{CH_4,BL,y}$

This step provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory requirements, or to address safety and odour concerns. ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0 provides 4 cases and corresponding instructions.

⁵⁰ Reference: Kocaeli University, Kocaeli Province Waste Characterisation Report (table 2.1 and 3.2), http://akademikpersonel.kocaeli.edu.tr/senayc/poster/senayc20.01.2010_13.55.35poster.pdf

⁵¹ Since the report provides the fraction of waste type, the $W_{j,x}$ is provided as a fraction to the total amount of waste disposed in the SWDS.

**Table 15** Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity:	Requirement to destroy methane	Existing LFG capture system
Case 1: No requirement to destroy methane exists and no existing LFG capture system	No	No
Case 2: Requirement to destroy methane exists and no existing LFG capture system	Yes	No
Case 3: No requirement to destroy methane exists and a LFG capture system exists	No	Yes
Case 4: Requirement to destroy methane exists and LFG capture system exists	Yes	Yes

The situation at the start of the project activity falls under case 1 since there are no legal requirements in Turkey to destroy methane and the LFG was not captured prior to the proposed project activity. Therefore:

$$F_{CH_4,BL,y}=0$$

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

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) is calculated in accordance with the “Tool to calculate baseline, project and leakage emissions from electricity consumption” version 1. The electricity source k in the tool corresponds to the sources of electricity generated by the grid, which is identified as the most plausible baseline scenario. $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y .

Generic approach

In the generic approach, baseline emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$BE_{EC,y} = \sum_k EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y}) \quad (12)^{52}$$

Where:

$BE_{EC,y}$ Baseline emissions from electricity consumption in year y (tCO₂e/yr)

⁵² This equation is referred as (#2) under the “Tool to calculate baseline, project and leakage emissions from electricity consumption”



$EC_{BL,k,y}$	Net amount of electricity generated using LFG in year y (MWh/yr)
$EF_{EL,k,y}$	Emission factor for electricity generation source k in year y ((tCO ₂ e/MWh)
$TDL_{k,y}$	Average technical and transmission and distribution losses for providing electricity to source k in year y
k	the sources of electricity generated by the grid

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

The emission factor for the electricity generation $EF_{EL,k,y}$ will be determined in accordance with Scenario A (Electricity consumption from the grid) as defined under the “Tool to calculate baseline, project and leakage emissions from electricity consumption” version 1 and as described under section B.2 “Applicability of the tool” of the PDD.

According to the tool, the project participants can either calculate the combined margin emission factor of the applicable electricity system (Option A1), or could use conservative default values (Option A2). The project participant chooses Option A1, which the combined margin emission factor of the applicable electricity system will be calculated using the procedures in the “Tool to calculate the emission factor for an electricity system” version 2.2.1, ($EF_{EL,k,y}=EF_{grid,CM,y}$).

This tool provides the following steps to calculate combined margin (CM) emission factor:

- Step 1. Identify the relevant electric systems;
- Step 2. Choose whether to include off-grid power plants in the project electricity system (optional);
- Step 3. Select an operating margin (OM) method;
- Step 4. Calculate the operating margin emission factor according to the selected method;
- Step 5. Calculate the build margin (BM) emission factor.
- Step 6. Calculate the combined margin (CM) emissions factor.

Step 1. Identification of the relevant electric power system

According to the “Tool to calculate the emission factor for an electricity system” (version 02.2.1), a project electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

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

The transmission lines in Turkey are operated by TEİAŞ (Turkish Electricity Transmission CO), which is a state owned company. The grid is 48,971 km long and constitutes of 606 transformer stations with a total transformer capacity of 98,852 MVA and 10 interconnections to neighbour countries⁵³. The interconnected grid system is operated continuously and there are no electricity price differences

⁵³ In compliance with the requirements of the applicable tool, the emission factor from neighbouring countries is considered 0 tCO₂e/MWh for determining the OM.



throughout the regions⁵⁴. Therefore the relevant electric power system is defined as the national grid system of Turkey.

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

According to the applicable tool, Project Participants may choose between the following two options to calculate the operating margin and build margin emission factor:

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

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

The Project Participant chooses Option I and therefore only grid power plants are included in the calculation.

Step 3. Selection of an operating margin (OM) method

According to the applicable methodological tool, the operating margin emission factor ($EF_{grid, OM, y}$) is based on one of the following methods:

- a) Simple OM; or
- b) Simple adjusted OM; or
- c) Dispatch data analysis OM; or
- d) Average OM.

Options b) and c) are not selected since there is no data available for these options. Option d) is not selected since low-cost/must-run resources do not constitute more than 50% of total grid generation. According to the tool, Simple OM can only be if low-cost/must-run resources constitute less than 50% of total grid generation. The low-cost/must-run resources include hydro, geothermal, wind, low-cost biomass, nuclear, and solar power generation.

The share of the installed capacity of renewable energy sources excluding hydro power is 1.9% of the total electricity generation and is therefore not taken into consideration. There is no indication that coal is used as a must-run and no nuclear energy plants are located in Turkey. That leaves hydro power as the only relevant low-cost must run source for electricity. The electricity generation from hydro power is 24% of the total electricity generation. Therefore the requirements for the use of the Simple OM calculations are satisfied.

⁵⁴ Reference: TEİAŞ (Turkish Electricity Transmission Co) official webpage <http://www.teias.gov.tr/>

**Table 16** Breakdown by sources of the electricity generation from the Turkish grid, 2010⁵⁵

Power plants by fuel type	2010 Generation	
	Generation (MWh)	Share (%)
Natural Gas	98,143,700	46.5
Coal	55,046,400	26
Hydro power	51,795,500	24.5
Fuel Oil	2,180,000	1.1
Geothermal + Wind	3,584,600	1.9
Other Renewable	457,500	0.02
Total	211,207,700	100

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

- **Ex-ante option:** If the *ex-ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants a 3-year generation-weighted average, based on the most recent data available at the time of submission of the VER-PDD to the DOE for validation.
- **Ex post option:** If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

For the proposed project activity the *ex-ante* option is selected. Data for calculating the three year average is obtained from the period 2008 – 2010 which are the most recent data available at the time of submission of the PDD to DOE.⁵⁶

Step 4. Calculating the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂e/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit; or
 Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

As the fuel consumption and the average efficiency data for each power plant / unit is not available Option B is used for simple OM calculation.⁵⁷

⁵⁵ Reference: TEİAŞ (Turkish Electricity Transmission Co) official webpage
[http://www.teias.gov.tr/istatistik2010/front%20page%202010-%C3%A7i%C3%A7ek%20kitap/uretim%20tuketim\(22-45\)/35\(75-10\).xls](http://www.teias.gov.tr/istatistik2010/front%20page%202010-%C3%A7i%C3%A7ek%20kitap/uretim%20tuketim(22-45)/35(75-10).xls)

⁵⁶ The index “y” in the equations refers to the years 2008-2010 to calculate the emission factor ex-ante.

⁵⁷ There are no nuclear power plants in Turkey and the share of the renewable energy is very small.

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

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

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (13)^{58}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$FC_{i,y}$	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO_2,i,y}$	CO ₂ emission factor of fossil fuel type i in year y (tCO ₂ /GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must run power plants/units, in year y (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y
y	The three most recent years for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option)

For this approach (simple OM) to calculate the operating margin, subscript m refers to the power plants/units delivering electricity to the grid, not including low-cost/must run power plants/units, and including electricity imports to the grid.

Step5. Calculation of the build margin emission factor

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

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

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up at the latest year for which

⁵⁸ This equation is referred as (#2) under the “Tool to calculate the emission factor for an electricity system”



information is available. For the second crediting period, the built margin emission factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the built margin emission factor calculated for the second crediting period should be used.

For the proposed project activity the Project Participant chooses Option 1 in terms of vintage of data.

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

- (a) Identify the set of five power units, excluding power units registered as VER project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET_{5-units}}$, in MWh).
- (b) Determine the annual electricity generation of the project electricity system, excluding power units registered as VER project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as VER project activities, that started to supply electricity to the grid most recently and that comprise 20% of total AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{>20\%}$) and determine their annual electricity generation ($AEG_{SET_{>20\%}}$, in MWh);
- (c) From $SET_{5-units}$ and $SET_{>20\%}$ select the set of power units that comprise the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use the SET_{sample} to calculate the build margin.

The most recent information available belongs to 2010 and based on TEİAŞ statistics which is the official information source for the grid⁵⁹. According to TEİAŞ figure, the annual electricity generation of the project electricity system excluding power units registered as VER project activities (AEG_{total}) is 211,207,700 MWh. Based on the AEG_{total} , the set of power units, excluding power units registered as VER project activities, that started to supply electricity to the grid most recently and that comprise 20% of total AEG_{total} , have been defined and the $AEG_{SET_{>20\%}}$ is determined as 42,241,540 MWh⁶⁰ and includes 267 units of power plants under $SET_{>20\%}$. Without the need of any further assessment it can be concluded that the $SET_{5-units} \ll SET_{>20\%}$ and therefore the $SET_{>20\%}$ is selected as SET_{sample} ⁶¹ for the calculation of the build margin (BM)⁶².

⁵⁹ Reference: www.teias.gov.tr

⁶⁰ Reference: Turkish Electricity Transmission Company / <http://www.teias.gov.tr/istatistikler.htm>; year 2009-2008-2007-2006.

⁶¹ None of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago.

⁶² Please refer to Annex 3 of the PDD for more detailed information on SET_{sample} .



The built margin (BM) emission factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units *m* during the most recent year *y* for which power generation data is available⁶³, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (14)^{64}$$

Where:

$EF_{grid,BM,y}$	Build margin CO ₂ emissions factor in year <i>y</i> (tCO ₂ /MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit <i>m</i> in year <i>y</i> (MWh)
$EF_{EL,m,y}$	CO ₂ emission factor of the power unit <i>m</i> in year <i>y</i> (tCO ₂ /MWh)
<i>m</i>	Power units included in the build margin
<i>y</i>	Most recent historical year for which power generation data is available

As per the “Tool to calculate the emission factor for an electricity system” (version 02.2.0), the CO₂ emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance from the tool in step 4 for simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which power generation data is available, where *m* is the power units included in the build margin.

As plant specific fuel consumption data is not available for Turkey, option A2 has been selected for the calculation of the CO₂ emission factor of each power unit *m* ($EF_{EL,m,y}$) as follows:

$$EF_{EL,m,y} = \frac{EF_{CO_2,i,y} \cdot 3.6}{\eta_{m,y}} \quad (15)^{65}$$

Where:

$EF_{EL,m,y}$	CO ₂ emission factor of the power unit <i>m</i> in year <i>y</i> (tCO ₂ /MWh)
$EF_{CO_2,m,i,y}$	Average CO ₂ emission factor of fuel type <i>i</i> used in power unit <i>m</i> in year <i>y</i> (tCO ₂ /GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit <i>m</i> in year <i>y</i> (ratio)
<i>m</i>	All power units serving the grid in year <i>y</i> except low-cost/must-run power units
<i>y</i>	The most recent year for which power generation data is available at the time of submission of the VER-PDD to the DOE for validation (ex-ante option)

Where several fuel types are used in the power unit, the lowest CO₂ emission factor for $EF_{CO_2,m,i,y}$ has been used.

⁶³ The most recent year for which power generation data is available is 2010. Reference: TEİAŞ Generation and Transmission Statistics www.teias.gov.tr

⁶⁴ This equation is referred as (#12) under the “Tool to calculate the emission factor for an electricity system”

⁶⁵ This equation is referred as (#3) under the “Tool to calculate the emission factor for an electricity system”

**Step 6. Calculation of the combined margin emission factor**

According to the applicable methodological tool, the calculation of the combined margin (CM) emission factor ($EF_{grid,CM}$) is based on one of the following methods:

- (a) Weighted average CM; or
- (b) Simplified CM.

In line with the requirements of the applicable tool, the Project Participant chooses option (a), weighted average CM.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad (16)^{66}$$

Where:

$EF_{grid,CM,y}$	Combined Margin emission factor (tCO ₂ /MWh)
$EF_{grid,OM,y}$	Operating margin emission factor (tCO ₂ /MWh)
$EF_{grid,BM,y}$	Build margin emission factor (tCO ₂ /MWh)
w_{OM}	Weight of the operating margin emission factor
w_{BM}	Weight of the build margin emission factor

As stated in the “Tool to calculate the emission factor for an electricity system” (version 02.2.0), the default weights for the operating margin and build margin emission factors for the proposed project activity type is defined as:

$$w_{OM}=0.5$$

$$w_{BM}=0.5$$

for the first crediting period and for subsequent crediting periods.

Changes required for the methodology implementation in 2nd and 3rd crediting periods

At the start of the second and third crediting period the Project Proponents will address two issues as required by the applicable methodology:

- Assess the continued validity of the baseline; and
- Update the baseline as defined above

Project Emissions

In accordance with ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, the project emissions are calculated as follows:

$$PE_y = PE_{EC,y} \quad (17)^{67}$$

⁶⁶ This equation is referred as (#13) under the “Tool to calculate the emission factor for an electricity system”



Where:

$PE_{EC,y}$ Emission from consumption of electricity due to the project activity in year y (tCO₂e/yr).

Since there are no consumption of fossil fuels due to the project activity, for the purpose other than electricity generation, there are no emissions from fossil fuel consumption and therefore $PE_{FC,y}$ is equal to “0” and has not been included in equation (17).

The project emissions from consumption of electricity by the project activity $PE_{EC,y}$ shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1. When applying the tool, electricity sources j in the tool corresponds to the sources of electricity consumed due to the project activity.

$PE_{EC,y}$ is calculated as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad (18)^{68}$$

Where:

$PE_{EC,y}$ Project emissions from electricity consumption in year y (tCO₂e/year)
 $EC_{PJ,y}$ Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/year)
 $EF_{EL,j,y}$ Emission factor for electricity generation for source j in year y (tCO₂e/MWh)
 $TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to source j in year y

The combined margin emission factor of the applicable electricity system, has been determined as emission factor for the electricity system ($EF_{EL,j,y}$), in line with Option A1 of scenario A (Electricity consumption from grid) under the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 1.

Leakage

In accordance with ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, no leakage effects are accounted.

⁶⁷ This equation is referred as (#21) under ACM0001

⁶⁸ This equation is referred as (#1) under “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”

**B.6.2. Data and parameters that are available at validation:**

Data and parameters under ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, that are available at validation and not monitored:

Data / Parameter:	ID.1 / $OX_{top\ layer}$
Data unit:	Dimensionless
Description:	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data used:	Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites”
Value applied:	0.1
Any comment:	Applicable to Step A defined under ACM0001

Data / Parameter:	ID.2 / GWP_{CH_4}
Data unit:	tCO ₂ e/tCH ₄
Description:	Global Warming Potential of CH ₄
Source of data used:	IPCC
Value applied:	21 for the first commitment period. Shall be updated accordingly to any future COP/MOP decision.
Any comment:	-

Data / Parameter:	ID.3 / n_{PJ}
Data unit:	Dimensionless
Description:	Efficiency of the LFG capture system that will be installed in the project activity
Source of data used:	-
Value applied:	Technical specifications of the LFG capture system to be installed (if available) or a default value of 50%
Any comment:	Applicable to Step A.1.1 defined under ACM0001

Data and parameters under the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0, that are available at validation and not monitored:

Data / Parameter:	ID.4 / R_u
Data unit:	Pa.m ³ /kmol.K
Description:	Universal ideal gases constant
Value to be applied:	8,314
Any comment:	-



Data / Parameter:	ID.5 / MM _{CH4}		
Data unit:	kg/kmol		
Description:	Molecular mass of CH ₄		
Value to be applied:			
	Compound	Structure	Molecular mass (kg/kmol(
	Methane	CH ₄	16.04
Any comment:	-		

Data and parameters under the “Tool to determine project emissions from flaring gases containing methane” that are available at validation and not monitored:

Data / Parameter:	ID.6 / $n_{flare,h}$
Data unit:	-
Description:	Flare efficiency in hour h
Value to be applied:	0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour h. 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 40 minutes during the hour h, but the manufacturers specifications on proper operation of the flare are not met at any point in time during the hour h. 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour h and the manufacturers specifications on proper operation of the flare are met continuously in during the hour h.
Any comment:	An enclosed flare system will be used in the proposed project activity.

Data / Parameter:	ID.7 / $p_{CH_4,n}$
Data unit:	kg/m ³
Description:	Density of methane under normal conditions
Value to be applied:	0.716
Any comment:	-

Data and parameters under the tool “Emissions from solid disposal sites” version 06.0.0, that are available at validation and not monitored:

Data / Parameter:	ID.8 / $\phi_{default}$
Data unit:	-
Description:	Default value for the model correction factor to account for model uncertainties
Source of data:	-
Value to be applied:	0.75
Any comment:	The proposed project activity falls under Application A



Data / Parameter:	ID.9 / OX
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data:	Based on extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.1
Any comment:	-

Data / Parameter:	ID.10 / F
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Any comment:	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data / Parameter:	ID.11 / DOC_{f,default}
Data unit:	Weight fraction
Description:	Default value for the fraction of degradable organic carbon (DOC) in MSW that can decompose in the SWDS
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Any comment:	The proposed project activity falls under Application A

Data / Parameter:	ID.12 / MCF_{default}
Data unit:	-
Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	1
Any comment:	The baseline falls under the definition “anaerobic managed solid waste disposal site

Data / Parameter:	ID.13 / DOC_i										
Data unit:	-										
Description:	Fraction of degradable organic carbon in waste type j (weight fraction)										
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4 and Table 2.5)										
Value to be applied:	The following values for the different waste types have been applied: <table border="1"> <thead> <tr> <th>Waste type j</th><th>DOC_i (% wet waste)</th></tr> </thead> <tbody> <tr> <td>Wood and wood products</td><td>43</td></tr> <tr> <td>Pulp, paper and cardboard</td><td>40</td></tr> <tr> <td>Food, food waste, beverages and tobacco</td><td>15</td></tr> <tr> <td>Textiles</td><td>24</td></tr> </tbody> </table>	Waste type j	DOC _i (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard	40	Food, food waste, beverages and tobacco	15	Textiles	24
Waste type j	DOC _i (% wet waste)										
Wood and wood products	43										
Pulp, paper and cardboard	40										
Food, food waste, beverages and tobacco	15										
Textiles	24										



	Garden, yard and park waste	20
	Glass, plastic, metal, other inert	0
Any comment:	-	

Data / Parameter:	ID.14 / k_j																
Data unit:	1/yr																
Description:	Decay rate for the waste type j																
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 5, Table 3.3)																
Value to be applied:	The following values for the different waste types have been applied: <table> <tr> <th colspan="2" rowspan="2">Waste type j</th><th>Boreal and Temperate (MAT < 20°C)</th></tr> <tr> <th>WET(MAP/PET >1)</th></tr> <tr> <td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard</td><td>0.06</td></tr> <tr> <td>Wood, wood products and straw</td><td>0.03</td></tr> <tr> <td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.10</td></tr> <tr> <td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.185</td></tr> </table>		Waste type j		Boreal and Temperate (MAT < 20°C)	WET(MAP/PET >1)	Slowly degrading	Pulp, paper, cardboard	0.06	Wood, wood products and straw	0.03	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.10	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185
Waste type j		Boreal and Temperate (MAT < 20°C)															
		WET(MAP/PET >1)															
Slowly degrading	Pulp, paper, cardboard	0.06															
	Wood, wood products and straw	0.03															
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.10															
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185															
Any comment:	According to the latest available report on Kocaeli Provincial Environment Annual Report (2006) ⁶⁹ the Mean Annual Temperature (MAT) is 15.1°C (p89 table C.4 2004); Mean Annual Precipitation (MAP) is 798.6 mm (p90 table C.6 2004) and Potential Evapotranspiration (PET) is 15.2 mm (p90 table C.5 2004).																

⁶⁹ Reference: http://www2.cedgm.gov.tr/icd_raporlari/kocaeliicd2006.pdf



Data and parameters under the “Tool to calculate the emission factor for an electricity system” version 02.2.1, that are available at validation and not monitored:

Data/ Parameter:	ID.15 / EG_{gross}
Data unit:	MWh
Description:	Gross electricity production by fossil fuel power sources (2008-2010)
Source of data used:	TEIAS (Turkish Electricity Transmission Company) www.teis.gov.tr The distribution of gross electricity generation by primary energy resources and the electricity utilities in Turkey (2008, 2009, 2010). www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2010/front%20page%202010-%C3%A7i%C3%A7ek%20kitap/uretim%20tuketim(22-45)/35(75-10).xls
Value applied:	See calculations of emission factor (B.6.1)
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to “Turkish Statistics Law and Official Statistics Program” ⁷⁰ TEIAS, the Turkish Electricity Transmission Company is the official source for the related data, hence providing the most up-to-date and accurate information available.
Any comment:	The average correction factor between gross/net generation is 95.8%. Its determination is presented in the Ex-ante calculation sheets.

Data/ Parameter:	ID.16 / FC_{iv}
Data unit:	m ³ / tonnes (m ³ for gaseous fuels)
Description:	Amount of fossil fuel type i consumed in the project electricity system by generation sources in year y (2008-2010)
Source of data used:	TEIAS (Turkish Electricity Transmission Company) www.teis.gov.tr Fuels consumed in thermal power plants in Turkey by the electricity utilities (2008-2010)
Value applied:	See calculations of emission factor (B.6.1)
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to “Turkish Statistics Law and Official Statistics Program” TEIAS, the Turkish Electricity Transmission Company is the official source for the related data, hence providing the most up-to-date and accurate information available.
Any comment:	-

⁷⁰ TEIAS 2005: <http://rega.basbakanlik.gov.tr/Eskiler/2005/11/20051118-1.htm>



Data/ Parameter:	ID.17 / $NCV_{i,y}$
Data unit:	GJ/tonnes (m^3 for gaseous fuels)
Description:	Net calorific value (energy content) of fossil fuel type i in year y
Source of data used:	Calculated based on TEIAS (Turkish Electricity Transmission Company) www.teis.gov.tr Heating values of fuels consumed in thermal plants in Turkey by the electricity utilities (2008-2010)
Value applied:	See calculations of emission factor (B.6.1)
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to “Turkish Statistics Law and Official Statistics Program” TEIAS, Turkish Electricity Transmission Company is the official source for the related data, hence providing the most up-to-date and accurate information available
Any comment:	-

Data/ Parameter:	ID.18 / $EF_{CO_2,i,y}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of fossil fuel type i used in power unit min year y
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Volume 2 (Energy) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventory http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm
Value applied:	See calculations of emission factor (B.6.1)
Justification of the choice of data or description of measurement methods and procedures actually applied:	There is no information on the fuel specific default emission factor in Turkey, hence, IPCC values has been used as referred in the “Tool to calculate the emission factor for an electricity system (version 2.2)”.
Any comment:	-

Data/ Parameter:	ID.19 / $EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated by power plant/unit m
Source of data used:	TEIAS (Turkish Electricity Transmission Company) www.teis.gov.tr Generation units put into operation in 2008; 2009; 2010
Value applied:	Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period using the most recent three historical years for which the data is available at the time of submission of the PDD to the DOE for validation.



Any comment:	-
Data/ Parameter:	ID.20 / $\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data used:	“Environmental Map” published by Environmental Inventory Head Department under Ministry of Environment and Forestry / http://www.cedgm.gov.tr/CED/Files/cevreatlas%C4%B1/atlas_metni.pdf (p.197 table X.3.1; Thermal Plants and Environment)
Value applied:	See calculations of emission factor (B.6.1)
Justification of the choice of data or description of measurement methods and procedures actually applied:	The average values of thermal plants in Turkey are taken from the report “Environmental Map” published by the Ministry of Environment and Forestry.
Any comment:	-

B.6.3. Ex-ante calculation of emission reductions:

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The ex-ante emission reductions are calculated using the formulas as described under section B.6.1. In the following section, the assumptions made and the results from the calculations are presented⁷¹.

Emission Reductions

Emission reductions are calculated through equation (1):

Table 17 Emission reductions of the proposed project activity

Year	Parameter		
	ER _y (tCO ₂ e/yr)	BE _y (tCO ₂ e/yr)	PE _y (tCO ₂ e/yr)
2012	88,869	88,884	15
2013	94,269	94,283	15
2014	99,196	99,210	15
2015	103,692	103,707	15
2016	93,056	93,071	15
2017	83,799	83,813	15
2018	75,713	75,728	15
2019	68,625	68,640	15

Baseline emissions

Baseline emissions are calculated through equation (2):

⁷¹ As a general approach; the starting date of the crediting period has not been taken into account under this section.

**Table 18** Baseline emissions of the proposed project activity

Year	Parameter		
	BE _v (tCO ₂ e/yr)	BE _{CH₄,v} (tCO ₂ e/yr)	BE _{EC,v} (tCO ₂ e/yr)
2012	88,884	80,868	8,016
2013	94,283	85,749	8,535
2014	99,210	90,160	9,050
2015	103,707	94,161	9,546
2016	93,071	84,170	8,901
2017	83,813	75,514	8,299
2018	75,728	67,990	7,738
2019	68,640	61,425	7,215

Baseline emissions of methane from SWDS

Baseline emissions of methane from SWDS are calculated through equation (3). A default value of 0.1 has been applied for $OX_{top-layer}$ and 21 for GWP_{CH_4} within the calculation.

Table 19 Baseline emissions of methane from SWDS

Year	Parameter		
	BE _{CH₄} (tCO ₂ /yr)	FE _{CH₄,PJ,y} (tCH ₄ /yr)	F _{CH₄,BL,y} (tCH ₄ /yr)
2012	80,868	4,279	0
2013	85,749	4,537	0
2014	90,160	4,770	0
2015	94,161	4,982	0
2016	84,170	4,453	0
2017	75,514	3,995	0
2018	67,990	3,597	0
2019	61,425	3,250	0

Amount of methane in the LFG which is flared and or used in the project activity

Amount of methane in the LFG which is flared and or used in the project activity in year y has been estimated ex-ante through FOD model and equation (13). The following default values have been applied to the FOD model:

Table 20 Default values for FOD

ϕ_y	0.75		
OX	0.1		
F	0.5		
DOC _{f,y}	0.5		
MCF _y	1.0		
k _j	Waste type j		Boreal and Temperate (MAT < 20°C)
			WET(MAP/PET >1)
	∞ –	Pulp, paper, cardboard	0.06



		Wood, wood products and straw	0.03															
	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.10															
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185															
DOC _j	<table><tr><th>Waste type j</th><th>DOC_i (% wet waste)</th></tr><tr><td>Wood and wood products</td><td>43</td></tr><tr><td>Pulp, paper and cardboard</td><td>40</td></tr><tr><td>Food, food waste, beverages and tobacco</td><td>15</td></tr><tr><td>Textiles</td><td>24</td></tr><tr><td>Garden, yard and park waste</td><td>20</td></tr><tr><td>Glass, plastic, metal, other inert</td><td>0</td></tr></table>				Waste type j	DOC _i (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard	40	Food, food waste, beverages and tobacco	15	Textiles	24	Garden, yard and park waste	20	Glass, plastic, metal, other inert	0
Waste type j	DOC _i (% wet waste)																	
Wood and wood products	43																	
Pulp, paper and cardboard	40																	
Food, food waste, beverages and tobacco	15																	
Textiles	24																	
Garden, yard and park waste	20																	
Glass, plastic, metal, other inert	0																	
f _v	0																	
n _{PJ}	50%																	

Amount of solid waste type j disposed or prevented from disposal in the SWDS.

Table 21 Fraction of solid waste type j disposed or prevented from disposal in the SWDS

Waste Type	Fraction (%)
Pulp, paper, cardboard (other than sludge)	30.92%
Wood, wood products and straw	0%
Textiles	0%
Other (non-food) organic putrescible garden and park waste	2.24%
Food, food waste, sewage sludge, beverages and tobacco	38.87%
Glass, plastic, metal, other inert	27.97%

The total amount of waste disposed to the SWDS between 1997 - 2019 has been estimated based on the data provided from IZAYDAŞ as follows:

Table 22 Total amount of waste disposed to the SWDS 1997-2019

Year	W _x (tons)
1997	51,100
1998	152,570
1999	164,250
2000	188,340
2001	183,595



2002	183,960
2003	180,310
2004	220,095
2005	259,880
2006	270,830
2007	273,750
2008	285,795
2009	331,055
2010	365,000 ⁷²
2011	365,000
2012	365,000
2013	365,000
2014	365,000
2015	365,000
2016 ⁷³	0
2017	0
2018	0
2019	0

Based on the above parameters the amount of methane in the LFG which is flared and or used in the project activity in year y has been estimated ex-ante as follows:

Table 23 The amount of methane in the LFG which is flared and or used

Year	FE _{CH₄,PJ,y} (tCH ₄ /yr)
2012	4,279
2013	4,537
2014	4,770
2015	4,982
2016	4,453
2017	3,995
2018	3,597
2019	3,250

Baseline emissions associated with electricity generation

Baseline emissions associated with electricity generation are calculated through equation (15). The amount of estimated electricity generation has been based on the technical feasibility study⁷⁴.

⁷² The data obtained from IZAYDAŞ only covers years between 1997 and 2010. For years after 2010 it is assumed that the SWDS will continue to receive 365,000 ton/year MSW till 2015.

⁷³ There will be no waste dumping to the waste lots that falls under the project activity after 2016.

⁷⁴ Technical feasibility study is available to the DOE.

**Table 24** Baseline emissions associated with electricity generation

Year	Parameter			
	$BE_{EL,PJ,y}$ (tCO ₂ /yr)	$EC_{BL,y}$ (MWh)	$EF_{EL,y}$ (tCO ₂ e/MWh)	TDL_y (%)
2012	8,016	13,193	0.602	1%
2013	8,535	14,047	0.602	1%
2014	9,050	14,895	0.602	1%
2015	9,546	15,712	0.602	1%
2016	8,916	14,650	0.602	1%
2017	8,299	13,659	0.602	1%
2018	7,738	12,736	0.602	1%
2019	7,215	11,875	0.602	1%

Determination of the emission factor for electricity generation***Calculating the operating margin emission factor:***

The simple operating margin CO₂ emission factor is calculated as per equation (13).

For the calculation of the Simple OM, the amount of fuel consumption ($FC_{i,y}$) is taken from website of TEIAS, which is the official source of related data. The fuel consumption values for relevant years are as follows:

Table25 Fuel consumption of generation sources connected to the grid (2008-2010)

$FC_{i,y}$					
	Units	2008	2009	2010	Total
Natural Gas	1000m ³	21,607,635	20,978,040	21,783,414	64,369,089
Lignite	tonnes	66,374,120	63,620,518	56,689,392	186,684,030
Coal	tonnes	6,270,008	6,621,177	7,419,703	20,310,888
Fuel Oil	tonnes	2,315,183	1,783,366	925,276	5,023,825

Turkish specific net calorific values ($NCV_{i,y}$) values for fossil fuel types have been calculated, however, data from the IPCC Guidelines for National Greenhouse Gas Inventory have been used as the source of data for the emission factor of the fossil fuel types ($EF_{CO_2,i,y}$).

The NCV and emission factors are as follows:

Table26 NCV and emission factor of fossil fuel type

	NCV_i (GJ/tonnes)			$EF_{CO_2,i}$ (tonnes/GJ)
	2008	2009	2010	
Natural Gas	36.634	37.177	37.382	0,0543
Lignite	6.827	6.427	7.131	0,0909
Coal	22.244	22.215	22.316	0,946
Fuel Oil	39.874	40.091	40.201	0,726

The electricity delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units ($EG_{gross,y}$) is obtained from TEIAS (Turkish Electricity Transmission



Company). The following table shows the gross electricity production for 2008-2010 produced by fossil fuel power sources.

Table 27 Gross electricity generation by fossil fuel power sources 2008-2010

	EG _{gross,y} (MWh)			
	2008	2009	2010	Total
Natural Gas	98,685,300	96,094,700	98,143,700	292,923,700
Lignite	41,858,100	39,089,500	35,942,100	116,889,700
Coal	15,857,500	16,595,600	19,104,300	51,557,400
Fuel Oil	7,518,500	4,803,500	2,180,000	14,502,000

The gross electricity production includes the electricity consumption of the power plants. To be able to calculate the net electricity fed into the grid by specific fuel sources, an average correction factor had to be calculated from the overall gross/net electricity generation data. This relation is derived in the following table.

Table 28 Relation between net and gross electricity generation 2007-2009

	2007	2008	2009
Gross generation [MWh]	191,558,000	198,418,000	194,812,900
Net generation [MWh]	183,339,000	189,761,000	186,619,300
Relation	95.7%	95.6%	95.8%
Average correction factor	95.7%		

The net electricity delivered to the grid by the fossil fuel plants (EG_{net,y}) is calculated in Table 29. The calculation of EF_{grid,OM,y} requires the inclusion of electricity imports with an emission factor of 0 tCO₂/GWh. By including the imports in the electricity production this requirement is fulfilled.

Table 29 Net electricity generation by fossil fuel power plants and electricity imports 2008-2010

		2008	2009	2010	Total
Net electricity production EG _{net,y} (MWh)	Natural Gas	94,454,712	91,975,170	93,936,330	280,366,211
	Lignite	40,063,665	37,413,753	34,401,281	11,878,699
	Coal	15,177,697	15,884,155	18,285,308	49,347,161
	Fuel Oil	7,196,186	4,597,576	2,086,545	13,880,307
Electricity imports		789,400	812,000	1,143,800	2,745,200
Electricity supplied to grid EG _y		157,681,659	150,682,654	149,853,264	458,217,577

Based on the above values, the simple operating margin CO₂ grid emission factor (EF_{grid,OMsimple,y}) calculated through Equation 13 is 0.659 tCO₂/MWh.

Calculating the build margin emission factor

The average CO₂ emission factor of fuel types (EF_{CO₂,m}) and the average net energy conversion efficiency of the power plants (η_{m,y}) used for the calculation of emission factor of the power units (EF_{EL,m,y}) through equation 15 are presented in the below table.

**Table 30** Emission factor of the power units

	Average emission factor $EF_{CO_2,m,i,y}$ (tCO ₂ /GJ)	Average conversion efficiency $\eta_{m,y}$	Emission factor of the power unit $EF_{EL,m,y}$ (tCO ₂ /MWh)
Natural Gas	0,0543	45.97%	0.425
Lignite	0,0909	32.68%	1.001
Coal	0,946	33.57%	1.014
Fuel Oil	0,726	33.19%	0.788
Hydro	n.a.	n.a.	0
Wind	n.a.	n.a.	0

The data on the electricity generated and delivered to the grid by power units ($EG_{m,y}$) are presented in the below table.

Table 31 Electricity generated by the power units included in the build margin calculation

$EG_{m,y}$ (MWh)			
	2009	2010	Total
Natural Gas	13,602,509	12,857,417	26,459,926
Lignite	3,000	155,593	158,593
Coal	1,923,333	9,080,000	11,033,333
Fuel Oil	4,331,777	258,824	4,590,601
Hydro	1,402,961	2,559,322	3,962,283
Other renewable	1,189,986	870,485	1,965,471
Total	22,453,566	25,781,641	48,140,207

The build margin emission factor $EF_{grid,BM,y}$ calculated through equation 14 is 0.544 tCO₂/MWh.

Calculating the combined margin emission factor

The combined margin emission factor $EF_{grid,CM,y}$ calculated through equation 16 is 0.602 tCO₂/MWh.

Project Emissions

The project emissions of the proposed project activity are calculated through equation 17 and 18. For ex-ante purposes the electricity consumption of the proposed project activity is estimated to be approximately 24 MWh/yr.

Table 32 Project emissions from electricity consumption

Year	Parameter			
	$PE_{EC,y}$ (tCO ₂ /yr)	$EC_{PJ,y}$ (MWh)	$EF_{EL,y}$ (tCO ₂ e/MWh)	TDL _y (%)
2012	15	24	0.602	1%
2013	15	24	0.602	1%
2014	15	24	0.602	1%
2015	15	24	0.602	1%
2016	15	24	0.602	1%



2017	15	24	0.602	1%
2018	15	24	0.602	1%
2019	15	24	0.602	1%

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Table 33 Ex-ante estimation of emission reductions

Years	Estimation of project activity emissions (tCO ₂ e)	Estimation of baseline emissions (tCO ₂ e)	Estimation of leakage emissions (tCO ₂ e)	Estimation of overall emission reductions(tCO ₂ e)
2012 ⁷⁵	12	74,070	0	74,058
2013	15	94,283	0	94,269
2014	15	99,210	0	99,196
2015	15	103,707	0	103,692
2016	15	93,071	0	93,056
2017	15	83,813	0	83,799
2018	15	75,728	0	75,713
2019 ⁷⁶	2	11,440	0	11,438
Number of crediting years	7			
Annual average over the crediting period (tCO₂e/y)	90,746			

⁷⁵ The figure for 2012 has been adjusted according to the starting date of the crediting period 01.03.2012

⁷⁶ The figure for 2019 has been adjusted according to the end of first crediting period 28.02.2019

**B.7. Application of the monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

Data and parameters under ACM0001 “Flaring or Use of Landfill Gas” version 12.0.0, that are monitored:

Data / Parameter:	ID.22 / Operation of the energy plant
Data unit:	Hr
Description:	Operation of the energy plant
Source of data:	Project participant
Measurement procedures (if any):	Each engine will have an own internal counting device. The data will be aggregated annually.
Monitoring frequency:	Hourly
QA/QC procedures:	-
Any comment:	Applicable to step A.1. This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational

Data and parameters under the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0, that are monitored:

Data / Parameter:	ID.23 / $V_{t,db}$
Data unit:	m ³ dry gas/h
Description:	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data:	-
Measurement procedures (if any):	
Monitoring frequency:	Continuous
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer’s specifications.
Any comment:	-

Data / Parameter:	ID.24 / $v_{CH_4,t,db}$
Data unit:	m ³ gas CH ₄ / m ³ dry gas
Description:	Volumetric fraction of CH ₄ in a time interval t on a dry basis
Source of data:	-
Measurement procedures (if any):	Continuous gas analyzer operating in dry-basis.
Monitoring frequency:	Continuous
QA/QC procedures:	Calibration should include zero verification with an inert gas (e.g. N ₂) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). Calibration and frequency of calibration is according to manufacturer’s specifications.
Any comment:	-



Data / Parameter:	ID.25 / T_t
Data unit:	K
Description:	Temperature of the gaseous stream in time interval t
Source of data:	
Measurement procedures (if any):	Instruments with recordable electronic signal (analog or digital).
Monitoring frequency:	Continuous
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer's specifications.
Any comment:	Since all parameters are converted to normal conditions during the monitoring process, this parameter is only monitored to verify the applicability condition is met related gaseous stream flow temperature being 60°C.

Data and parameters under the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” version 01, that are monitored:

Data / Parameter:	ID.26 / EC_{BL,y}
Data unit:	MWh
Description:	Net amount of electricity generated using LFG
Source of data:	
Measurement procedures (if any):	The electricity generated using LFG is measured continuously with a electricity meter
Monitoring frequency:	Continuous
QA/QC procedures:	Maintenance and calibration of equipment will be carried out according to the instructions of the manufacturer.
Any comment:	The electricity meters are used to measure the net electricity exported to the grid and used for billing purposes. Therefore the meters are sealed by TEİAŞ (Turkish Electricity Transmission CO).

Data / Parameter:	ID.27 / EC_{PJ,y}
Data unit:	MWh
Description:	Quantity of electricity consumed by the project activity.
Source of data:	
Measurement procedures (if any):	The electricity consumption is measured from electricity meters and aggregated annually.
Monitoring frequency:	Continuous
QA/QC procedures:	Maintenance and calibration of equipment will be carried out according to the instructions of the manufacturer.
Any comment:	The electricity consumption will be monitored using the same bi-directional electricity meter, which is used to measure the electricity exported to the grid. The electricity meters are used to measure the electricity consumption are used for billing purposes. Therefore the meters are sealed by TEİAŞ (Turkish Electricity Transmission CO).



Data / Parameter:	ID.28 / TDL_v
Data unit:	
Description:	Average technical transmission and distribution losses
Source of data:	Recent, accurate and reliable data available within the host country
Measurement procedures (if any):	Will be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the project activity is connected. The distribution losses can either be calculated by the project participant or be based on references from utilities, network operators or other official documentation (such as protocols for electricity meter readings)
Monitoring frequency:	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures:	
Any comment:	

Data and parameters under the “Tool to determine project emissions from flaring gases containing methane” that are monitored:

Data / Parameter:	ID.29 / $FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of residual gas in dry basis in the hour h
Source of data to be used:	Measurements by project participants using a flow meter
Measurement procedures	
Monitoring frequency	Continuously. Values to be averaged hourly.
QA/QC procedures to be applied:	Flow meters are calibrated according to the manufacturer’s recommendation.
Any comment:	

Data / Parameter:	ID.30 / $f_{V,CH_4,RG,h}$
Data unit:	
Description:	Volumetric fraction of methane in the residual gas on dry basis
Source of data to be used:	Measurements by project participants using a continuous gas analyser
Measurement procedures	
Monitoring frequency	Continuously. Values to be averaged hourly.
QA/QC procedures to be applied:	Calibrated according to the manufacturer’s recommendation.
Any comment:	

Data / Parameter:	ID.31 / T_{flare}
Data unit:	$^{\circ}C$
Description:	Temperature in the exhaust gas of the enclosed flare
Source of data to be	Measurements by project participants



used:	
Measurement procedures	Measurement of a temperature above 500 °C in the exhaust gas stream in the flare indicates that the flare is operating in a reliable way. (Continuously measurement by thermocouple)
Monitoring frequency	Continuously
QA/QC procedures to be applied:	The thermocouple is replaced or calibrated every year.
Any comment:	

B.7.2. Description of the monitoring plan:

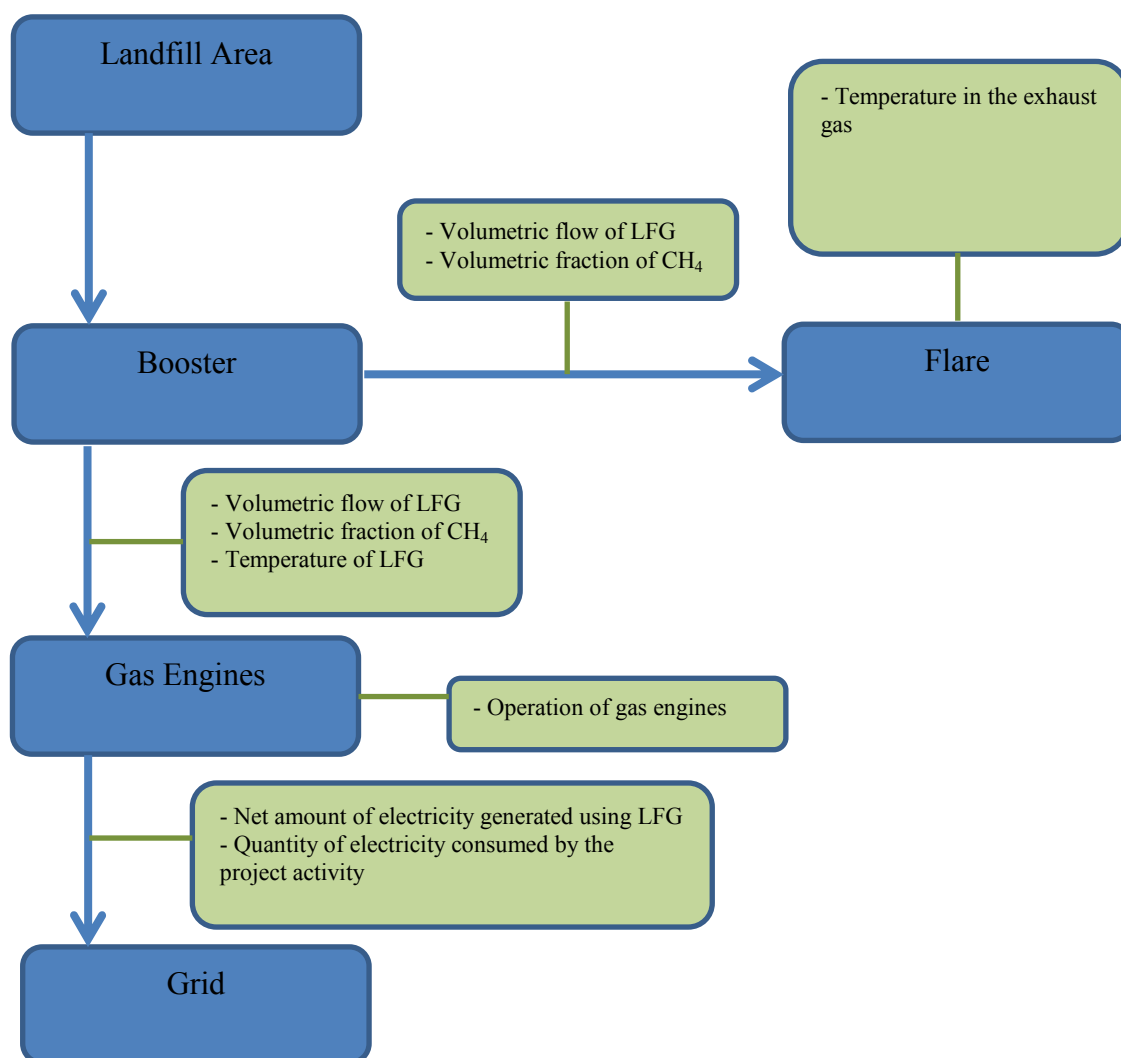
>>

Monitoring Plan

Monitoring will be carried out following the procedures set by the consolidated baseline methodology ACM0001 version 12 and all applicable tools of the above explained parameters. The monitoring consists of:

- Amount of landfill gas combusted in power generation units
- Temperature of the landfill gas sent to power generation to ensure compliance regarding dry basis for measurement
- Amount of landfill gas flared
- Temperature in the exhaust gas of the enclosed flares to determine the flare efficiency
- Concentration of methane of the landfill gas
- Total amount of electricity exported to the grid
- Operating hours of power generation units
- Total amount of the electricity imported from the grid

Simplified monitoring diagram is as follows⁷⁷:



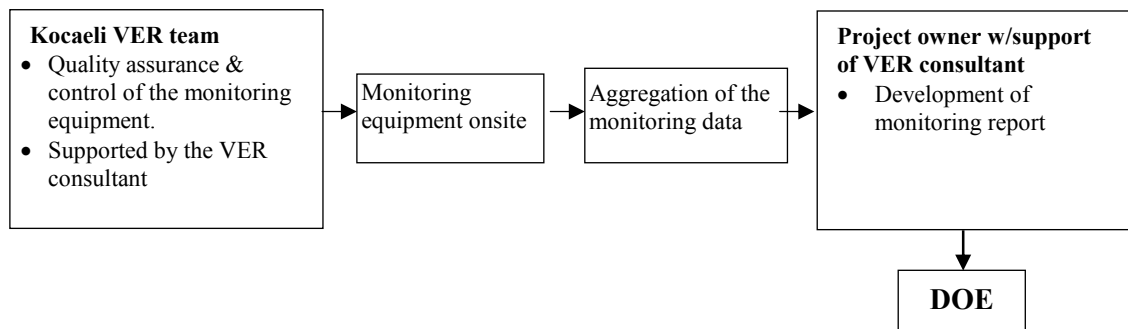
Responsibilities for monitoring

The project owner is responsible for the operation and maintenance of the landfill and the installed equipment⁷⁸. The project owner is also responsible for the administration of the data, setting up a VER team who will be responsible for monitoring all data required to estimate emission reductions.

In the diagram below the organization of monitoring management and data application is presented.

⁷⁷ For complete details on required monitored data and parameters please refer to section B.7.1 in the PDD.

⁷⁸ Except for the electricity meter that monitors both electricity imports and exports, since the monitoring device is sealed by TEİAŞ (Turkish Electricity Transmission Company) and the Project Participant cannot interfere with the device.



Registration of the monitored data

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

Corrective actions and emergency preparedness

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

QA/QC procedure

Strong quality assurance and quality control procedure will be taken to monitor the equipment and data collection. Equipment and facilities will be subject to a regular maintenance and testing regime to ensure accuracy following supplier's manual.

Measuring of exported and imported electricity

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

Flare efficiency

Temperature and inlet flow rate of LFG in normal operation will be monitored according to manufacturer's specification.

In case of enclosed flares and use of the default value for the flare efficiency, the efficiency in the hour h ($n_{\text{flare}, h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour h .



- 50% if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour h, but the manufacture's specifications on proper operation of the flare are not met at any point in time during the hour h.
- 90% if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour h and the manufacture's specifications on proper operation of the flare are met continuously during the hour h.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

>>

Date of completing the final draft of this baseline section:

07/02/2012

Name of person/entity determining the baseline:

The baseline has been prepared by OakDanışmanlık in consultation with Körfez Enerji A.Ş.

Company name: OakDanışmanlık
Visiting Address: Acıbadem Mah. Şemibey Sok. Belkıs Apt. N:3 D:6
Kadıköy / İstanbul, TURKEY
Contact Person: Ömer Akyürek
Telephone number: +90 216 3471671
E-mail: oak@oakdanismanlik.com

SECTION C. Duration of the project activity / crediting period**C.1. Duration of the project activity:****C.1.1. Starting date of the project activity:**

>>

22.03.2011

C.1.2. Expected operational lifetime of the project activity:

>>

16 years

C.2. Choice of the crediting period and related information:**C.2.1. Renewable crediting period:****C.2.1.1. Starting date of the first crediting period:**

>>

01.03.2012

C.2.1.2. Length of the first crediting period:

>>

3x7 years

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

>>

n.a.

C.2.2.2. Length:

>>

n.a.

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

In line with the requirements of “Regulation on Environmental Impact Assessment”, the proposed project has been exempted from performing an Environmental Impact Assessment.⁷⁹

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

n.a.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

As required by the Gold Standard a Local Stakeholders Consultation and a Feedback Round has to be undertaken by the project participant in order to encourage the stakeholders to express their opinion and incorporate it in the project. In this way, the project developer, together with the public, ensures a project going along the main principles of sustainability. For more details on both the Local Stakeholder Consultation (LSC) and the Stakeholder Feedback Round see the LSC report and the GS Passport⁸⁰.

Local Stakeholder Consultation (LSC)

The proposed project activity is exempted from conducting an Environmental Impact Assessment (EIA) according to Turkish Law and Regulations however the project participant has organized two Local Stakeholders Meeting on 01.12.2010 and on 08.07.2011 in accordance with the requirements of the Gold Standard Foundation v2.1. Details of The Local Stakeholders Meetings could be found under the LSC report.

⁷⁹ Exemption letter has been provided to the validating DOE

⁸⁰ Gold Standard v2.1 rules and requirements are applicable to the proposed project activity.

***Stakeholder Feedback Round (SFR)***

The Gold Standard stakeholders' consultation process has two main events: a "live" stakeholders consultation meeting and the stakeholders feedback round. The first consultation meeting includes a discussion of the design and consequent impacts of the project while the feedback round provides ground for stakeholders to provide feedback on how their comments have been taken into account.

The documents including the LSC report, the GS Passport and the PDD has been delivered to the stakeholders who have been selected as stakeholders to the project activity. The main communication method has been through e-mails and delivery of hard copies of the mentioned documents for those who don't have an email address (specifically the locals through the muchtar). Also the documents has been made available under the project participant's webpage (<http://www.ortadogugrup.com.tr/>).

The feedback round has started on 01.05.2012 with sending out the documents to the stakeholders and no feedback has been received till 01.07.2012.

E.2. Summary of the comments received:

>>

The details of the Stakeholders Consultation Process could be found under the GS LSC Report and the GS Passport.

E.3. Report on how due account was taken of any comments received:

>>

The details of the Stakeholders Consultation Process could be found under the GS LSC Report and the GS Passport.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	Körfez Enerji A.Ş.
Street/P.O.Box:	KAPTANPAŞA MH. PİYALEPAŞA BULVARI
Building:	ORTADOĞU PLAZA NO:14 KAT:20
City:	OKMEYDANI / ISTANBUL
State/Region:	
Postcode/ZIP:	
Country:	TURKEY
Telephone:	+90 212/210 25 25
FAX:	+90 212 221 51 52
E-Mail:	fethullah.demircan@ortadogugrup.com.tr
URL:	http://www.ortadoguenerji.com.tr
Represented by:	Fethullah Demircan
Title:	
Salutation:	
Last name:	
Middle name:	
First name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal e-mail:	



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

**Annex 3****BASELINE INFORMATION**SET_{sample}

2010			
Plant Name	Fuel Type	Added Installed Capacity MW	Generation MWh
Can Tekstil (Çorlu/Tekirdağ)	Natural Gas	7,832	60.246
Altınmarka	Natural Gas	4,6	37.024
Akbaşlar (İlave)	Natural Gas	1,54	12.078
Global Enerji (Pelitlik)	Natural Gas	3,544	27.057
Rasa Enerji (Van)	Natural Gas	26,19	166.622
Aksa Enerji (Antalya)	Natural Gas	25	192.500
Yıldız Entegre Ağaç (Kocaeli)	Natural Gas	12,368	79.794
Ataer Enerji Elektrik Üretim A.Ş.	Natural Gas	49	277.886
Cengiz Enerji San ve Tic A.Ş. (Tekkeköy)	Natural Gas	101,95	802.000
Uğur Enerji Üretim San ve Tic A.Ş.	Natural Gas	48,2	405.136
Aksa Enerji (Antalya)	Natural Gas	25	192.500
Altek Alarko Elektrik Santralleri	Natural Gas	60,1	415.570
Flokser Tekstil (Çerkezköy/Tekirdağ)	Natural Gas	5,2	42.000
RB Karesi İthalat İhracat Tekstil	Natural Gas	8,6	65.000
Cengiz Enerji San ve Tic A.Ş. (Tekkeköy)	Natural Gas	101,95	802.000
Keskinoğlu Tavukçuluk ve Dam. İşl.	Natural Gas	3,5	25.000
Binatom Elektrik Üretim A.Ş.	Natural Gas	2	13.000
Can Enerji Elektrik Üretim A.Ş. (Tekirdağ)	Natural Gas	29,1	203.000
Kurtoğlu Bakır Kurşun San ve A.Ş.	Natural Gas	1,6	12.000
Sönmez Enerji Üretim (Uşak)	Natural Gas	33,242	256.297
Kırka Boraks (Kırka) (Eti Maden İşl) (İlave)	Natural Gas	10	65.934
Enerji SA (Bandırma)	Natural Gas	930,8	7.540.000
Uğur Enerji Üretim San ve Tic A.Ş. (İlave)	Natural Gas	12	100.864
Marmara Pamuklu Mensucat (İlave)	Natural Gas	26,19	203.450
Aliağa Çakmaktepe Enerji (İlave)	Natural Gas	69,84	557.920
Sönmez Enerji Üretim (Uşak) (İlave)	Natural Gas	2,564	19.769
Polyplex Europa Polyester Film	Natural Gas	7,8	61.000
Altek Alarko Elektrik Santralleri	Natural Gas	21,89	151.361
Rasa Enerji (Van) (İlave)	Natural Gas	10,124	64.409
International Hospital İstanbul A.Ş.	Natural Gas	0,8	6.000
	Natural Gas 2010 Total	1.643	12.857.417



CDM – Executive Board

page 68

Tüpraş Rafineri (İzmit) (İlave)	Fuel Oil	40	258.824
	Fuel Oil 2010 Total	40	258.824

Eti Soda Üre. Paz. Nak. Ve Elek. Üre. San.	Lignite	24	144.000
Konya Şeker San. Ve Tic. A.Ş.	Lignite	6	11.593
	Lignite 2010 Total	30	155.593

Eren Enerji Elektrik Üretim A.Ş.	Coal	160	1.068.235
Eren Enerji Elektrik Üretim A.Ş. (İlave)	Coal	600	4.005.882
Eren Enerji Elektrik Üretim A.Ş. (İlave)	Coal	600	4.005.882
	Coal 2010 Total	1360	9080000

Kulp IV HES (Yıldızlar En. Elk. Ür. A.Ş.)	Hydro	12,3	23.000
Cindere Hes (İlave)	Hydro	9,065	16.073
Bayburt HES (Bayburt Enerji Üret.)	Hydro	14,6	24.000
Uzunçayır HES (Tunceli) (İlave)	Hydro	27,33	60.659
Alakır HES (Yurt Enerji Üretim)	Hydro	2,1	4.000
Peta Mühendislik En. (Mursal II Hes)	Hydro	4,5	11.000
Asa Enerji (Kale Reg ve HES)	Hydro	9,6	18.000
Hetaş Hacısalihoğlu (Yıldızlı HES)	Hydro	1,2	3.000
Doğubey Elektrik (Sarımehmet Hes)	Hydro	3,1	6.000
Nuryol Enerji (Defne Reg ve Hes)	Hydro	7,2	13.000
Özgür Elektrik (Azmak I Reg. Ve Hes)	Hydro	5,913	12.026
Birim Hidr. Üretim. A.Ş. (Erfelek Hes)	Hydro	3,225	5.458
Beytel Elek. Ür A.Ş. (Çataloluk Hes)	Hydro	9,5	17.000
Nisan E. Mekanik. En. (Başak Reg. HES)	Hydro	6,9	12.000
Uzunçayır HES (Tunceli) (İlave)	Hydro	27,33	60.659
Fırtına Elektrik Ür. A.Ş. (Sümer HES)	Hydro	21,6	39.000
Karen Karadeniz El. A.Ş. Aralık Hes	Hydro	12,4	32.000
Birim Hidr. Üretim. A.Ş. (Erfelek Hes)	Hydro	3,225	3.006
Karadeniz El. Üretim (Uzundere 1 Hes)	Hydro	31	46.350
Akım Enerji (Cevizlik Reg. Ve Hes)	Hydro	91,4	187.000
Çakıt HES (Çakıt Enerji A.Ş.)	Hydro	20,2	54.000
Erenler Reg ve Hes (BME Bir Müt. En)	Hydro	45	48.000
Paşa Reg ve Hes (Özgür Elektrik)	Hydro	8,7	19.000
Güzel Çay I HES (İlk Elektrik Enerji)	Hydro	3,14	9.304
Kale Reg ve Hes (Kale Enerji Üretim A.Ş.)	Hydro	34,1	66.000
Erikli Akocak Reg ve Akocak Hes	Hydro	41,25	73.000
Çamlıkaya Reg ve Hes	Hydro	5,6	11.000



CDM – Executive Board

page 69

Dinar Hes (Elda Elektrik Üretim)	Hydro	4,4	9.000
Damlapınar Hes (Cenay Elektrik Üretim)	Hydro	16,4	52.000
Dim Hes (Diler Elektrik Üretim)	Hydro	38,3	70.000
Kirpilik Reg. Ve Hes (Özgür Elektrik)	Hydro	6,2	13.000
Özgür Elektrik (Azmak I Reg. Ve Hes)	Hydro	5,913	12.026
Yavuz Reg. Ve Hes (Masat Enerji)	Hydro	22,5	47.000
Kayabükü Reg. Ve Hes (Elite Elek.)	Hydro	14,6	28.000
Erikli Akocak Reg ve Akocak Hes	Hydro	41,25	73.000
Gök Reg. Ve Hes (Gök Enerji El. San.)	Hydro	10	24.000
Bulam Reg ve Hes (Mem Enerji Elk)	Hydro	7	19.000
Karşıyaka Hes (Akua Enerji Üret)	Hydro	1,6	5.000
Ceyhan Hes (Berkman Hes) (Enova En)	Hydro	12,6	29.000
Güdül 1 Reg ve Hes (Yaşam Enerji)	Hydro	2,4	8.000
Ceyhan Hes (Berkman Hes) (Enova En)	Hydro	12,6	29.000
Tektaş Elektrik (Andırın Hes)	Hydro	40,5	60.000
Selen Elektrik (Kepezkaya Hes)	Hydro	28	70.000
Reşadiye 2 Hes (Turkon Mng Elekt)	Hydro	26,1	119.000
Kozan Hes (SerEr Enerji)	Hydro	4	5.000
Kahraman Reg ve Hes (Katırcıoğlu)	Hydro	1,4	3.000
Narinkale Reg ve HES (EBD Enerji)	Hydro	3,1	6.000
Erenköy Reg ve Hes (Türkerler)	Hydro	21,5	49.000
Kahta I Hes (Erdemyıldız Elek. Ürt)	Hydro	7,1	20.000
Uluabat Kuvvet Tüneli ve Hes	Hydro	48,5	105.000
Sabunsuyu II Hes (Ang Enerji Elk)	Hydro	7,4	12.000
Burç Bendi ve Hes (Akkur Enerji)	Hydro	27,3	64.000
Karadeniz El. Üretim (Uzundere 1 Hes) (İlave)	Hydro	31	46.350
Murgul Bakı (Ç. Kaya) (İlave)	Hydro	19,6	31.587
Güzel Çay II HES (İlk Elektrik Enerji)	Hydro	4,96	14.696
Uluabat Kuvvet Tüneli ve Hes (İlave)	Hydro	48,5	105.000
Reşadiye 1 Hes (Turkon Mng Elekt)	Hydro	15,6	71.126
Egemen 1 Hes (Enersis Elektrik)	Hydro	8,8	18.131
Yedigöze Hes (Yedigöze Elektrik)	Hydro	155,3	268.000
Umut III Reg ve Hes (Nisan Elek)	Hydro	12	15.000
Feke 2 Barajı (Akkur Enerji)	Hydro	69,3	126.000
Egemen 1B Hes (Enersis Elektrik)	Hydro	11,1	22.869
Kalkandere Reg ve Yokuşlu Hes	Hydro	14,5	36.000
Hydro 2010 Total		1.263	2.559.322

CEV Enerji Üretim (Gaziantep Çöp Biyogazı)	Biogas	1,1	8.600
Ortadoğu Enerji (Odayeri) (Eyüp İst)	Biogas	4,245	33.357
ITC KA Enerji Sincan	Biogas	1,416	11.126
ITC Adana Biokütle Sant	Biogas	11,32	91.475
Tuzla Jeotermal	Geothermal	7,5	55.000



CDM – Executive Board

page 70

Menderes Geothermal Dora - 2	Geothermal	9,5	73.000
Rotor Elektrik (Osmaniye RES)	Wind	20	64.444
Asmakinsan (Bandırma 3 RES)	Wind	20	37.500
Soma Enerji Üretim (Soma RES)	Wind	4,5	11.364
Rotor Elektrik (Osmaniye RES)	Wind	17,5	56.389
Deniz Elektrik (Sebanoba RES)	Wind	10	32.000
Akdeniz Elektrik (Mersin RES)	Wind	33	50.000
Asmakinsan (Bandırma 3 RES)	Wind	4	7.500
Boreas Enerji (Bores I Enez RES)	Wind	15	42.000
Rotor Elektrik (Osmaniye RES)	Wind	17,5	56.389
Bergama RES En. Ür. A.Ş. Aliağa RES	Wind	52,5	176.167
Bakras En. Elkt. Ür. A.Ş. Şenbük RES	Wind	15	40.000
Alize Enerji (Keltepe RES)	Wind	1,8	5.391
Rotor Elektrik (Gökçedağ RES)	Wind	20	64.444
Soma Enerji Üretim (Soma RES)	Wind	7,2	18.182
Bergama RES En. Ür. A.Ş. Aliağa RES	Wind	37	124.156
Mazı 3 RES Elektrik (Mazı 3 RES)	Wind	7,5	20.000
Borasko Enerji (Bandırma RES)	Wind	12	30.105
Ziyaret RES (Ziyaret RES Elektrik)	Wind	12,5	42.500
Soma Enerji Üretim (Soma RES)	Wind	7,2	18.182
Soma RES (Bilgin Rüzgar San. En. Ür)	Wind	32	92.800
Soma Enerji Üretim (Soma RES)	Wind	6,3	15.909
Belen Elektrik (Belen RES) (İlave)	Wind	6	11.667
Ütopya Elektrik (Düzova RES) (İlave)	Wind	15	30.000
Soma RES (Bilgin Rüzgar San. En. Ür) (İlave)	Wind	27,5	79.750
Soma Enerji Üretim (Soma RES) (İlave)	Wind	9	22.727
Ziyaret RES (Ziyaret RES Elektrik) (İlave)	Wind	22,5	76.500
Rotor Elektrik (Gökçedağ RES) (İlave)	Wind	2,5	8.056
Soma RES (Bilgin Rüzgar San) (İlave)	Wind	30	87.000
Kuyucak RES (Alize Enerji Üret)	Wind	8	29.375
Kuyucak RES (Alize Enerji Üret) (İlave)	Wind	17,6	64.625
Sares RES (Garet Enerji Üretim)	Wind	15	51.000
Turguttepe RES (Sabaş Elektrik Ür)	Wind	22	55.000
	Renewable 2010 Total	264	870.485
2010 TOTAL		4.599	25.781.641

2009			
Plant Name	Fuel Type	Added Installed Capacity	Generation



CDM – Executive Board

page 71

		MW	MWh
Ak Gıda San. Ve Tic. A.Ş. (Pamukova)	Natural Gas	7,50	61.000
Aksa Akrilik Kimya San. A.Ş. (Yalova)	Natural Gas	70,00	539.000
Aksa Enerji (Antalya)	Natural Gas	16,20	124.740
Aksa Enerji (Antalya)	Natural Gas	300,00	2.310.000
Aksa Enerji (Antalya)	Natural Gas	300,00	2.310.000
Aksa Enerji (Manisa)	Natural Gas	10,50	83.144
Antalya Enerji	Natural Gas	41,80	302.096
Arenko Elektrik Üretim A.Ş. (Denizli)	Natural Gas	12,00	84.000
Bil Enerji (DG+M)(Balgat)	Natural Gas	36,60	255.000
Cam İş Elektrik	Natural Gas	126,10	1.008.000
Çelikler Taah. İnş. (Rixox Grand)	Natural Gas	2,00	16.000
Dalsan Alçı San. Ve Tic. A.Ş.	Natural Gas	1,20	9.000
Delta Enerji Üretim ve Tic. A.Ş.	Natural Gas	47,00	365.817
Delta Enerji Üretim ve Tic. A.Ş.	Natural Gas	13,00	101.183
Desa Enerji Elektrik Üretim A.Ş.	Natural Gas	9,80	70.000
E. Şehir. End. Enerji (DG+M)(Eskişehir-2)	Natural Gas	59,00	452.000
Ege Birleşik Enerji (LPG+DG+M)(Aliağa)	Natural Gas	12,80	107.000
Entek Köseköy (İztek)	Natural Gas	0,80	6.366
Entek Köseköy (İztek)	Natural Gas	36,30	288.876
Falez Elektrik Üretim A.Ş.	Natural Gas	11,70	88.000
Global Enerji (Pelitlik)	Natural Gas	8,60	65.665
Gül Enerji Elkt. Üret. Sn. Ve Tic. A.Ş.	Natural Gas	24,30	170.000
Habaş Aliağa	Natural Gas	224,50	1.796.000
Hayat Kağıt	Natural Gas	7,50	56.000
Kasar Dual Tekstil San. A.Ş. (Çorlu)	Natural Gas	5,70	38.000
Ken Kipaş Elektrik Üretim (Karen)	Natural Gas	41,80	180.000
Ken Kipaş Elkt. Ür. (Karen) (K.Maraş)	Natural Gas	17,50	75.359
Maksi Enerji EeLEKTRİK Üretim A.Ş.	Natural Gas	7,70	55.000
Marmara Pamuklu Mens. Sn. Tic. A.Ş.	Natural Gas	34,90	271.533
Mauri Maya San A.Ş.	Natural Gas	0,30	2.478
Mauri Maya San A.Ş.	Natural Gas	2,00	16.522
Modern Enerji (B. Karıştırır)	Natural Gas	96,80	
MOSB Enerji Elektrik Üretim Ltd. Şti.	Natural Gas	84,80	595.702
Nuh Çimento San. Tic. A.Ş.	Natural Gas	47,00	329.000
Rasa Enerji (VAN)	Natural Gas	78,60	500.000
Selkasan Kağıt Paketleme	Natural Gas	9,90	73.000
Sönmez Elektrik (Uşak)	Natural Gas	8,70	67.057
Şahinler Enerji (Çorlu/Tekirdağ)	Natural Gas	26,00	185.000
TAV İstanbul Terminal İşletme A.Ş.	Natural Gas	3,30	27.612
TAV İstanbul Terminal İşletme A.Ş.	Natural Gas	6,50	54.388
Tesko Kipa Kitle Paz. Tic. Ve Gıda A.Ş.	Natural Gas	2,30	18.000
Yurtbay Elektrik Üretim A.Ş.(DG+M)	Natural Gas	6,90	50.000
Zorlu Enerji (B. Karıştırır)	Natural Gas	49,50	394.970
	Natural Gas 2009 Total	1.909,40	13.602.509



CDM – Executive Board

page 72

Erdemir (Ereğli-Zonguldak)	Fuel Oil	39,20	240.000
Habaş Bilecik Paşalar	Fuel Oil	18,00	144.000
Habaş İzmir Habaş	Fuel Oil	36,00	288.000
Petkim (Aliağa)	Fuel Oil	222,00	1.554.000
Petkim (Aliağa)	Fuel Oil	52,00	364.000
Silopi Elektrik Üretim A.Ş.	Fuel Oil	44,80	315.000
Süper Film (G. Antep)	Fuel Oil	25,30	203.000
Tire Kutsan (Tire)	Fuel Oil	8,00	37.000
Tüpraş Rafineri (Aliağa/İzmir)	Fuel Oil	24,70	171.777
Tüpraş O.A. Rafineri (Kırıkkale)	Fuel Oil	10,00	70.000
Silopi Elektrik Üretim A.Ş.	Fuel Oil	135	945000
	Fuel Oil 2009 Total	615,00	4.331.777

Alkim Alkali Kimya	Lignite	0,40	3.000
	Lignite 2009 Total	0,40	3.000

İçdaş Çelik	Coal	135,00	961.667
İçdaş Çelik	Coal	135,00	961.667
	Coal 2009 Total	270,00	1.923.333

Akçay Hes Elektrik Üretim (Akçay HES)	Hydro	28,80	45.000
Akua Enerji (Kayalık Reg ve HES)	Hydro	5,80	20.000
Anadolu Elektrik (Çakırlar HES)	Hydro	16,20	28.000
Bağışlı REG ve HES (Ceykar Elekt.)	Hydro	9,90	15.720
Bağışlı REG ve HES (Ceykar Elekt.)	Hydro	19,70	31.280
Bereket Enerji (Koyul Hisar)	Hydro	42,00	155.000
Beyobası En. Ür. A.Ş. (Sırma HES)	Hydro	5,90	11.000
Cindere HES (Denizli)	Hydro	19,10	30.000
Değirmenüstü En (Kahramanmaraş)	Hydro	12,90	17.378
Denizli Elektrik (EGE I HES)	Hydro	0,90	2.000
Elestaş Elektrik (Yaylabel HES)	Hydro	5,10	10.000
Elestaş Elektrik (Yazı HES)	Hydro	1,10	3.000
Erva Enerji (Kabaca Reg ve HES)	Hydro	4,20	7.412
Erva Enerji (Kabaca Reg ve HES)	Hydro	4,20	7.412
Filyos Enerji (Yalnızca Reg ve HES)	Hydro	14,40	33.000
Kalen Enerji (Kalen I II HES)	Hydro	15,70	23.575
Karel Enerji (Pamukova)	Hydro	9,30	40.000
Kayen Alfa Enerji (Kaletepe HES)	Hydro	10,20	17.000
Kısık	Hydro	9,60	20.000
Lamas II IV HES (TGT Enerji Üretim)	Hydro	35,70	71.000



CDM – Executive Board

page 73

Obruk HES	Hydro	212,40	337.000
Özgür Elektrik (Azmak II Reg ve HES)	Hydro	24,40	43.000
Öztay Enerji (Günayşe Reg ve HES)	Hydro	8,30	14.000
Özyakut Elek. Ür. A.Ş. (Güneşli HES)	Hydro	0,60	1.333
Özyakut Elek. Ür. A.Ş. (Güneşli HES)	Hydro	1,20	2.667
Reşadiye 3 HES (Turkon MNG Elekt.)	Hydro	22,30	88.000
Sarıtepe HES (Genel Dinamik Sis. El)	Hydro	2,50	4.592
Sarıtepe HES (Genel Dinamik Sis. El)	Hydro	2,50	4.592
Şirikçioğlu El. (Kozak Bendi ve HES)	Hydro	4,40	7.000
Taşova Yenidereköy HES (Hameka A.Ş.)	Hydro	2,00	6.000
Tektuğ (Erkenek)	Hydro	6,00	14.400
Tektuğ (Erkenek)	Hydro	6,50	15.600
Tocak I HES (Yurt Enerji Üretim Sn.)	Hydro	4,80	6.000
Tüm Enerji (Pınar Reg ve HES)	Hydro	30,10	65.000
Uzunçayır HES (Tunceli)	Hydro	27,30	49.000
Yapısan (Karıca Reg ve Darıca HES)	Hydro	48,50	77.000
Yapısan (Karıca Reg ve Darıca HES)	Hydro	48,50	77.000
Yeşilbaş Enerji (Yeşilbaş HES)	Hydro	14,00	26.000
ypm Gölova HES (Suşehri / Sivas)	Hydro	1,10	2.000
YPM Sevindik HES (Suşehri / Sivas)	Hydro	5,70	18.000
Hydro 2009 Total		719,40	1.402.961

Datça RES (Datça)	Wind	0,80	2.270
Datça RES (Datça)	Wind	8,90	25.257
Datça RES (Datça)	Wind	11,80	33.486
Gürmat Elektrik (Gürmat Jeotermal)	Geothermal	47,40	313.000
ITC KA Enerji (Sincan)	Waste	2,80	22.000
ITC KA Enerji Mamak Katı Atık Top. Merk	Waste	2,80	21.062
Kores Kocadağ RES (Urla / İzmir)	Wind	15,00	56.000
Mazı 3 RES Elekt. Ür. A.Ş.(Mazı 3 RES)	Wind	10,00	35.111
Mazı 3 RES Elekt. Ür. A.Ş.(Mazı 3 RES)	Wind	12,50	43.889
Akenerji (Ayyıldız RES)	Wind	15,00	51.000
Alize Enerji (Çamseki RES)	Wind	20,80	82.000
Alize Enerji (Keltepe RES)	Wind	18,90	65.000
Alize Enerji (Sarıkaya RES) (Şarköy)	Wind	28,80	96.000
Ayen Enerji (Akbük RES)	Wind	16,80	65.600
Ayen Enerji (Akbük RES)	Wind	14,70	57.400
Baki Elektrik (Şamlı Rüzgar)	Wind	36,00	176.000
Baki Elektrik (Şamlı Rüzgar)	Wind	33,00	161.333
Belen Elektrik Belen Rüzgar-Hatay	Wind	15,00	47.500
Belen Elektrik Belen Rüzgar-Hatay	Wind	15,00	47.500
Borasko Enerji (Bandırma RES)	Wind	21,00	83.533
Borasko Enerji (Bandırma RES)	Wind	24,00	95.467



CDM – Executive Board

page 74

Cargill Tarım ve Gıda San. Tic. A.Ş.	Biogas	0,10	700
Ortadoğu Enerji (Kömürcüoda)	Waste	5,80	45.000
Ortadoğu Enerji (Oda Yeri)	Waste	4,20	33.071
Ortadoğu Enerji (Oda Yeri)	Waste	5,70	44.882
Rotor Elektrik (Osmaniye RES)	Wind	17,50	66.348
Rotor Elektrik (Osmaniye RES)	Wind	17,50	66.348
Rotor Elektrik (Osmaniye RES)	Wind	22,50	85.304
Sayalar Rüzgar (Doğal Enerji)	Wind	3,60	11.368
Soma Enerji Üretim (Soma RES)	Wind	18,00	60.000
Soma Enerji Üretim (Soma RES)	Wind	10,80	36.000
Soma Enerji Üretim (Soma RES)	Wind	16,20	54.000
Ütopya Elektrik (Düzova RES)	Wind	15,00	46.000
	Renewable 2009 Total	221,00	1.094.986,09
2009 Total		3.735,20	22.358.566

Annex 4

MONITORING INFORMATION
