

Validation Opinion on Post-Registration Changes of Registered CDM Project Activity

Loma los Colorados Landfill Gas
Project

GLC Report No: 114, rev. 06

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Summary:	
Context of the performed validation assessment on post-registration changes:	<input type="checkbox"/> Prior to commencement of a verification for the project activity <input checked="" type="checkbox"/> When performing a verification for the project activity - Monitoring period: From 2009-09-01 to 2010-08-31 (incl. both days) - Number of the verification: 4 th verification <input type="checkbox"/> Independent assessment (independent from a verification for the project activity)
Category of assessed post-registration changes:	<input type="checkbox"/> Changes that do not require prior approval by the CDM Executive Board (in accordance with Appendix 1 of the CDM Project Standard (CDM PS) (changes to be approved under the "Issuance" process track) <input checked="" type="checkbox"/> Changes that require prior approval by the CDM Executive Board (changes to be approved under the "Prior approval" process track)

Details of the project activity / PoA of which post-registration changes were assessed:		
UNFCCC Ref.	0822	
Project title:	Loma los Colorados Landfill Gas Project	
Host country:	Chile	
Sectoral Scope, Technical Area	CDM Sectoral Scope 13 – Waste handling and disposal 13.1 – Waste handling and disposal	
Methodology:	ACM0001	ACM002
Version:	Version 4	Version 6
Name:	"Consolidated baseline methodology for landfill gas project activities"	"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"
Project Size:	<input checked="" type="checkbox"/> Large Scale <input type="checkbox"/> Small Scale	

Project assessed by:	Assessment reviewed by:	Work approved by:
Marco A. Ratton José-Emilio Moreno	Fernando Rangel Villasana	Markus Weber
Date of this revision:	Revision No.	Number of pages
2012-08-20	06	64

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Type of assessed post-registration changes:	
Temporary deviations from the monitoring plan or the monitoring methodology (TDEV)	<input type="checkbox"/> No revised PDD / PDD / PoA-DD + generic CPA-DD is/are submitted enclosed to this Assessment Report. All temporary deviations are of a type specified in Appendix 1 of the CDM PS. <input type="checkbox"/> yes <input type="checkbox"/> no Temporary deviation period: -
Corrections that do not affect project design (CORR)	<input checked="" type="checkbox"/> (one revised PDD / PoA-DD + generic CPA-DD (incl. a version with tracked changes) is/are submitted enclosed to this Assessment Report) All corrections are of a type specified in Appendix 1 of the CDM PS. <input checked="" type="checkbox"/> yes <input type="checkbox"/> no
Change to the start date of the crediting period (CGCP)	<input type="checkbox"/> (one revised PDD / PoA-DD + generic CPA-DD (incl. a version with tracked changes) is/are submitted enclosed to this Assessment Report) The change to the start date of the crediting period requires prior approval as specified in the CDM PS. <input type="checkbox"/> yes <input type="checkbox"/> no Note: Prior approval by the CDM EB is not required in case of (a) bringing forward the start date up to one year earlier or (b) postponing the start date by up to one year (by up to two years for project activities in LDCs). Proposed start date of the crediting period:
Permanent changes from the monitoring plan or the monitoring methodology (CGMPMETH)	<input checked="" type="checkbox"/> (one revised PDD / PoA-DD + generic CPA-DD DD (incl. a version with tracked changes) is/are submitted enclosed to this Assessment Report) All changes are of a type specified in Appendix 1 of the CDM PS <input checked="" type="checkbox"/> yes <input type="checkbox"/> no
Changes to the project or programme design (CGPD)	<input checked="" type="checkbox"/> (one revised PDD / PoA-DD + generic CPA-DD (incl. a version of that PDD / PoA-DD + generic CPA-DD with tracked changes) + revised investment analysis spreadsheet (if applicable) + revised emission reduction calculation spreadsheet (if applicable) is/are submitted enclosed to this Assessment Report. (a) In the case of a project activity, the changes have an impact on: <input type="checkbox"/> Scale <input checked="" type="checkbox"/> Additionality <input type="checkbox"/> Applicability and application of baseline Methodology <input type="checkbox"/> None of the above (b) In the particular case of a PoA, the changes relate to: <input type="checkbox"/> Expanding geographical coverage <input type="checkbox"/> Including additional host Parties

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History of report revisions:

Rev.	Date	Person	Function	Action
01	2012-07-23	Marco A. Ratton	Assessment Team Leader (ATL)	Initial version
02	2012-07-27	Fernando Rangel Villasana	Reviewer	Review with corrections and comments
03	2012-08-02	Marco A. Ratton	ATL	Corrections and improvements (as requested by the Reviewer) were made.
04	2012-08-06	Fernando Rangel Villasana	Reviewer	Review with comments
05	2012-08-12	Marco A. Ratton	ATL	Further corrections and improvements (as requested by the Reviewer) were made.
06	2012-08-20	Mweb	Approval	Approval

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Abbreviations

CDEC-SIC	Centro de Despacho Económico de Carga - Sistema Interconectado Central (power dispatch coordinating entity in Chile)
CDM	Clean Development Mechanism
CDM-EB	CDM Executive Board (the board)
CLLC-1	Central Loma Los Colorados – 1
CLLC-2	Central Loma Los Colorados – 2
CH ₄	Methane
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DOE	Designated Operational Entity
ER	Emission Reduction
GHG	Greenhouse gas(es)
GLC	Germanischer Lloyd Certification GmbH
IRR	Internal rate of return
LFG	Landfill gas
LPG	Liquefied petroleum gas
MP	Monitoring Plan
MR	Monitoring Report
PDD	Project Design Document
PP	Project Participant
R&D	Research and development
SELLC-2	Power substation for CLLC-2 electricity generation facility
QA/QC	Quality Assurance / Quality Control
UNFCCC	United Nations Framework Convention on Climate Change

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1 BACKGROUND AND SUMMARY OF THE POST-REGISTRATION CHANGES

Germanischer Lloyd Certification GmbH (GLC) was commissioned by the project participant KDM S.A. to perform the 4th verification for the CDM project activity "Loma Los Colorados Landfill Gas Project" (UNFCCC Project no. 0822) (monitoring period from 2009-09-01 to 2010-08-31). As part of the verification assessment, the GLC's assessment team confirmed the need to address via submission of a combined "Post-registration change requests for prior approval" encompassing the following types of changes (under the "Prior approval" process track):

- Permanent changes from the registered monitoring plan
- Permanent occurred and yet to be fully implemented (planned) changes in the project design
- Corrections in information made available in the PDD (which does not affect the project design)

All the applicable post-registration changes were addressed in a revised version of the PDD. This validation opinion report includes the assessment and opinion of GLC about the above summarized categories of changes for the registered CDM project activity as per the latest version of the revised PDD (version 5.3, dated 2012-08-02). In accordance with applicable guidance of the Clean Development Mechanism Project Standard ^{/22/}, the assessments and opinions for all applicable post-registration changes are combined into one single validation opinion report (to be submitted to UNFCCC for approval under the "Prior approval" process track).

During the initial phase of its verification assessment for the 4th monitoring period of the project activity (monitoring period from 2009-09-01 to 2010-08-31), the GLC's assessment team was able to confirm (during the performed on-site visit to the project site (during 2012-07-24 to 2012-07-27) and also based on interviews with the project participants) that post-registration changes as described in this validation opinion report are indeed changes which are to be addressed as per the applicable CDM guidance for addressing post-registration changes.

The findings of previous Verification Reports ^{/48/ /49/ /50/} for the project activity were also taken into account in the context of the assessment.

This validation opinion report presents the GLC's assessment and opinion for the post-registration changes of the project activity of which are being addressed in the context of the 4th verification for the project activity. The assessment was performed by GLC on the basis of applicable UNFCCC criteria, requirements and procedures for the assessment of post-registration changes for a registered CDM project activity. The assessment was performed based on the recommendations and guidance of the latest version of the Validation and Verification Standard (VVS) ^{/21/}.

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2 ASSESSMENT TEAM

A competent assessment team with relevant knowledge and experience in the specific scopes and sectors was appointed by GLC. The appointment of the team takes into account the required scope, technical area and project activity knowledge requirements for assessing the post-registration changes.

Table 2-1: Assessment team members, summary of qualification and knowledge

	Name	Function ¹⁾	Sectoral scope specific knowledge	Technical area specific knowledge	Local knowledge	Type of involvement						
						Desk review	On-site visit / Interviews	Reporting	Supervision of work	Technical review	Expert input	Approval
<input checked="" type="checkbox"/> Mr. <input type="checkbox"/> Ms.	Marco A. Ratton	ATL/ LE	X	X	X	X	X	X	X		X	
<input checked="" type="checkbox"/> Mr. <input type="checkbox"/> Ms.	José-Emilio Moreno	TE	X	X		X					X	
<input checked="" type="checkbox"/> Mr. <input type="checkbox"/> Ms.	Fernando Rangel Villasana	R	X	X						X	X	
<input checked="" type="checkbox"/> Mr. <input type="checkbox"/> Ms.	Markus Weber	FR/ FA								X		X

1) ATL: Assessment Team Leader; TE: Technical Expert; LE: Local Expert; R: Reviewer; FR: Final Reviewer; FA: Final Approval

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3 DESCRIPTION OF THE POST-REGISTRATION CHANGES

This section provides an overview of the following post-registration changes which are addressed in a revised version of the PDD (version 5.3) ^{1/} which was made available and assessed by the GLC's assessment team:

- Permanent occurred and yet to be fully implemented (planned) changes in the project design
- Permanent changes from the registered monitoring plan,
- Corrections in information made available in the PDD (which does not affect the project design)

Section 4 includes details about the GLC's assessment of the post-registration changes, including assessment of compliance with applicable CDM requirements. Section 5 presents in the summarized validation opinion (validation statement) performed assessment.

3.1 Overview of the permanent changes to the design of the project activity

The occurred and yet to be fully implemented (planned) post-registration permanent changes in the project design are related to the implementation and operation of the project's electricity generation component for the project activity and are summarized as follows:

- ***Occurred and planned (yet to be fully implemented) gradual installation of electricity generation equipment fuelled by collected landfill gas (engine-generator sets) with higher energy conversion efficiency than as earlier assumed (thus resulting in higher installed capacity)***

The installation of power generation equipment with higher energy conversion efficiency (as occurred and yet to be fully implemented permanent changes in the original project design) have resulted (and will result) in relative increments in total electricity generation installed nameplate capacity for the project activity along the gradual and phased implementation of its electricity generation component.

Besides of the verified quantitative and qualitative increment of collection of LFG as part of the operation of the project activity, the use of more efficient engine-generator sets (with higher LFG-to-electricity conversion efficiency) made it technically feasible to install equipment with higher total installed electricity generation capacity (in MW). As also indicated in the revised version of the PDD ^{1/}, operational aspects were also a driver for the occurred and planned changes in the project design:

"(...) better understanding and assurance by KDM S.A in terms of real flow of LFG collection in the project site. This is a direct outcome of gained operational experience and competence developments within all operational aspects of the project activity by the whole project operation team of KDM S.A.¹ These aspects have actually promoted

¹ As confirmed by the GLC's assessment team through checking of historical data, during the initial operational stage of the project, the flow of collected LFG was always lower than related projections in the PDD until November 2008. From November 2008

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significant improvements in terms of flow of LFG actually collected and also significant improvements in terms of expected variability of collected LFG flow (LFG flow variability has decreased significantly). These two main operational aspects resulted in higher technical utilization potential for collected LFG (as fuel for electricity generation), making relative increments in terms of installed power generation capacity technically feasible. The higher availability of LFG thus also triggered increment in power generation installed capacity (when compared to earlier estimates and forecasts at the time of the project implementation decision making in mid 2006)."

- ***Occurred and yet to be fully implemented installation of electricity generation equipment under a revised timeline/schedule***

The project implementation time schedule was revised. Such revision includes:

- Occurred relative delay in the installation of the first electricity generation units;
- Revised schedule for the implementation of capacity additions so far occurred.
- Revised schedule for the implementation of capacity additions forecasted.

The project's electricity generation component is planned to be implemented by the gradual installation of the electricity generation facilities "Central Loma Los Colorados - 1" (CLLC-1) and "Central Loma Los Colorados - 2" (CLLC-2) ². While CLLC-1 electricity generation facility was implemented in the end of year 2009 (with final configuration of 2.0 MW of installed power generation capacity), the initial phase of CLLC-2 started to operate in September 2011. An internal presentation material issued by KDM S.A. (dated September 2010) ^{/31/} outlines the whole plan for implementing the CLLC-2 power plant with gradual power generation capacity additions by taking into account available updated projections of LFG collection at the Loma Los Colorados landfill. This presentation material was made available to the GLC's assessment team and highlights that optimized electricity generation level could be reached by revising the earlier planned gradual power generation capacity addition schedule (incl. size of power generation equipment to be installed) by taking into account the revised forecasted LFG collection curve (which was made available in a graph in the presentation) and better quality of collected gas.

As also informed by KDM S.A., this curve was derived based on real flow of collected LFG during previous years. Significant qualitative and quantitative improvements occurred in terms of flow of LFG actually collected and variability of collected LFG flow (e.g.: LFG flow has significantly increased and the flow variability has decreased significantly). These aspects triggered the development by KDM S.A. of more realistic LFG collection projections.

Complete specifications of engine-generator sets which were already installed and will be installed as part of the revised gradual implementation of the project's electricity generation component are presented below in Section 3.1.2.

- ***Occurred installation of two additional backup captive off-grid electricity generators (fuelled by diesel) (for meeting emergency and safety operational requirements of the CLLC-2 electricity generation facility)***

onwards, LFG collection figures have been equal and even superior to related estimates in the PDD. The occurred improvements in the performance of the project's LFG collection system represents a credible evidence of the claimed gained operational experience and competence development by the project operation team of KDM S.A.

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As part of the implementation of gradual implementation phase of the project's electricity generation component, two additional captive off-grid electricity generators (fuelled by diesel) were added for meeting emergency and safety operational requirements of the new CLLC-2 electricity generation facility. A captive off-grid electricity generator fuelled by diesel was earlier installed in the project site (in March 2007) in order to temporarily meet the electricity demand for the project's LFG collection and flaring system whenever grid electricity supply is interrupted. The implementation of the initial diesel generator was previously addressed and approved in the context of a previous verification via submission of a revision of the monitoring plan for the project activity. The two additional new backup captive electricity generators (also fuelled by diesel) were installed in September 2011 (as part of the implementation of the CLLC-2 electricity generation facility). While the implementation of such additional electricity generators are part of the design of the CLLC-2 facility, the installation of these additional backup units are also regarded as permanent changes in the project design in the context of the submission of the post-registration changes in the context of the 4th verification².

The descriptions of the changes in the project design are correctly and sufficiently described in the revised version of Project Design Document (PDD) (version 5.3 dated 2012-08-02).³

3.1.1 Specifications of the engine-generator sets (fuelled by LFG) which were installed and which will be installed as part of the revised gradual implementation of the project's electricity generation component

The following table summarizes the specifications of engine-generator sets which were already installed and will be installed as part of the revised gradual implementation of the project's electricity generation component. Installed and yet to be installed power generation equipment fuelled by LFG are of improved performance (higher LFG-to-electricity conversion efficiency) and are also of higher nameplate power generation capacity (when compared to equipment originally considered to be installed as per the previous version of the PDD (version 4) ^{12/}). The specifications of equipment earlier considered to be installed (Waukesha VHP L7042 GL) are also presented in the comparative table below:

² While the CLLC-2 electricity generation facility was implemented in the context of the 6th verification (monitoring period from 2011-05-01 to 2012-05-31, the installation of the two additional captive off-grid electricity generators (which were installed as part of the CLLC-2 power plant) thus assumed as also occurring in the context of the the monitoring period for the 6th verification. This verification assessment is also being performed by GLC. It is however important to note that as established by applicable guidance of the CDM Project Standard ^{12/}, the assessments and opinions for all confirmed occurred and planned changes are combined into this single assessment (which is being submitted to approval in the context of the 4th verification). It is also relevant to note that although the registered PDD already refers to the use of captive off-grid electricity generators (where it is not specified the number of units), the addition of the additional backup electricity generators are anyway included as permanent changes in the project design for sake of completeness and transparency.

³ Details and specifications about the currently installed captive off-grid electricity generators (fuelled by diesel) (e.g. manufacturer, model, power, Serial Numbers, etc.) were not included in the revised version of the PDD. As claimed by KDM S.A. such equipment (which are only mobile units and are expected to be utilized during temporary or emergency situations) may be eventually permanently or temporarily replaced by similar or comparable units along the crediting period due to reasons such as maintenance/overhauling schedules, or even due to commercial reasons (terms and condition for equipment purchasing, leasing, etc.). It is thus the opinion of the GLC's assessment team that the decision of KDM S.A. of not including specification details of such electricity generators in the PDD is deemed reasonable and acceptable. It is important to note that, as argued by KDM S.A., specification details about these backup units are to be regularly included in the Monitoring Reports along the crediting period.

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Table 3-1: Comparative table for specifications of electricity generation equipment fuelled by LFG

Comparative table for specifications of electricity generation equipment fuelled by LFG			
	Specifications of installed and yet to be installed engine-generator sets		Specification of engine-generator sets considered at the time of compilation of the initial version of the registered PDD in mid 2006
	CLLC-1 electricity generation facility (2.0 MW of total nameplate power generation installed capacity)	CLLC-2 electricity generation facility (~31.1 MW of total nameplate power generation installed capacity in its final configuration)	-
Manufacturer	GE-Waukesha	GE-Jenbacher	Waukesha
Model	GE-Waukesha APG1000 series	GE-Jenbacher J420 series (or similar, in the case of the yet to be installed units)	Waukesha VHP Series
Engine model	16V-150LTD	JGS-420 GS-LL (or similar, in the case of the yet to be installed units)	VHP L7042 GL
Number of units	2	22	25
Installation / operation starting date and considered further implementation schedule (for additional units)	<ul style="list-style-type: none"> - Installation during first half of year 2009 - Testing's start on 7 June 2009 - Continuous operation (connection to the electricity grid) on 26 November 2009 	<ul style="list-style-type: none"> - In September 2011, the first 7 units were installed. - During year 2012, additional 4 units are expected to be installed. - Gradual installation of additional 11 units to occur following the schedule presented in the revised PDD. 	<ul style="list-style-type: none"> - 1 unit in 2008 - 12 units by 2009 - 4 units by 2013 - 5 units by 2017 - 3 units by 2022
Combustion Cycle	Miller	Otto	Otto
Combustion type	lean burn	lean burn	lean burn
Aspiration type	Turbocharged 2 stage with admission air cooling	Turbocharged 2 stage with admission air cooling	Turbocharged with admission air cooling
Process Controller Technology	ESM [®]	Leanox [®]	CEC [®] + DSM [®]
Electric Power (nominal)	1,000 kW	1,413 kW	875 kW
Technical LFG-to-electricity conversion efficiency	about 42% (from 40% to 42% depending on operational conditions) This is regarded as equivalent to continuous flow of about 550 Nm ³ /h of LFG (with 50% CH ₄)	about 42% (from 40% to 42% depending on operational conditions) This is regarded as equivalent to continuous flow of about 550 Nm ³ /h of LFG	about 35% (from 32% to 36% depending on operational conditions) This is regarded as equivalent to continuous

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	content) for generating a continuous power of 1 MW of electricity.	(with 50% CH ₄ content) for generating a continuous power of 1 MW of electricity.	flow of about 688 Nm ³ /h of LFG (with 50% CH ₄ content) for generating a continuous power of 1 MW of electricity.
Generator voltage	400 V	400 V	400 V
Cylinder configuration	V16	V20	V12

As further assessed in Section 4, the installation of electricity generation equipment with specifications that are different than specifications earlier considered are claimed by KDM S.A. to be a direct consequence of more recently occurred technological improvements and local market developments within in the field of utilization of LFG as fuel for electricity generation in Latin America (including in Chile).

Thus, the revised implementation of the project's electricity component in terms of specifications of equipment is reasonably claimed by KDM S.A. not to be resulted from a willingness of this project participant to adopt technology different than technology earlier considered in the initial project design, but a direct outcome of changes in local market conditions.

It is important to note that, as also claimed by KDM S.A, and acknowledged by the GLC's assessment team, despite of use of more modern equipment, the adopted basic technological concept for generation of electricity is still being the same as earlier considered at the time of compilation of the initial version of the PDD. Regardless of the changes in equipment specifications, the project's electricity generation is still being based on the following:

- Export of net electricity generation through the National Electricity Grid of Chile.
- Utilization of internal combustion engines (fuelled uniquely by LFG collected by the project activity) which are coupled to a 50 Hz alternate current power generator and power transformer.

The following documented evidences were assessed by the GLC's assessment team in order to confirm all information provided in this section:

- Fact sheet (brochure) with general technical specifications for the full range of Waukesha engine-generator sets ^{/26/}.
- Fact sheet (brochure) with detailed technical specifications for the Waukesha VHP L7042GL engine-generator set ^{/27/}.
- Fact sheet (brochure) with detailed technical specifications for the GE Waukesha APG1000 engine-generator set ^{/28/}.
- Fact sheet (brochure) with detailed technical specifications for the GE Jenbacher Type 4 Series engine-generator set ^{/29/}.

Furthermore, during a conducted on-site visit to the project site (during the period from 2012-07-24 to 2012-07-28), the GLC's assessment team was also able to confirm the installation and operation of the two GE Waukesha APG1000 engine generator sets and nine GE Jenbacher Type 4 Series engine-generator sets currently installed⁴.

⁴ As indicated in Table 3-1, the initial 7 units of GE Jenbacher Type 4 Series engine-generator sets were installed in September 2011. During year 2012, additional 4 units are expected to be installed.

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3.1.2 Specifications of the additional two captive off-grid electricity generators (fuelled by diesel) which were installed as part of the implementation of CLLC-2 electricity generation facility

The following table summarizes the specifications of the two additional backup captive off-grid electricity generators (fuelled by diesel) which were installed in the project site for meeting emergency and safety operational requirements of the CLLC-2 electricity generation facility.

Table 3-2: Specifications of backup captive off-grid electricity generators

	Specifications of backup captive off-grid electricity generators fuelled by diesel	
	Backup unit for the CLLC-2 electricity generation facility	Backup unit for the SLLC-2 power substation
Manufacturer	SDEC	Mecc Alt Spa.
Model	SD-C400	ECP34-2S
Specific fuel consumption	0.23 kg/kWh	n/a
Power output	440 kVA (352 kW)	100 kVA (80 kW)
Serial Number (S/N)		H341010223
Installation / operation starting date	September 2011	September 2011

The following documented evidences were assessed by the GLC's assessment team in order to confirm all information provided in this section:

- Fact sheet (brochure) with general technical specifications for the SDEC / SD-C400 electricity generator ^{/54/}.
- Fact sheet (brochure) with general technical specifications for the Mecc Alt Spa. / ECP34-2S electricity generator ^{/55/}.

Furthermore, during a conducted on-site visit to the project site (during the period from 2012-07-24 to 2012-07-28), the GLC's assessment team was also able to confirm the installation of the two backup units. During the site visit, the backup SDEC / SD-C400 electricity generator was under operation on 2012-08-25 due to performance of testing work in the CLLC-2 electricity generation facility (and its temporary disconnection from the electricity grid).

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3.2 Overview of the permanent changes from the registered monitoring plan and/or monitoring methodology

The revised version of the PDD (version 5.3) ^{/1/} also incorporates revision of the registered monitoring plan which encompasses the following:

- *More appropriate approaches and options for monitoring parameters associated with the determination of project emissions due to the consumption of electricity sourced from the grid and/or electricity sourced from a captive off-grid electricity generator (fuelled by diesel) by the project activity.*
- *A more appropriate approach for monitoring parameters associated with the determination of project emissions due to the consumption of Liquefied Petroleum Gas (LPG) by the project activity⁵*
- *Incorporation in the monitoring plan of the option of performing measurements of CH₄ fraction in collected LFG by using a calibrated portable gas analyzer (only during temporary circumstances when the continuous CH₄ content gas analyzer unit is not available)⁶*

The permanent changes from the registered monitoring plan encompass the addition of new monitoring parameters and further monitoring details. The revision of the monitoring plan aims to make the overall design of the monitoring plan in accordance to the actual project implementation and monitoring practice. It is crucial to note that while the overall objective of the revision of the monitoring plan is to complement and improve monitoring requirements and details, the revised monitoring plan does not aim to address any previous or existent inability or incapacity of the project participants to implement the earlier registered monitoring plan.

⁵ As further assessed in Section 4, it is important to note that while LPG has been used for igniting the flares since the starting of the project activity and the registered PDD refers to such fossil fuel consumption, the use of LPG by the project activity is thus not hereby addressed as a permanent change in the project design. While consumption of LPG by the project activity has been regarded as project emissions in the context of previous verification assessments, the decision of KDM S.A. to incorporate, in the revised version of the PDD, a more appropriate approach for monitoring parameters associated with the determination of project emissions due to the consumption of LPG by the project activity, such changes are thus addressed as permanent changes from the registered monitoring plan. This is deemed acceptable and correct.

⁶ By acknowledging that ACM00001 (version 4) explicitly allows use of portable gas analyzer for measuring the fraction of methane in the landfill gas (wCH_{4,y})⁶, as part of the operation of the project activity KDM S.A. has historically followed (whenever needed) the applicable instructions of the internal documented working procedure for the whole project activity (*I-RSL-013 – Instructivo Sistema de Captacion y Abatimiento de Biogas* ^{/30/}). As confirmed by the GLC's assessment team, this procedure *inter alia* specifies that, whenever the continuous CH₄ content gas analyzer is not functioning, measurements of CH₄ fraction in collected LFG should be done by using a portable gas analyzer (with measurements being performed and recorded every 5 minutes). In the context of the related revision of the registered monitoring plan (as described in the PDD), references to applicable guidance of the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements"⁶ are also included (for determination of minimum sampling size and related calculation to address associated uncertainties).

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3.3 Overview of performed corrections in the PDD (that do not affect the project design)

In the context of the submission of a revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/}, the project participant KDM S.A. also took the opportunity to correct previously existent minor errors and mistakes of the initial registered version of the PDD ^{/2/} in terms of general project description and application of applied baseline and monitoring methodologies. No corrections to project information or parameters fixed at validation (as described in the registered PDD) have been made.

Corrections and text improvements are not directly related to the project design. The corrections include *inter alia* previously existent mistakes and errors in the calculation formulas, references to measurement units, symbols for parameters, references to equations, etc). This is deemed reasonable and acceptable. Section 4.9 includes a table that outlines in details the changes made in each section of the original PDD, original investment analysis spreadsheet and spreadsheet with *ex-ante* estimations of emission reductions. The table also includes the GLC's overall assessment about the text editing's. Corrected information as per the revised of the PDD reflects the actual project information.

3.4 Overview of temporary deviations from the registered monitoring plan and/or monitoring methodology

Not applicable. No temporary deviations from the registered monitoring plan and/or monitoring methodology have occurred.

3.5 Summary of the change to the start date of the crediting period

Not applicable. No change to the start date of the crediting period is being requested.

4 ASSESSMENT OF THE POST-REGISTRATION CHANGES

This section includes further description and the complete assessment of the post-registration changes (as per the latest version of the revised PDD (version 5.3 dated 2012-08-02) ^{/1/}) vis-à-vis all currently applicable requirements for addressing post-registration changes for a registered CDM project activity.

The assessment of the changes includes:

- The reasons and rationale for the changes
- The timing of the changes (assessment whether the changes were known prior to the registration of the project as a CDM project activity),
- The impact of the changes in terms of the overall operation of the project activity
- The impact of the changes in terms of specific requirements for CDM project activities (if/how the changes raise potential concerns in term of scale, additionality, application of selected methodology(ies) for the project activity).

4.1 Occurred and yet to be fully implemented (planned) permanent changes in the project design in the project's electricity generation component

As per assumptions valid for the initially registered version of the PDD (version 4) ^{/2/}, the implementation of the project's electricity generation component would originally start in year 2008 with the commissioning and start of operation of an electricity generation facility with nameplate installed power generation capacity of 0.8 MW (as the first step of the gradual implementation schedule for the project's electricity generation component). Also as per the earlier version of the registered PDD ^{/2/}, as a result of the expected phased implementation of project's electricity generation component (along its expected lifetime), increments in total nameplate installed capacity for this project component (addition of extras engine-generator sets) would occur following an earlier forecasted gradual implementation schedule (which is also indicated in the PDD version 4) and utilizing engine generator sets with 0.8 MW of nameplate power generation capacity each. Also as per the initial version of the registered PDD ^{/2/}, the project's electricity generation component was expected to reach an accumulated and final installed power generation capacity of about 20.0 MW by year 2022. Due to the reasons assessed below, these schedule and forecasts ended up not being followed and they are not expected to be followed in the future either.

As appropriately stated in the revised version of the PDD ^{/1/}:

"Since the initial conceptualization of the design for the project activity, gradual and phased implementation schedule for the project's electricity generation component has been assumed as fully dependent on the following project's design and operational aspects/requisites:

- *(i) expected and projected relative increments in terms of LFG generation and LFG collection along the crediting period and*
- *(ii) high share of collected LFG being utilized as fuel for electricity generation (instead of flaring collected LFG)*

(...)

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In the particular context of the initial registered version of the PDD, gradual phased increments in the total installed nameplate power generation capacity were also estimated based on the following aspects/elements:

- *(i) ex-ante estimations of LFG generation and collection by the project activity (by using the first order decay model – FOD model as required by ACM0001 (version 4))*
- *(ii) by considering an earlier assumed maximum technical LFG utilization rate (as fuel for electricity generation) for the total flow of LFG effectively collected of about 80% (due to expected variability in the flow rate, it was expected that not more than 80% of all collected LFG would end up being utilized as fuel for electricity generation)*
- *(iii) by considering an earlier assumed technical LFG-to-electricity conversion efficiency as follows: about 688 m³/h of constant LFG flow (with 50% CH₄ content) was assumed as required for generating a constant power of 1.0 MW of electricity. This earlier assumed technical conversion efficiency for related equipment was obviously applicable under circumstances with power generation equipment operating continuously and under optimal operational conditions in terms of fuel supply (quality of fuel), fuel quality and conditions of the electricity grid)."*

4.1.1 Timeline for the occurred changes and schedule for yet to be fully implemented (planned) changes

Timeline for the implementation of the CLLC-1 electricity generation facility:

The occurred delay in the installation of the first engine-generator sets (CLLC-1 electricity generation facility equipped with two GE-Waukesha APG1000) represents the first occurred relevant post-registration permanent change in the project design (as per the earlier registered version of the PDD (version 4) ¹²⁾): While as per the initial version of the registered PDD, the first engine-generator sets would be installed in year 2008, power generation equipment were only installed and started to operate later in year 2009. The following circumstances are associated with this occurred delay:

Procurement and commercial difficulties:

As claimed by the project participants during interview conducted by the GLC's assessment team, this relative delay occurred mainly due to procurement and commercial difficulties faced by KDM S.A. The fact that equipment for electricity generation (using LFG as fuel) were not representing a widely available and/or commonly used technology in Chile and other countries in Latin America at that time promoted a negative impact over the implementation of the initial phase of the project's electricity generation component as claimed by KDM S.A.⁷.

⁷ As widely known among local experts and practitioners in the field of biogas from landfills, the GLC's assessment team is also aware that utilization of LFG as fuel for electricity generation is still not being a widely available and/or commonly used technology in the whole Latin America. In South America, currently there are only four implemented initiatives using LFG as fuel for electricity generation:

- the CDM project activity "São João Landfill Gas to Energy Project (SJ)" in Brazil (of which implementation of the electricity generation component is dated year 2007) (<http://cdm.unfccc.int/Projects/DB/DNV-CUK1145141778.29/view>)
- the CDM project activity "Bandeirantes Landfill Gas to Energy Project (BLFGE)" in Brazil (of which implementation of the electricity generation component is dated year 2004)

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As also explained by the project participant KDM S.A. (through interviews conducted by the GLC's assessment team), business related issues involving selection of equipment supplier and contractors by KDM S.A. as well as agreements with local power distribution companies / power transmission companies were also driver for the occurred more than one year relative delay in the actual implementation and start of operation of the first engine-generator sets.

Perceived risks and uncertainties related to the verified underperformance of the project's LFG collection system:

Furthermore, as also argued by the KDM S.A. the verified relative underperformance of the project's LFG collection system during its initial operational phase (where the amount of LFG actually collected by the project in its initial operational stage was by far below related *ex-ante* estimates in the registered PDD (version 4) ^{/2/}) also represented a strong risk and uncertainty driver for KDM S.A. This aspect also contributed for the occurred delay in the initial implementation of the project's electricity generation component. As acknowledged by KDM S.A., capital expenditures (investments) for the initial implementation of the project's electricity generation component were somehow postponed due to such perceived uncertainties and risks related to underperformance of project (in terms of collection of LFG). This is further assessed in Section 4.1.1. Historical records of LFG collection ^{/18/} were made available by KDM S.A. as evidences of the relative underperformance of the project activity during its initial operational phase (when compared to LFG collection forecasts in the registered version of the PDD ^{/2/}). Figures available in the Monitoring Reports ^{/19/} for the first and second period verifications for the project activity also confirm such underperformance.

During the period between the project CDM registration (March 2007) and year 2008, it became clear to KDM S.A. that the original plan and timeline of installing the first generator of 0.8 MW in year 2008 (as per the time plan of the registered PDD) was not going to be met. The decision to install the first engine-generator sets under a revised schedule and using equipment with nameplate capacity different than 0.8 MW and of improved energy conversion efficient is demonstrated to be dated after the registration of the project as a CDM project activity. In order to confirm that, the GLC's assessment team assessed the following documents related to the installation of the 2 units of GE-Waukesha APG1000 series engine-generator sets:

- Approved KDM S.A.'s internal equipment purchasing order No. 349370 that deals with acquisition and installation of the related equipment for the 2 GE-Waukesha APG1000 series engine-generator sets. Purchasing order issued against Maestranza Diesel S.A. (dated 2008-09-25) ^{/7/}

- the CDM project activity "Salvador da Bahia Landfill Gas Management" in Brazil (of which start of operation of the project's electricity generation component is dated January 2011).

There are other registered (or under registration) CDM project activities encompassing LFG utilization for electricity generation. However in none of these other project based initiatives an electricity generation component is currently implemented.

The GLC's related assessment is based on information made available at UNFCCC's CDM website and also declarations from BATTRE S.A. (project participant for the CDM project activity "Salvador da Bahia Landfill Gas Management").

By taking into account the very reduced number of electricity generation facilities promoting utilization of LFG, it is the opinion of the GLC's assessment team it is reasonable to claim that that equipment for electricity generation (using LFG as fuel) were not representing a widely available and/or commonly used technology in Chile and other countries in Latin America in mid 2006 and it is still not representing a widely available and/or commonly used technology in the whole South America either.

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- Approved KDM S.A.'s internal equipment purchasing order No. 350119 that deals with acquisition and installation of one LFG blowers manufactured by LFG Specialties. Purchasing order issued against LFG Specialties LLC. (dated 2008-11-03) ^{/8/}
 - Approved KDM S.A.'s internal equipment purchasing order No. 350256 that deals with acquisition and installation of the related cooling system equipment for the 2 GE-Waukesha APG1000 series engine-generator sets. Purchasing order issued against Maestranza Diesel S.A. (dated 2008-11-11) ^{/9/}
- Approved KDM S.A.'s internal equipment purchasing order No. 600033 that deals with acquisition and installation of the related transmission and control system equipment for the 2 GE-Waukesha APG1000 series engine-generator sets + testing services. Purchasing order issued against Maestranza Diesel S.A. (dated 2009-10-21) ^{/10/}

The above listed documents represent credible evidences that confirm the revision of the implementation schedule for the initial phase of the project's electricity generation component.

Timeline and schedule for the implementation of the CLLC-2 electricity generation facility:

The schedule for further capacity additions in terms of power generation equipment was also changed as per earlier forecast made available in the earlier registered version of the PDD (version 4) ^{/2/}. The occurred timing for the 2nd implementation phase of the project's electricity generation component and schedule for yet to be fully implemented further capacity additions also represents post-registration permanent change in the project design. The total and final power generation installed capacity is now expected to gradually increase up to 33.1 MW (by year 2026) (instead of 20.0 MW by year 2022 as per the earlier version of the registered PDD ^{/2/}). Moreover, capacity additions will occur under a revised implementation schedule (which is detailed in the revised version of the PDD ^{/1/}). The following circumstance is associated with the change in the capacity addition schedule:

The revised project's implementation schedule (from the 2nd implementation phase of the project's electricity generation component onwards) is somehow also related to the use of more efficient power generation equipment (which actually triggered the increase in power generation capacity along the expected project lifetime) and occurred improvements in the operation of the LFG collection system. During the expected project's lifetime period, capacity additions occurred and are planned to occur via utilization of up to 22 units of 1.4 MW Jenbacher G-420 engine-generator sets (of which general specifications are presented below).

In this sense, power generation equipment installed and yet to be installed under a revised schedule has nameplate power generation capacity which is different than 0.8 MW each (as earlier considered).

The decision to gradually implement up to 22 GE Jenbacher model J420 engine-generator sets (as part of the subsequent phases of the project's electricity generation component) are dated after the registration of the project as a CDM in project activity. The following timeline for the subsequent phases of the project's electricity generation component is applicable:

- As confirmed by the GLC's assessment team, after evaluation of different offers and technical solutions, KDM S.A. had signed in May 2011 a contractual agreement with company Generadora Trasandina S.A. involving the gradual installation and operation of up to 22 GE Jenbacher model J420 engine-generator sets (with 1.4 MW of nameplate installed capacity each). Generadora Trasandina S.A. is the representative in Chile for the equipment manufacturer GE-Jenbacher GmbH & Co OG. In order to confirm that, the GLC's assessment team assessed the following documents:

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- Technical and commercial offer from Generadora Trasandina S.A. to KDM S.A. related to the gradual implementation of GE-Jenbacher J420 series engine-generator sets and ancillary equipment + operation of the power plant. (dated 2010-05-10) ^{/11/}.
- Technical and commercial offer from DLP-ener Constructora Ltda. to KDM S.A. related to the civil construction of edifications and supplementary facilities for the power plant equipped with the GE-Jenbacher J420 series engine-generator sets (dated 2010-10-26) ^{/13/}.
- Approved KDM S.A.'s internal equipment purchasing order No. 600234 that deals with acquisition of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Alstom Grid Chile S.A. (dated 2010-10-14) ^{/14/}
- Approved KDM S.A.'s internal equipment purchasing order No. 600420 that deals with acquisition and installation of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Rhona S.A. (dated 2011-03-24) ^{/15/}.
- Approved KDM S.A.'s internal equipment purchasing order No. 600445 that deals with assembly and installation of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Alstom Grid Chile S.A. (dated 2011-04-05) ^{/16/}.

The above listed documents represent credible evidences that confirm the revision of the implementation schedule for the subsequent phases of the project's electricity generation component.

It is also relevant to note that, as part of the implementation of CLLC-2 electricity generation facility, apart of a previously existent captive off-grid electricity generators (fuelled by diesel), two additional captive off-grid electricity generators (also fuelled by diesel) were installed and became functional in September 2011. These backup electricity generators were installed in order to supply electricity to the project activity during temporarily circumstances where the supply of grid electricity is interrupted. One captive electricity generator (fuelled by diesel) with 440 kVA (352 kW) of power output is currently connected to Electricity generation facility 2 (CLLC-2). The other installed captive electricity generator (fuelled by diesel) with 100 kVA (80 kW) of power output is connected to the power substation of the electricity generation facility 2 (SELLC-2). The previously existent captive electricity generator is connected to the project's LFG collection and flaring system.

4.1.2 Reasons and rationale for the occurred and planned permanent changes in the project design

Reasons for the occurred and planned relative increments in total nameplate installed power generation capacity for the project's electricity generation component and revision of its gradual implementation schedule:

As stated in the latest version of revised the PDD (version 5.3) ^{/1/} the two main reasons for the occurred and planned relative increments in total nameplate installed power generation capacity for the project activity and the revision of its gradual implementation schedule are as follows:

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"In the context of the actual implementation and operation of the project activity, the occurred and planned revised implementation schedule for the project's electricity generation component is regarded as a direct outcome/consequence of the following two main reasons and aspects:

- *(i) Better understanding and assurance by KDM S.A, in terms of real flow of LFG collection in the project site. This is a direct outcome of the development of operational experience and competence developments within all operational aspects of the project activity by KDM S.A. These aspects have actually promoted significant improvements in terms of flow of LFG actually collected and also significant improvements in terms of expected variability of collected LFG flow (LFG flow variability has decreased significantly). These two main aspects have allowed a higher technical utilization rate of collected LFG (as fuel for electricity generation), making relative increments in terms of installed power generation capacity feasible. The higher availability of LFG also triggered the higher power generation installed capacity (when compared to earlier estimates and forecasts at the time of the project implementation decision making in mid 2006).*
- *(ii) availability in the Chilean market of power generation equipment (fuelled by LFG) (engine-generator sets) with about 20% higher conversion efficiency than equipment specification previously considered in the earlier conceptualization of the project activity in mid 2006." (reflected in terms of flow of LFG with 50% methane content required to generate 1.0 MW of power)*

The GLC's assessment team has assessed the following documented evidences which confirm the correctness of item (i) in the assertions above (quoted from the latest version of the revised PDD ^{/1/}):

- KDM S.A.'s internal records destruction and utilization of collected LFG by the project activity "Loma Los Colorados Landfill Gas Project" during the period from March 2007 to May 2012 ^{/18/}
- Monitoring Reports for the 1st, 2nd and 3rd verifications of the project activity (verification periods from 2007-03-17 to 2007-06-17; from 2007-06-18 to 2008-03-12 and from 2008-03-13 to 2009-08-31 respectively) ^{/19/}.

The above listed documents represent credible evidences that during the period from March 2007 to May 2012 significant improvements in terms of quantitative flow of LFG actually collected by the project activity indeed occurred.

As no significant increment in the average amount of municipal solid waste (MSW) daily disposed in the landfill occurred, it is deemed reasonable to assume that the verified increment in collected LFG flow is thus a direct result of occurred developments and improvements in terms of project operational experience and expertise (including competence developments within all operational aspects of the project activity) as claimed by KDM S.A. Related uncertainties in the application of the First Order Decay model (FOD model) in the context of the *ex-ante* estimations of emission reductions in the PDD also play a role in the differences between earlier estimated and actually measured or yet to be measured amount of LFG to be combusted by the project activity.

Moreover, the GLC's assessment team was thus able to confirm the rationale for the above-described changes:

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- As a result of achievement of improved LFG collection (higher flow of collected LFG and lower related variability in LFG flow and CH₄ content (in comparison with earlier assumptions at the time of the initial design conceptualization for the project activity in mid 2006), the potential for LFG utilization flow became available to be utilized as fuel for electricity generation. That made feasible a potential utilization rate of collected LFG (as fuel for electricity generation) at least 20% higher than as per earlier assumptions. The outcome of this improved availability of collected LFG was the rational and reasonable decision of KDM S.A. to revise the project design by promoting increments in terms of installed power generation capacity. Higher flow of collected LFG as fuel being utilized for electricity generation (instead of combustion of excess of collected LFG in enclosed high temperature flares) represents a rational, more economic attractive and environmental friendlier decision of KDM S.A.

The latest version of the revised PDD (version 5.3 dated 2012-08-02) ^{/1/} also includes the following statements regarding the implementation of power generation equipment with high conversion efficiency:

"Reasons and rationale for the changes in specification of equipment:

- *Due to market conditions and technology development, "LFG to electricity" power generation equipment currently available in the Chilean market is more advanced, modern and efficient (in terms of energy conversion efficiency) than equipment earlier considered at the time of the compilation of the initial version of the PDD in mid 2006. It is important to note that such relative "gain" in terms of energy conversion efficiency for the installed (and expected to be installed) equipment purely reflects the recent technology/market development within in the area of utilization of LFG as fuel for electricity generation (and not a willingness of project participant to adopt technology different than technology considered in the initial project design). It is also important to note that adopted technology concept was not changed at all: both as per the situation considered at the time of the compilation of the initial version of the PDD as well as in the context of the occurred and planned implementation of the project's electricity generation component, internal combustion engines (fuelled by LFG) which are coupled to alternate current generators are considered to be used. The occurred "gain" in efficiency is thus merely due to the improvements in the design of equipment: use of equipment with more advanced mechanics and electronics (better geometry of engine components, better design and control of fuel-air mixing valves, improved engine controls, etc.). The recent availability of more technologically advanced LFG fuelled power generation equipment in selected markets in Latin America (e.g. Chile, Brazil, Colombia, etc.) is to some extent a positive externality of the CDM in the view of KDM S.A."*

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The GLC's assessment team has assessed the following documented evidences which confirm the assertions above (quoted from the latest version of the revised PDD ^{/1/}):

- Fact sheet (brochure) with general technical specifications for the full range of Waukesha engine-generator sets ^{/26/}.
- Fact sheet (brochure) with detailed technical specifications for the Waukesha VHP L7042GL engine-generator set ^{/27/}.

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- Fact sheet (brochure) with detailed technical specifications for the GE Waukesha APG1000 engine-generator set ^{/28/}.
- Fact sheet (brochure) with detailed technical specifications for the GE Jenbacher Type 4 Series engine-generator set ^{/29/}.
- Performance targets under the Programme California Advanced Reciprocating Internal Combustion Engine (ARICE) considered for the period from year 2007 to year 2010 (including fuel-to-electricity efficiency). The ARICE programme is a programme established by the California Environmental Protection Agency. (The GLC's assessment team also assessed general fact details about the ARICE programme by revising related documentation ^{/34/}).

The GLC's assessment team was able to confirm the rationale for the above-described changes: with more technologically advanced power generation equipment being more recently being made available in the Chilean market, the adoption of such equipment (instead of equipment with design dated 1970's) represents a rational decision of KDM S.A.

As a conclusion, the GLC's assessment team was able to confirm that the following 3 aspects are the drivers which allowed KDM S.A. to promote both increments in capacity additions and a revision of the gradual implementation plan of the project's electricity generation component:

- (i) availability of more efficient power generation equipment in the Chilean market
- (ii) the occurred relative increase in LFG collection flow as a direct result of better management of LFG collection activity
- (iii) the verified decrease of LFG flow variability (when compared to earlier related assumptions and forecasts) which is also an outcome of better management of LFG collection activity

Based on its sectoral expertise, the GLC's assessment team confirms the plausibility of the explanations from KDM S.A. regarding the rationale and reasons for the above-described occurred and planned permanent changes in the design of the project activity. The GLC's assessment team acknowledges it is common practice in initiatives promoting electricity generation using LFG as fuel that installed nameplate capacity for the power plant as well as implementation schedule for related capacity additions are fully dependent on the LFG availability.

As part of its related technical assessment, the GLC's assessment team also highlights the following additional notes:

Additional note 1:

Design of power plants based on the projected flow of collected LFG vis-à-vis uncertainties in estimating amount of collected LFG to be utilized in LFG collection and destruction/utilization projects

The GLC's assessment team also acknowledges that in a typical LFG collection and destruction/utilization initiative with electricity generation, it is common practice and to a certain level it is expected to use high share of collected LFG as fuel for electricity generation (instead of combusted collected LFG in the enclosed high temperature flares). As it is very hard to predict with high level of certainty, the optimum installed capacity for an electricity generation facility fuelled by collected LFG, the occurred revision of the gradual capacity additions in related nameplate total installed capacity for power generation equipment by KDM

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S.A. is thus a direct reflect of all uncertainties typically applicable to LFG collection and destruction/utilization projects.

In the case of LFG collection and destruction/utilization projects under the CDM, as also claimed by KDM S.A., it is widely acknowledged that estimates of LFG generation and collection in landfill by using the first order decay model (FOD model) in the context of *ex-ante* estimations of emission reductions in PDDs incorporate high uncertainty level. Based on assessment of related literature ^{/31/ /51/ /52/}, the GLC's assessment team is aware that there are several design and operational aspects of both the landfill and the LFG collection system that influence the amount of LFG to be actually collected. Thus, like in the case of the project, other CDM project activities of this type may achieve emission reduction of a magnitude which does not match estimates in the PDDs. The GLC's assessment team also acknowledges that high variability in collected LFG flow has been a problem which is faced by initiatives promoting the use of LFG as fuel for electricity generation. Whenever the flow and quality of collected LFG vary significantly, this can cause difficulties in operating a LFG-to-electricity plant.

As confirmed by the GLC's assessment team, when the project design was conceived in mid 2006, there were lots of uncertainties about the amount of LFG that could be technically collected by the project activity. This is typical in any initiative promoting LFG collection and utilization.

In the context of project's implementation decision-making process (and compilation of the PDD), KDM S.A. declares that it was assumed a too much conservative (but at time assumed as realistic) assumption that no more than 80% of the effectively collected LFG would end up being technically used as fuel to electricity generation (due inter alia to expected high uncertainty about flow as well as expected high variability of LFG flow and CH₄ content in collected LFG). After two years of experience with the operation of the project activity (which is operated in conjunction with the Loma Los Colorados landfill), KDM S.A. obtained much more confidence (which has been confirmed up to a certain limit) that the project's operation would indeed achieve or even exceed the earlier projected LFG collection rate (as per figures in the registered PDD ^{/2/}). Moreover, it was confirmed that the feasibility of operating the project with a desirable very low variability level in terms of flow of collected LFG and CH₄ content in collected LFG. These two positive aspects (which directly resulted in more LFG flow being available to be utilized for electricity generation) were thus the main driver to the decision of KDM S.A. to revise the gradual implementation schedule for the project's electricity generation component.

Additional note 2:

Utilization of more advanced power generation equipment in LFG collection and destruction/utilization projects:

With respect to the technology and performance of the engine-generator sets, the GLC's assessment team was able to confirm that at the time of the implementation decision-making phase of the project (in mid 2006), the investment analysis and related emission reduction estimations in the PDD were performed by KDM S.A. and hired CDM consultants/experts by considering the use of multiples engine-generator sets manufactured by GE-Waukesha and of VHP-L7042GL model (with 0.8 MW of nameplate installed capacity each). This was the model of engine-generator set which was available in the Chilean market at that time and regarded as the best option by KDM S.A. at that time (by taking into account local availability of

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authorized service, spare parts, reliability). As confirmed by the GLC's assessment team, the GE-Waukesha VHP-L7042GL series are proven to be reliable engine-generator sets. However, the basic design of the engine is dated from the 1970's (or even earlier). The old design of the engine is directly reflected in the performance of the engine-generator sets in terms of energy conversion efficiency: the set has an energy conversion efficiency of about 32-36% (as per data of the manufacturer each GE-Waukesha VHP-L7042GL unit would thus require on average a technically estimated continuous LFG flow of about 688 m³/h to continuously generate equivalent of 1.0 MW of electricity).

The GLC's assessment team is aware that in the last decades there has been an increasing interest from gas engine makers in electricity generation based on LFG gas as the number of these applications has significantly increased (especially in Western Europe). As a consequence of this, new and more efficient engine-generator set models have been made available in the global market in the latest years. As correctly outlined in the revised PDD, newer models have a better performance compared with previous models (with energy conversion efficiency in the range of 40-42%) due to the use of more advanced mechanical and electrical/electronic design solutions (better geometry of engine components, better material, better design and control of fuel-air mixing valves, improved engine controls, etc.). In the particular case of the engine generator sets currently installed in the project site (GE-Waukesha APG1000 series and GE-Jenbacher J420 series), the LFG-to-electricity technical energy conversion efficiency is equivalent to a continuous LFG flow (with 50% CH₄ content) of about 550 m³/h for generating 1.0 MW of continuous power. By considering the lower specific LFG consumption of the installed (and planned to be installed) engine-generator sets, the verified occurred relative increase in LFG collection flow and the verified decrease of LFG flow variability (when compared to earlier related assumptions and forecasts) it was assumed as feasible the average increment in the total installed capacity of the project's electricity generation component along its gradual implementation time frame.

Moreover, the GLC's assessment team is also aware that the power generation equipment using LFG as fuel such as the ones supplied by GE-Jenbacher are indeed more efficient and reliable than earlier designed solutions (such as Waukesha VHP-L7042GL model). In the particular case of GE-Jenbacher equipment, the GLC's assessment team is also aware that, as also widely known among experts in the field of power generation using LFG, the use of advanced mechanics and electronics (better geometry of engine components, better design and control of fuel-air mixing valves, improved engine controls and management system, etc.) has been a powerful technical driver/approach to overcome the typical operational challenges involving the utilization of LFG as fuel for power generation. The GLC's assessment team also has the opinion that, as claimed by KDM S.A., it is quite recent the local availability of more technologically advanced engine-generation sets using LFG as fuel in selected markets in Latin America (e.g. Chile, Brazil, Colombia). The GLC's assessment team is also of the opinion that occurred and ongoing related market developments are to some extent a positive externality of the CDM. As further assessed in Section 4.1.1, all currently available and operational initiatives promoting utilization of LFG as fuel for electricity generation in the whole South America are registered as project based initiatives under the CDM.

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Reasons for installation of two additional backup captive electricity generators:

While prior to the implementation of the two additional backup generators, another backup generator were installed (in March 2007), these new additional backup units were installed in order to meet applicable emergency and safety requirements for the operation of the CLLC-2 electricity generation facility and the power substation currently connected to such power plants. These units are expected to be used only during emergency situations (where supply of grid electricity is not available and the CLLC-2 power plant is not under operation). This is also indicated in the revised version of the PDD.

Section 4.6, 4.7 and 4.8 include further assessment of the permanent changes in the project design for the project activity (assessment on if these changes raise potential concerns with specific CDM requirements).

4.2 Permanent changes from the registered monitoring plan and/or monitoring methodology

The monitoring plan of the PDD was revised by KDM S.A. by incorporating more appropriate and correct approaches for determining and monitoring project emissions due to:

- Consumption of grid electricity and electricity sourced by a captive off-grid electricity generation (fuelled by diesel) by the project activity;
- Consumption of Liquefied Petroleum Gas (LPG) by the project activity.

The revised monitoring plan also includes the option of performing measurements of CH₄ fraction in collected LFG by using a calibrated portable gas analyzer (only during temporary circumstances when the continuous CH₄ content gas analyzer unit is not available) in the monitoring plan.

4.2.1 Monitoring of parameters related to the consumption of electricity by the project activity

Electricity demand of the project activity has been met by electricity supplied from the grid and also by electricity supplied by captive off-grid electricity generators fuelled by diesel (during temporary circumstances connection to the electricity grid is not available)⁸. It is important to note that while the project activity's electricity demand has been met by grid electricity since start of its operation, currently there are 3 captive off-grid electricity generators (fuelled by diesel) installed in the project as follows:

- One captive electricity generator (fuelled by diesel) with 276 kW of output and connected to project's LFG destruction facility (flaring station) (installed in March 2007)
- One captive electricity generator (fuelled by diesel) with 400 kVA (352 kW) of output and connected to Electricity generation facility 2 (CLLC-2) (installed in September 2011 as part of the implementation of the CLLC-2 electricity generation facility).

⁸ As confirmed by the GLC's assessment team a revision of the monitoring plan was earlier performed in the context of a previous verification assessment in order to include monitoring details for determining project emissions due to consumption by the project activity of electricity sourced by a captive off-grid electricity generator fuelled by diesel that was installed in March 2007. The installation of the two additional backup captive off-grid electricity generators (also fuelled by diesel) are part of the design of the CLLC-2 electricity generation facility and are also regarded as a permanent change in the project design. It is important to note that this validation opinion for post-registration changes also includes the addition of a more appropriate approach to monitor related project emissions from all the installed captive electricity generators as permanent changes from the registered monitoring plan.

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- One captive electricity generator (fuelled by diesel) with 100 kVA (80 kW) of output and connected to the power substation of CLLC-2 (SELLC-2). (installed in September 2011 as part of the implementation of the CLLC-2 electricity generation facility).

While the installation of the two additional electricity generators dated September 2011 are hereby being addressed as permanent changes in the project design in the context of the 4th verification, in the context of the revision of the monitoring plan, the following additional monitoring parameters were added in order to allow more appropriated determination of project emissions due to the consumption of electricity:

- Amount of grid electricity consumed by the project activity ($EC_{grid,y}$)
- Amount of electricity sourced by the captive off-grid electricity generator (fuelled by Diesel) and consumed by the project activity ($EC_{captive,y}$)
- Emission factor for electricity sourced by the the captive off-grid electricity generator ($E_{FEL,captive,y}$)
- Quantity of fuel diesel combusted by the captive off-grid electricity generator ($FC_{Diesel,y}$)
- Net calorific value of the fuel Diesel ($NCV_{Diesel,y}$)
- CO₂ emission factor of fuel Diesel ($EF_{CO2,Diesel,y}$)
- Quantity of electricity generated by captive off-grid electricity generator fuelled by Diesel ($EG_{Diesel-generator,y}$)
- Rated capacity of the installed captive off-grid electricity generator (fuelled by Diesel) ($PP_{Diesel-generator,y}$)

The following clarifications for monitoring the parameter "Quantity of net electricity generated by the project activity using LFG as fuel which is exported during year y (in MWh)" ($EL_{EXPLFG,y}$) were also added in the revised version of the PDD:

- *"Note that grid electricity may eventually and temporarily be used by the project's electricity generation facility(ies) (during temporary circumstances the electricity generation facility(ies) is/are not under operation). In this context $EL_{EXPLFG,y}$ is accounted as the difference between (electricity exported to the grid + electricity exported to the landfill) and electricity imported from the grid for meeting electricity demand of the electricity generation facilities)."*
- *"During temporary circumstances the electricity generation facility(ies) is/are not under operation, electricity demand for the electricity generation facility(ies) (e.g. lighting, cooling, heating of engine-generator sets' cooling, etc.) may be met by (a) imports of grid electricity or (b) use of a captive off-grid electricity generator fuelled by fossil fuel. Under case (a), associated GHG emission will be accounted by deducting the amount of imported grid electricity from total electricity exported by the electricity generation facility(ies) (on the basis of measurements/calculations of amount net-exported electricity as above indicated). Under case (b), associated emissions will be determined as "Project emissions due to consumption of electricity sourced by the captive off-grid electricity generator (fuelled by Diesel) in year y " ($PE_{EC,captive,y}$)."*
- *"Note that as part of operation of electricity generation facility(ies), a small fraction of the electricity generated by the engine-generator sets is consumed by ancillary equipments of the electricity generation facility(ies):*
 - *LFG treatment and cooling system*

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- Radiator (heat exchangers) of the engine-generator sets cooling fluid
- Etc.

Electricity consumption from these sources should not be deducted from measurements of electricity generated by the project as electricity meters are positioned after the power transformer which feeds these ancillary equipment within the power lines."

It is the GLC's opinion that the content of the disclaimers are sufficiently explanative and thus acceptable. It is also noteworthy that in the context of the revision of the monitoring plan, the parameters "Total amount of electricity imported to meet project requirement " ($EL_{IMP,y}$) and "CO₂ emission factor of the grid" (CEF_g) were replaced by the parameters listed above.

Apart of the revision of the Section of the PDD that deal with the description and application of the monitoring plan, sections of the PDD that describes the approaches to be adopted for the determination of related project emissions were also revised accordingly. As outlined in the revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/}:

- Project emissions due to consumption of grid electricity in year y ($PE_{EC,grid,y}$) are determined (in tCO₂) by following the applicable monitoring and calculation procedures as per applicable guidance of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) ^{/24/}. The GLC's assessment team confirmed that related sections of the PDD were revised by correctly taking into account the applicable guidance of this methodological tool.
- Project emissions due to consumption of electricity sourced by the captive off-grid electricity generator (fuelled by diesel) in year y ($PE_{EC,captive,y}$) are determined (in tCO₂) by following one of the four applicable monitoring/calculation approaches as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) ^{/24/}. The revised PDD incorporates monitoring provision for the utilization of options $B1$, $B2$, $B3$ or $B4$ of the methodological tool. The GLC's assessment team confirmed that related sections of the PDD were revised by correctly taking into account the applicable guidance of this tool.

4.2.2 Monitoring of parameters related to the consumption of LPG by the project activity

Since the start of operation of the project activity, LPG has been regularly consumed for igniting the high temperature enclosed flares. In the context of the revision of the monitoring plan, the following additional monitoring parameters were added in order to ensure correct determination (monitoring and calculations) of project emissions due to the consumption of LPG:

- Quantity of fuel LPG combusted by the project activity ($FC_{LPG,y}$)
- CO₂ emission factor for fuel LPG ($EF_{CO_2,LPG,y}$)
- Net calorific value of the fuel LPG ($NCV_{LPG,y}$)

Sections of the PDD that describes the approaches to be adopted for the determination of related project emissions were also revised accordingly. As outlined in the revised version of the PDD ^{/1/}:

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- In order to determine project emissions from LPG combustion ($PE_{LPG,y}$) for igniting the flares, applicable monitoring/calculation guidance of the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (version 2) ^{125/} is applied. The GLC's assessment team confirmed that related sections of the PDD were revised by correctly taking into account the applicable guidance of this methodological tool.

It is important to note that while LPG has been used for igniting the flares since the starting of the project activity and the registered PDD refers to such fossil fuel consumption⁹, the use of LPG by the project activity is not addressed as a permanent change in the project design.

As the quantitative impact of project emissions due to the consumption of LPG by the project activity (over the total emission reductions to be achieved by the project activity) is very small¹⁰, as per the original and revised versions of the PDD, this source of project emissions is not accounted in the context of the *ex-ante* estimations of emission reductions. This is deemed reasonable and acceptable.

4.2.3 Monitoring of CH₄ fraction in collected LFG by using a portable gas analyzer

As confirmed by the GLC's assessment team, ACM0001 (version 4) has the following requirements related to measurement of fraction of methane in collected LFG:

"The fraction of methane in the landfill gas ($w_{CH_4,y}$) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level, using calibrated portable gas meters and taking a statistically valid number of samples and accordingly the amount of landfill gas from $LFG_{total,y}$, $LFG_{flare,y}$, $LFG_{electricity,y}$, and $LFG_{thermal,y}$ shall be monitored in the same frequency. The continuous methane analyser should be the preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.)."

As also confirmed by the GLC's assessment team, more recently than the publication of ACM0001 (version 4), UNFCCC has published the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements" which includes guidelines on how to perform periodic (not continuous) monitoring of the fraction of methane in LFG and how to use the results of these

⁹ As per Section D.3 of the registered version of the PDD (version 4):

"(...) In the case of using LPG as fuel, consumption will be measured by weighing the tanks weekly, recording the weight and the difference from the previous measurement.

(...)

For both cases, diesel and LPG fuel, the recorded data will be used to make the proper discount to the project emissions.

(...)

The emission factor used for LPG and Diesel are IPCC 2006 default values for stationary combustion sources (Volume 2, Chapter 3, page 50, Table 3.5.2.) The higher value will be used by conservative means."

¹⁰ In the context of previous and ongoing verification assessments, project emissions due to the consumption of LPG by the project activity are very low and are reported as follows:

- 1st verification (monitoring period from 2007-03-17 to 2007-06-17): 0.2710 tCO₂
- 2nd verification (monitoring period from 2007-06-18 to 2008-03-12): 0.2710 tCO₂
- 3rd verification (monitoring period from 2008-03-13 to 2009-08-31): 0.5427 tCO₂
- 4th verification (monitoring period from 2009-09-01 to 2010-08-31): 0.2778 tCO₂
- 5th verification (monitoring period from 2010-09-01 to 2011-04-30): 0.1389 tCO₂
- 6th verification (monitoring period from 2011-05-01 to 2012-05-31): 0.27714 tCO₂

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measurements in the context of determination of emission reductions for project activities encompassing LFG collection and destruction/utilization. As per this methodological guidance, which is applicable to all the older versions (from version 1 to version 10) of ACM0001, in the absence of continuous measurements of fraction of CH₄ in collected LFG (e.g. due to malfunction or non-availability of a continuous gas analyzer, measurements should be made on a sampling basis and emission reductions should be determined by considering the calculated value for the so-called "*Lower bound of the 95% confidence interval of fraction of methane in the landfill gas*" ($w_{CH_4,lb,y}$) as the value to be applied for fraction of methane in the landfill gas during the considered period (not covered by continuous measurements of fraction of CH₄ in collected LFG).

For determining emission reductions achieved by the project activity (only during temporary circumstances when the continuous gas analyzer is not functional), records of the every 5-minutes performed measurements of CH₄ fraction in collected LFG (measurements to be performed by using a portable gas analyzer unit) may be considered by following applicable guidance of the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements".

The following disclaimers were thus made available in the description of the monitoring plan in the PDD (Sections D.2.2.1 (column "Comment"); D.2.2.1 (column "Recording Frequency"), D.3 and D.4):

- *"Continuous gas quality analyzer, measures oxygen (O₂), methane (CH₄) and eventually carbon dioxide (CO₂) contents in LFG sent to the flares and for the electricity generation facility(ies). Alternatively, in case Continuous gas quality analyzer is temporarily not available, periodical measurements are to be performed at a 95% confidence level, using a calibrated portable gas meter by applying a statistically valid number of samples. Under such temporarily circumstances, the applicable guidance of the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements" should be followed. The use of continuous gas analyzer is the preferred option."*
- *"Continuous measurement. Values are to be recorded and reported with frequency of at least every minute. During the temporarily utilization of portable CH₄ content gas analyzer, measurements and recording + reporting of measurements are to be done under a frequency never lower than every 5 minutes."*
- *"KDM S.A. will measure methane content using a continuous CH₄ content gas analyzer unit. A portable CH₄ content gas analyzer unit will be used to perform measurements of methane fraction in collected LFG under temporary circumstances when the continuous CH₄ content gas analyzer unit is not available. Equipment will be regularly calibrated/verified in accordance with recommendations from the equipment manufacturer."*

4.2.4 Conclusion about the assessment of the changes from the registered monitoring plan

As a conclusion, the GLC's assessment team has confirmed that the changes in the earlier registered monitoring plan of the PDD (as well as revision of sections of the PDD that describes the approaches to be adopted for the determination of related project emissions) were correctly performed. Revised sections of the PDD include deemed correct monitoring and calculation approaches for the determining

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project emission from consumption of electricity (sourced by the grid and by captive off-grid electricity generators) and LPG by the project activity. It is also important to note that the following relevant disclaimers were appropriately added in revised version of the PDD ^{/1/} (as footnotes in Section B.1):

- *"The use of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" is not required as per ACM0001 (version 4). Anyhow, due to lack of applicable guidance in ACM0001 (version 4), this tool is applied to determine project emissions due to the consumption of grid electricity and also due to consumption of electricity sourced by a fossil fuel captive off-grid electricity generator."*
- *"The use of the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" is not required as per ACM0001 (version 4). Anyhow, due to lack of applicable guidance in ACM0001 (version 4), this tool is thus applied to determine project emissions due to the consumption of fossil fuel by the project activity for use other than electricity generation (e.g. consumption of LPG to ignite the flares)."*

It is also the opinion of the GLC's assessment team that the revised approaches adopted for determination of project emissions (including related revision in the monitoring plan and revisions in sections of the PDD that outline the determination approaches for project emissions) are deemed reasonable and acceptable.

All disclaimers quoted above which deals with the use of a portable gas analyzer for measuring CH₄ fraction of collected LFG and were added in the monitoring plan in the PDD in Sections D.2.2.1; D.2.2.1, D.3 and D.4 are deemed correct and acceptable.

The GLC's assessment team has thus confirmed that the revision of the monitoring plan of the PDD (as well as revision of sections of the PDD that describes the approach to be adopted for the determination of related project emissions) represents a deemed correct and appropriate approach for:

- determining project emission from consumption of electricity (which is sourced by the grid and by a captive fossil fuel electricity generator) by the project activity
- determining project emission from consumption and LPG by the project activity
- determining fraction of CH₄ in collected LFG during temporary circumstances when the continuous gas analyzer is not functional.

The revision of the monitoring plan (and revision of related sections of the PDD describing the approaches for determining project emissions) does not affect the accurateness and correctness of the determination of baseline emissions. It is important to note that the use of portable gas analyzer for monitoring CH₄ fraction in the LFG is allowed by ACM0001 (version 4). Moreover, the application of the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements" is conservative. Moreover, the occurred and planned post-registration permanent changes (which are related to the implementation and operation of the electricity generation component of the project activity) do not compromise the compliance of the monitoring plan with the applied methodologies ACM0001 (version 4) and ACM0002 (version 6) either.

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The level of accuracy and completeness in overall monitoring of the project activity is regarded as not compromised either.

Section 4.6, 4.7 and 4.8 includes further assessment of the permanent changes from the monitoring plan (assessment on if these changes raise potential concerns with specific CDM requirements).

4.3 Corrections that do not affect the project design

As summarized in Section 3.3, in the context of the submission of a revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/}, the project participant KDM S.A. also took the opportunity to correct previously existent minor errors and mistakes of the initial registered version of the PDD ^{/2/} in terms of general project description and application of applied baseline and monitoring methodologies. No corrections to project information or parameters fixed at validation, as described in the registered PDD have been made. Section 4.9 includes a table that outlines in details the changes made in each section of the original PDD, original investment analysis spreadsheet and spreadsheet with *ex-ante* estimations of emission reductions. Such table also includes the GLC's overall assessment about the text editing's. Corrected information as per the revised of the PDD reflects the actual project information.

4.4 Temporary deviations from the registered monitoring plan and/or monitoring methodology

Not applicable. No temporary deviation from the registered monitoring plan and/or monitoring methodology has occurred.

4.5 Change in the starting date of the crediting period

Not applicable. No change to the start date of the crediting period is being requested.

4.6 Assessment whether the changes were known prior to the registration of the project as a CDM project activity

As further assessed in Section 4.1.3, KDM S.A. has taken a decision on the occurred and planned permanent changes in the project design (involving the project's electricity generation component) after the earlier registered version of the PDD (version 4) ^{/2/} was submitted to UNFCCC for registration. It is thus confirmed that the occurred and planned permanent changes in the project design (as presented in this assessment report) were not known by KDM S.A. prior to the registration of the project activity as a CDM project activity.

Consumption of electricity sourced by captive off-grid electricity generator:

While the project activity's electricity demand has been met by grid electricity since the starting of its operations, a 275 kW captive off-grid electricity generator (fuelled by Diesel) was installed and has started to supply electricity to the project activity (during temporarily circumstances where the supply of

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grid electricity is interrupted) in March 2007. Additional 2 captive off-grid electricity generators fuelled by diesel were installed as backup electricity supply sources for the electricity CLLC-2 generation facility in September 2011.

Consumption of LPG:

LPG has been consumed by the project activity (to ignite the flares) since its starting of operation. While the project activity was implemented and started to operated after its registration as a CDM project activity, all these events are thus dated after the registration of the project under the CDM.

However, as confirmed by KDM S.A., at the time of initial version of the registered PDD was completed, it was already known that LPG would be used to ignite the flares. KDM S.A. acknowledges that lack of adequate monitoring and calculation approaches for accounting project emissions due to LPG consumption and consumption of electricity sourced by a captive off-grid electricity generator in the previous versions of the PDD represents failure in appropriately completing the earlier versions of the PDD caused by CDM consultants earlier hired by KDM S.A. This deficiency in the PDD is now corrected.

4.7 Assessment whether the changes will impact the overall operation of the project activity and its ability to achieve GHG emission reductions as stated in the PDD

In general terms, in a technological and operational perspective, the occurred and planned post-registration permanent changes in the project design (involving the project's electricity generation component) will not negatively impact the overall operation / ability of the project activity to deliver emission reductions as stated in the registered version of the PDD (version 4) ^[2]. Higher quantity of electricity is actually expected to be generated as a result of the changes. As per the applied methodologies (ACM0001 (version 4) and ACM0002 (version 6), the more electricity (using LFG as fuel) is electricity, more emission reductions are achieved. The addition of extra backup captive off-grid generator do not have any negative impact over the overall operation / ability of the project activity to deliver emission reductions either as such backup units are expected to be use only during not frequent emergency circumstances when connection to the electricity grid is interrupted.

The permanent changes from the registered monitoring plan do impact the overall operation of the project activity and its ability to achieve GHG emission reductions either.

No change in the technological concept of the project activity:

The changes in the project's electricity generation component which are described and assessed in this validation opinion report represent related capacity additions and do not represent changes in the general technology concept adopted by the project activity. Moreover, the additional two new backup captive off-grid electricity generators (fuelled by diesel) represent additional backup source/option for the supply of electricity (being generated by diesel) to the previously existing captive unit whenever connection of the project activity to the electricity grid is temporarily interrupted.

As a summary, the project is still encompassing collection of LFG at the Loma Los Colorados landfill and its destruction (in enclosed high temperature flares) and/or its utilization as gaseous fuel for

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electricity generation in internal combustion engine-generator sets. The post-registration changes do not represent any change in terms of the technological concept of the project activity.

Changes do not affect applicable monitoring requirements of applied methodologies:

The changes do not affect the applicability of ACM0001 (version 4) and/or ACM0002 (version 6). None of the applicability requirements for these methodologies are adversely affected by the changes.

As a direct result of increase in the total expected nameplate installed capacity of the project's electricity generation component (along its gradual implementation phases) + use of more efficient equipment, higher amounts of electricity are expected to be generated and exported through the grid along the project's lifetime, increased amount of electricity is expected to be exported through the grid. That represents a direct and proportional increment in the amount of reductions to be claimed by the project activity (due to displacement of electricity that in the absence of the project activity would be generated by existing fossil fuel powered generation sources connected to the grid and new additions).

During the first crediting period the annual average estimation of emission reductions is however only slightly increased due to the fact the biggest share of expected emission reductions to be achieved by the project activity are accounted as emission reductions promoted by the methane destruction component of the project activity. As part of the operation of the project activity, methane emissions are abated through combustion of collected LFG in the engine-generator sets and/or in the project's enclosed high temperature flares. In the absence of the changes in the project design, the incremental share of collected LFG would be combusted in the project's high temperature enclosed flares.

Revision of ex-ante estimates of emission reduction:

Regarding quantitative emission reductions due to the project's renewable energy component (displacement of electricity that otherwise would be generated by existing fossil fuel powered generation sources connected to the grid and new additions) by applying ACM0002 (version 6) methodology, it is to be noted that the occurred delay in the implementation of the initial phase of the project's electricity generation component has partially offset the increment in emission reductions resulted of increment in installed capacity for power generation.

For sake of completeness, revised ex-ante estimation of emission reductions were included in the revised version of the PDD (version 5.3 dated 2012-08-02) ¹¹ and in the revised calculation spreadsheet for the *ex-ante* estimation of emission reductions ^{16/ 11}. Both documents were made available and assessed by the GLC's assessment team.

Permanent changes from the registered monitoring plan improve correctness, completeness and appropriateness of related monitoring requirements:

The permanent change in the registered monitoring plan (as well as revision of sections of the PDD that describes the approaches to be adopted for the determination of related project emissions) represent an overall improvement in terms of correctness, completeness and appropriateness for related monitoring requirements for determining baseline emissions (measurement of fraction of CH₄ in collected LFG) and project emissions (due to consumption of electricity and LPG by the project activity). These changes will

¹¹ The *ex-ante* estimation of emission reductions enclosed to the PDD was revised due to the permanent post-registration changes in the design of project's electricity generation component only (increase of power generation nameplate capacity and gradual capacity additions over a revised gradual implementation schedule). It is reasonably assumed that the addition of 2 extra captive electricity generations (fuelled by diesel) and the revision of the monitoring plan do not have any material impact over the *ex-ante* estimations of emission reductions.

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not negatively impact the overall operation of the project activity and its ability to achieve GHG emission reductions.

4.8 Assessment whether the changes impact the project activity in terms of additionality, scale, applicability of the applied CDM baseline and monitoring methodology and compliance of the monitoring plan with applied methodologies

The table below summarizes if/how the post-registration changes raise potential concerns with specific CDM requirements:

Table 4-1: Assessment of potential concerns of the post-registration changes with specific CDM requirements

CDM requirement of which related potential impact caused by the changes in the project design should be assessed	Do the changes raise potential concerns with the CDM requirement? ¹²	
	Yes	No
Additionality of the project activity (see assessment details in Section 4.8.1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Scale of CDM project activity (see assessment details in Section 4.8.2)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Applicability and application of approved baseline methodology (see assessment details in Section 4.8.3)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Compliance of the monitoring plan with the applied monitoring methodologies (or level of accuracy of the monitoring compared with the requirements contained in the registered monitoring plan) (see assessment details in Section 4.8.4)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

4.8.1 Impact of the changes in the context of the additionality of the project activity

At the time when the project activity "Loma Los Colorados Landfill Gas Project" was validated, the project's additionality was primarily demonstrated by application of the following steps of the "Tool for demonstration and assessment of additionality" (version 2):

- Step 2 (investment Analysis)
- Step 3 (barrier Analysis)
- Step 4 (Common Practice Analysis)

¹² Raising potential concerns means that the changes have an impact on the CDM requirement in question. It does not necessarily mean that the CDM requirement is not anylonger met.

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The Sections below include assessment of the impact of the changes over the applied stepwise approach for demonstrating the project's additionality.

4.8.1.1 Impact over "Step 2 – Investment analysis"

Under the application of Step 2 of the "Tool for demonstration and assessment of additionality" in the PDD, benchmark analysis was selected as the analysis method with internal rate of return (IRR) being selected as the financial indicator. As the result for the performed benchmark analysis, the project's IRR was calculated as -0.75%. Moreover, as also required by the "Tool for demonstration and assessment of additionality", a sensitivity analysis was carried out. As a result of the performed sensitivity analysis, it was demonstrated that none of the variations in the selected key parameters (total investment, O&M costs, electricity sale price and power price¹³) would make the IRR cross the Variations of $\pm 20\%$ in the value of selected key parameters were applied in the context of the sensitivity analysis. As outlined in the Validation Report ^{120/} for the project activity (dated 2006-12-18), the performed of the investment analysis was at the time of the validation assessment for the project activity regarded as deemed correct. As a conclusion of the related validation assessment, it was confirmed that the project was not financially attractive in the absence of CDM revenues.

In order to demonstrate that the additionality for the project is not undermined by the occurred and planned permanent changes in the project design, a revision in the benchmark analysis was thus performed by KDM S.A. As established by applicable CDM guidance, the revision in the investment analysis was performed on the basis of original figures and assumptions as per the original investment analysis (with only the values of the key parameters affected by the changes being modified). The revision of the investment analysis is required to demonstrate that the project activity would remain being additional if the occurred and planned changes were earlier incorporated in the project design prior to its validation.

The following table summarizes the performed changes in key parameters as per the original IRR calculation spreadsheet¹⁴:

¹³ As assessed by GLC, in Chile, power generation companies receive a capacity payment for their installed power capacity, if it is considered that they contribute to the energy reserves in case of a contingency. This income, which is determined by *inter alia* considering the firm power preliminary factor (FPPF) (which establishes the percentage of firm power that a certain power plant can provide) is normally determined as follows:

$$\text{Income} = \text{Capacity} * \text{Capacity Factor} * \text{Firm Power Price} * \text{FPPF}$$

¹⁴ In order to confirm that the revised investment analysis spreadsheet was elaborated on the basis of the original investment analysis spreadsheet + changes in key parameters affected by the changes, the following checking steps were performed by the GLC's assessment team:

- 1) As the original investment analysis spreadsheet is not webhosted at the project's page at UNFCCC's CDM website, a copy of the original MS-Excel investment analysis spreadsheet (in xls format) was received from KDM S.A.
- 2) The GLC's assessment team compared all values of cash flow presented in the received .xls format file against all figures that are indicated in a PDF format cash flow table made available project page at UNFCCC's CDM website (file "*calculation sheet 3.pdf*" which is presented/hyperlinked as "*Appendix 3 - calculation sheet 3*").
- 3) As an outcome of the checking, it was confirmed / assumed that the received file was indeed the original investment analysis spreadsheet. All changes in key parameters were made in a identical file, thus generating the revised version of the investment analysis calculation spreadsheet for the project activity.

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Table 4-2: Summary of performed changes in key parameters affected by the changes in the project's design in the original version of the investment analysis spreadsheet

Description of the key parameter affected by the occurred and planned changes in the project design	Applied value / assumption as per the original version of the investment analysis spreadsheet	Applied value / assumption as per the revised version of the investment analysis spreadsheet	GLC's assessment about the performed change the value/assumption change in the investment analysis spreadsheet
Total investment capital expenditures within the project's electricity generation component ¹⁵	Total of USD 29.28 Million (being gradually invested as per earlier assumed project implementation schedule) ¹⁶	Total of USD 48.11 Million (being gradually invested as per a revised project implementation schedule) ¹⁶ (including a 21 km power transmission line from CLLC-2 to Punta Peuco power substation) ¹⁷	The revised value is in accordance with all evidences made available to the GLC's assessment team. Moreover, the timing for the capital expenditures is in accordance to the revised project implementation schedule. Applied values are based on quotation from year 2010 and 2011 and were adjusted to price index applicable to year 2006 (with related capital expenditures being made in 2011 (as occurred) and along the remaining projects life time (as indeed planned). This is deemed correct and conservative (as the revised investment capital expenditure values become lower when capital expenditures values are adjusted to year 2006 price index). In order to enhance transparency and completeness, a support additional investment analysis workbook ^{15/} is enclosed to the revised PDD. This supporting workbook includes a detailed breakdown of all associated investments applicable for the revised project design and also includes the related adjustments of assumptions to price index

¹⁵ It is important to note that as per the original investment analysis spreadsheet, the average investment capital expenditures per installed MW along the whole project's lifetime is USD 1.46 Million per installed MW of nameplate capacity . As per the revised investment analysis spreadsheet, this value is calculated as USD 1.45 Million (when the required investment for the 21 km transmission line is considered) and as USD 1.26 Million (when the when the required investment for the 21 km transmission line is not considered). This denotes that existent relative investment cost reductions (when estimations dated mid 2006 are compared against real quotations dated 2010 (adjusted to price index of year 2006) were incorporated in the investment analysis, thus increasing the economic attractiveness of the project. This is conservative and deemed acceptable.

¹⁶ Due to the nature of the changes in the project design (which includes a revised schedule for the implementation of the project's electricity generation component), the distribution of the total projected investment capital expenses of USD 48.11 millions along the project's lifetime (as per the revised investment analysis) is different when compared the total projected investment capital expenses of USD 29.28 millions along the project's lifetime (as per the original investment analysis).

As confirmed by the GLC's assessment team, the revised investment plan (as presented in the also revised investment analysis spreadsheet) correctly reflects the revised implementation schedule for the project's electricity generation. The revised implementation schedule for the power generation capacity additions is assessed in Section 3.1. Moreover, the revised timeline also correctly incorporates the occurred 2-years delay in the implementation of first phase of the project's electricity generation component (CLLC-1 power plant).

¹⁷ As per the original investment analysis spreadsheet, no investment and O&M costs in power transmission lines were considered. This was acknowledged by KDM S.A. as mistake when elaborating the PDD. GLC confirmed that the closest power transmission substation is located 21 km away from the project site. Moreover, as per the applicable rules of the power market in Chile, it is the responsibility of the independent power producers (IPPs) to build and operated high voltage transmission lines if required.

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			<p>of year 2006. It is important to note that while the implementation of two additional backup captive off-grid electricity generator (fuelled by diesel) were implemented as part of the design of the CLLC-2 electricity generation facility, all required investment for these backup units are included in the revised values for gradual investment capital expenditures within the project's electricity generation component.</p> <p>The schedule for all associated investment along the project's revised implementation schedule is also outlined in the workbook.</p>
Average operation and maintenance (O&M) cost per generated kWh of generated electricity (for the electricity generation facility) ¹⁸	USD 0.030 per kWh of generated electricity (USD 30.00 per MWh for generated electricity)	<p>Average of USD 0.0231 per kWh of generated electricity (USD 23.10 per MWh for generated electricity)</p> <p>A supplementary spreadsheet (which is also enclosed to the revised version of the PDD) presents detailed breakdown of the</p>	<p>As confirmed by the GLC's assessment team through assessment of related documented evidences, the calculated average value for O&M cost per kWh of generated electricity (in the power plants) for the whole project's lifetime was correctly determined based on service quotations received by KDM S.A. dated 2010 and 2011 and applicable for the CLLC-2 electricity generation facility (Jenbacher G420 units). The value was also conservatively¹⁹ assumed as also applicable for CLLC-1 electricity generation facility. In order to enhance transparency and completeness, a support investment analysis workbook^{15/} is enclosed to the revised PDD. This supporting workbook includes a detailed breakdown of all associated O&M costs applicable for the revised project design and also</p>

¹⁸ While as per the original investment analysis spreadsheet, the average O&M cost per kwh of generated electricity is USD 0.030, as per the revised investment analysis spreadsheet, this value is calculated as USD 0.0231. This denotes that existent relative operation and maintenance cost reductions were incorporated in the investment analysis (when estimations dated mid 2006 are compared against real service quotations dated 2010 and 2011). Such relative reduction in O&M costs increases the economic attractiveness of the project. The original and revised value for average operation and maintenance (O&M) cost per generated kWh of generated electricity is applicable only for the project's electricity generation component). Related O&M costs for the project's LFG collection and flaring system are not included in the calculations of the original USD 0.030 and revised USD 0.0231 values. It is deemed reasonable and acceptable the assumption that the occurred and planned changes in the project design are not expected to affect O&M costs for the project's LFG collection and flaring system. As the project's was already initially conceived for utilization of collected LFG as fuel for electricity generation, no changes in the LFG collection system are required. Normally, when converting LFG use from flaring to fuel for electricity generation, set of improvements in the design and operation of the LFG collection system (LFG collection wells) are required in order to ensure that the quality of collected LFG meets typical specific requirements of installed engine-generator sets (in terms of CH₄ content, O₂ content, etc.).

¹⁹ The CLLC-2 electricity generation facility is equipped with engine-generator sets with more modern and advance construction /design than equipment used for the CLLC-1 power plant. Moreover, CLLC-2 incorporates an improved LFG pre-treatment /cleaning system (using activated carbon filtration tanks). By resulting in supply of LFG flow with very reduced free of contaminantes to the CLLC-2 power plant, the LFG pre-treatment system allows:

- Operation of the engine-generator sets with extended frequencies for lube oil draining, preventive maintenance stops, replacement of components (e.g. spark plugs, oil filters, etc.)

Due to this facts, average O&M costs for the CLLC-2 power plant (per installed MW) are lower than costs applicable for CLLC-1 power plant.

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		maintenance and operation costs.	includes the related adjustments of assumptions to price index of year 2006. The schedule for all associated O&M costs along the project's revised implementation schedule is also outlined in the supporting workbook. It is important to note that while the implementation of two additional backup captive off-grid electricity generator (fuelled by diesel) were implemented as part of the design of the CLLC-2 electricity generation facility, the estimated O&M costs for these backup units are included in the revised value for average operation and maintenance (O&M) cost per generated kWh of generated electricity.
Operation and maintenance (O&M) cost per generated kWh of generated electricity (for the transmission line)	The set of estimated annual nominal values represents an average cost of USD 0.0001 per kWh of generated electricity	The set of estimated annual nominal values represents an average cost of USD 0.0026 per kWh of generated electricity	As confirmed by the GLC's assessment team through assessment of related documented evidences, the calculated average value for O&M cost per kWh of generated electricity (in the transmission line) for the whole project's lifetime was correctly determined based on service quotations received by KDM S.A. dated 2010 and 2011 and applicable for the CLLC-2 electricity generation facility (Jenbacher G420 units).
Total nameplate installed capacity	20.0 MW (with capacity additions being gradually added as per earlier assumed project implementation schedule)	33.1 MW (with capacity additions being gradually added as per the revised project implementation schedule)	The revised value is in accordance with evidences being made available to the GLC's assessment team. As per the investment analysis spreadsheet, increments in the installed capacity along the gradual implementation phase of the project's electricity generation components are directly reflected in increments in calculated projections of revenues due to sale of generated electricity.

Revised IRR value:

The revision of the original version of the investment analysis clearly shows the impact of the changes in the project design over the IRR calculation.

As a result of the changes of the key parameters in the original investment analysis (as presented in Table 4-2), the project's IRR is changed as follows:

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Table 4-3: Summary of performed changes in key parameters as per the original IRR calculation spreadsheet for the project activity

Financial indicator for the investment analysis of the project activity	Original investment analysis spreadsheet / original PDD	Revised version of the investment analysis spreadsheet / revised version of the PDD
IRR (with selected benchmark rate of +10%)	-0.75%	+2.50%

Key parameters price of electricity exported by the project activity and benchmark rate:

It is important to note that besides of other parameters, the earlier assumed price of electricity exported by the project activity (USD 50 per MWh) and benchmark rate (10%) were not changed in the revised investment analysis spreadsheet. The values for the key parameters benchmark rate and electricity price as considered in the context of the project's implementation decision making process (in mid 2006) (and presented in the original investment analysis spreadsheet) were maintained in the revised investment analysis spreadsheet. It is the opinion of the GLC's assessment team that this is deemed correct, acceptable and in accordance with applicable CDM rules due to the following aspects/reasons:

- *Electricity price and benchmark rate are not a key parameters affected by the modifications to the project activity:*

Based in its sectoral expertise, the GLC's assessment team is aware that although market rules, economics, policies, practices as well as perceived risks for the power market in Chile could be regarded are still being the same²⁰ than the ones valid at the time of the project implementation decision making process; due to the normal dynamics of the Chilean power market and country economics, the price that has been paid to KDM S.A. (per MWh of electricity exported through the grid) is obviously not the same as the one earlier considered in the investment analysis (about 6 years ago). Moreover, the minimum rate of return for investment (to be required by KDM S.A. or by other investors for different types of investments) is probably not any longer the same as in year 2006. Anyhow, both price of electricity and benchmark rate are correctly

²⁰ As acknowledged in the revised version of the PDD, additional regulations and procedures for power generation by Independent Power Producers (IPP) in Chile were issued after the initial implementation of the project activity and its registration as CDM project activity:

- Decree N° 244 – Bylaw for non-conventional and small-scale electricity generation sources. This bylaw established regulations for law N°19,940. It establishes requirements for grid connection as well as options for commercialization of electricity at a stabilized price and some fee exemptions for using the main transmission system.
- Law N° 20,257 - Introduces modifications to the General Electrical Services law, establishing as mandatory for the electric generation companies to comply with a minimum of 5% of their energy injections to be supplied by non-conventional renewable energy sources (ERNC), either directly or indirectly. This percentage will be gradually increased to reach 10% by year 2024.
- Resolution N° 1,278 – ERNC Law regulation. This resolution normalizes the implementation of Law N° 20,257, which requires power generation companies to inject in the grid a determined share of electricity being generated from non-conventional renewable energy sources.

It is reasonable to assume that such new rules and procedures do not significantly affect the market conditions and estate of the Chilean power market.

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assumed by the project participant as key parameters (original input data) that are not affected by the modifications to the project activity and are not under control of KDM S.A. either. As highlighted in the Clean Development Mechanism Project Standard ^{122/} (Para. 220):

"In cases where the proposed or actual changes affect the additionality of the registered CDM project activity, as referred to in paragraph 219(d) above, the demonstration of the impacts of changes shall be based on all original input data.

In addition:

(a) In the case of investment analysis, project participants shall only modify the key parameters in the original spreadsheet calculations affected by the proposed or actual modifications to the project activity; (...)"

As correctly argued by the project participants, changes in market conditions in the Chilean power market and country and global economics (which directly impact the market price for electricity and/or the minimum rate of return for investments) are all circumstantial market aspects which obviously could not be foreseen by KDM S.A. in the context of the project's implementation decision making in mid 2006 (prior to its registration as a CDM project activity in early 2007). Moreover, as one of the players in the competitive power market in Chile, KDM S.A. obviously do not have any control or influence over market price for electricity and/or minimum rate of return for investments in the country power market. Thus, it is deemed correct to assume that variations in these key parameters should not be taken into account in the revised investment analysis.

In the context of non-consideration of eventual changes in market price for electricity and/or minimum rate of return for investments in the country power market within the revised investment analysis, the argument that the occurred and planned changes in project design are triggered by changes in terms of qualitative and quantitative availability of LFG and availability of more efficient equipment in the market is also relevant. This aspect is also assessed below.

- *Collected LFG is the only fuel used for electricity generation by the project activity:*

The project's electricity generation component consumes LFG which is collected as part of operation of the project activity. LFG is the only fuel for power generation. No other fuel is used. The design (including operation regime and size) of the electricity generation facilities CLLC-1 and CLLC-2 are thus completely dependent on the availability and flow of collected LFG. As highlighted in the revised version of the PDD and assessed in this report, generation and collection of LFG in landfills normally includes very high qualitative and quantitative uncertainties. In this context, estimating the size (capacity) of the project's electricity generation component (and its gradual capacity additions) based on available qualitative and quantitative estimation of LFG collection (dated 2006) prior to any associated engineering, design and construction work means incorporating all such related uncertainties into the definition of the size (capacity) of the project's electricity generation component and its gradual implementation schedule.

- *Highest share of collected LFG is to be utilized as fuel for electricity generation:*

Like most of the existing LFG collection and utilization projects implemented worldwide, the project design for the Lomas Los Colorados Landfill Gas Project have always considered having the highest share of collected LFG being utilized as fuel for electricity generation (instead of

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flaring)²¹. Giving preference to the use of collected LFG as fuel for electricity generation (instead of flaring it) is a rational decision as generation and export of electricity promotes associated revenues.

It is crucial to take into account that, in the particular case of project activity, it was demonstrated that occurred developments and improvements in terms of operation of the project's LFG collection component have promoted significant improvements in terms of volume (flow) of LFG actually collected by the project from the beginning of year 2010 onwards. These operational improvements (which are further assessed in Section 3.1) also promoted significant reduction of flow variability of collected LFG as an additional benefit. These two positive benefits have resulted in a higher potential technical utilization rate of collected LFG as fuel for electricity generation. In 2010, KDM S.A. decided to take advantage of such higher potential technical utilization rate of collected LFG by promoting relative increments in terms of installed power generation capacity (when compared to earlier assumption and projections involving the yet to occur gradual capacity additions of the project's electricity generation component). Thus, the CLLC-2 electricity generation facility was designed with installed capacity (to be gradually added) higher than as per earlier forecasts (based on projections dated year 2006).

It is deemed reasonable to assume that both higher availability of LFG and reduced variability of its flow triggered the implementation of the project's electricity generation component with higher installed capacity than earlier assumed in the PDD.

- *Availability of equipment with improved LFG-to-electricity energy conversion efficiency are consequences of recently occurred technological and market developments in Chile:*

While the use of power generation equipment with LFG-to-electricity efficiency about 20% higher than the efficiency considered in the original PDD also promotes quantitative increase in the amount of electricity exported by the project activity, the use of more efficient equipment is seen as a direct consequence of recently occurred technological and market developments in Chile in the area of use of LFG as fuel for electricity generation. Although in several areas, gains in terms of efficiency of equipment and appliances occur along the time as a result of technological research and development (R&D), it is deemed reasonable to assume that the future availability in the market of more efficient equipment (with average LFG-to-electricity conversion efficiency of 42% instead of 36%) is an aspect could not be foreseen by the project participants at the time of the initial conceptualization of the project activity and its decision making process. This is further assessed in Section 4.1.4.

Revised sensitivity analysis:

A revision of the sensitivity analysis was also carried out as part of the revision of the whole investment analysis. As a result of the performed revision of the sensitivity analysis, it was demonstrated that none of the variations in the selected key parameters affected by the changes in the project activity (total investment, O&M costs and electricity sale price) would make the IRR cross the selected benchmarking rate of 10%. Variations of $\pm 20\%$ in the value of selected key parameters were applied in the context of the sensitivity analysis.

²¹ In the particular case of the Lomas Los Colorados Landfill Gas Project, the use of highest share of collected LFG as fuel for electricity generation is also reflected in the ex-ante estimations of emission reductions as presented in the initial registered version of the PDD.

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Assessment of the editing's in the original the investment analysis spreadsheet and plausibility and correctness of revised input data:

The GLC's assessment team was also able to confirm that, as established by applicable CDM guidance, the demonstration of the impacts of the occurred and planned (yet to be fully implemented) permanent changes in the project design over the project's additionality is entirely based on all original input data (with only key parameters actually affected by the changes being modified in the original investment analysis spreadsheet). Moreover, the impact of such revision is clearly explained in Section B.3 in the revised version PDD (version 5.3 dated 2012-08-02) ^{/1/}.

All related documented evidences provided by KDM S.A. were assessed by the GLC's validation team in order to confirm the appropriateness of the performed revision in the investment analysis. The assessed documents are listed in the table below. Details about the assessed documents are presented in Section 6.

Table 4-4: Documented evidences assessed by the GLC's validation team in order to confirm the appropriateness of the performed revision in the investment analysis

Documented evidences assessed by the GLC's validation team in order to confirm the appropriateness of the performed revision in the investment analysis																																												
/3/ /4/ /5/ /6/ /7/ /8/ /9/ /10/ /11/ /12/ /13/ /14/ /15/ /16/ /17/ /26/ /27/ /28/ /29/ /35/ /36/ /37/ /38/ /39/ /40/ /41/ /42/ /43/ /44/ /45/ /46/ /47/																																												

Note: Details about the documents are presented in Section 6 (References)

The assessed documents represent credible evidences that confirm the appropriateness of the revision of investment analysis in terms of values for the changed technical and economic parameter (Total capital investment, average operation and maintenance (O&M) cost per generated MWh of electricity, total nameplate installed capacity, assumed LFG-to-electricity energy conversion efficiency) the implementation schedule for the subsequent phases of the project's electricity generation component.

The GLC's assessment team highlights that, by following applicable CDM guidance for assessing post-registration changes in the project design, its assessment did not encompass any re-assessment of the appropriateness and correctness of the original investment analysis (as per the original version of the PDD). By not performing any re-assessment of the original investment analysis (enclosed to the initial registered version of the PDD), the GLC's assessment team assumes the original investment analysis spreadsheet is deemed appropriate and correct (as earlier confirmed by the DOE in charge of the validation assessment for the project activity and as outlined in the Validation Report ^{/20/} for the project activity (dated 2006-12-18)).

Conclusion:

As assessed by GLC, the revised investment analysis spreadsheet ^{/3/} clearly demonstrates that even by considering the projected incremental revenues for the project activity (due to projected increment in the amount of electricity generated by the project activity), the project activity is still being not financially attractive in the absence of CDM revenues. As a conclusion, by taking into account all applicable guidance for assessing impact of the changes in terms of additionality of the project activity, it is the opinion of the GLC's assessment team that the project's additionality is sufficiently demonstrated and not undermined by the occurred and planned (yet to be fully implemented) changes in the project design.

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4.8.1.2 Impact over "Step 3 – Barrier analysis"

The application of Step 3 (Barrier analysis) of the "Tool for demonstration and assessment of additionality" in the context of assessment and demonstration of additionality (as per the original version of the PDD ^{/2/}) is correctly assumed as not changed due to the post-registration changes in the project design. Thus, no revision of Step 3 – Barrier analysis was performed in the context of the revision of the PDD for addressing the post-registration changes in the project design. It is the opinion of the GLC's assessment team that it is deemed correct and reasonable to assume that earlier identified barriers are not adversely affected by the occurred and planned (yet to be fully implemented) changes in the design of the project activity. Occurred and yet to be fully implemented relative increments in the amount of electricity to be generated by the project activity along the also revised gradual implementation of the project's electricity generation component are regarded as not impacting the earlier identified barriers.

4.8.1.3 Impact over "Step 4 – Common practice analysis"

The application of Step 4 (Common Practice Analysis) of the "Tool for demonstration and assessment of additionality" in the context of assessment and demonstration of additionality (as per the original version of the PDD) is correctly assumed as not changed due to the post-registration changes in the project design. Thus, no revision of Step 4 (Common Practice Analysis) was performed. It is the opinion of the GLC's assessment team this is deemed correct and reasonable. If the post-registration change in the project design were somehow considered at the time of initial conceptualization of the project and incorporated in the initial version of the PDD, these changes would not impact the common practice analysis at the time of the validation of the project activity.

It is opportune to highlight that, as claimed by the project participant, there is still no initiative in Chile other besides the project activity that promotes collection and utilization of LFG for electricity generation. This was confirmed by the GLC's assessment team through assessment of the official (and publicly available) national registry ^{/53/} of non-conventional renewable electricity generation sources from Centro de Despacho Económico de Carga - Sistema Interconectado Central (CDEC-SIC) (power dispatch coordinating entity in Chile).

4.8.1.4 Conclusion about the assessment of the changes in the context of the additionality of the project activity

As a conclusion, by taking into account all applicable guidance for assessing impact of permanent changes of project design in terms of additionality of registered CDM project activities, the GLC's assessment team was able to confirm that it was sufficiently demonstrated that earlier assessed and demonstrated project's additionality is not undermined by the occurred and planned post-registration permanent changes in the project design.

As required by the latest version of the Clean Development Mechanism Project Standard ^{/22/}, the revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/} sufficiently reports the impacts of the occurred and planned changes to the registered CDM project activity in terms of assessment and demonstration of additionality for the registered project activity.

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4.8.2 Assessment of the impact of the changes in terms of scale of the project activity

By taking into account that the nature of the changes in the project design, the GLC's assessment team confirms that the occurred and planned post-registration permanent changes in the project design do not adversely affect the scale of the project activity.

4.8.3 Assessment of the impact of the changes in terms of applicability of the applied baseline and monitoring CDM methodology(es)

Permanent changes in the project design:

By taking into account that the nature of the changes in the project design, the GLC's assessment team confirms that, as indicated in the revised PDD (version 5.3 dated 2012-08-02) ^{/1/}, the occurred and planned (yet to be fully implemented) post-registration permanent changes in the project design do not promote any impact in terms of eligibility and application of the baseline and monitoring methodologies ACM0001 (version 4) and ACM0002 (version 6).

Permanent changes from the registered monitoring plan:

The revision of the monitoring plan does compromise monitoring requirements and applicability criteria for ACM0001 (version 4) and ACM0002 (version 6) baseline and monitoring methodologies either. The revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/} includes additional calculation and monitoring provisions by applying applicable guidance of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) ^{/24/} and of the "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (version 2) ^{/25/}.

The permanent changes from the monitoring plan represent monitoring improvements. The revision of the monitoring plan aims to address in a more appropriate manner project emissions due to the consumption by the project activity of electricity and LPG respectively. It is important to note that, differently than more recent versions of ACM0001, ACM001 (version 4) does not deal with project emissions due to consumption fossil fuel (i.e. LPG in the case of the project) and electricity sourced by different sources (i.e. grid and captive off-grid fossil fuel electricity generators in the case of the project). It is GLC opinion that the application of both tools is deemed reasonable and acceptable and do not compromise the application ACM0001 (version 4) and ACM0002 (version 6). It is important to note that a disclaimer justifying the reasonability of the application of these methodological tools was added in the revised version of the PDD ^{/1/} (as footnotes in Section B.1).

As a conclusion, the application of the above-referred methodological tools (which are of more recent issuance than ACM0001 version 4) does not compromise the conservativeness of the monitoring process, including the related emission reduction calculations. This is indicated in the revised version of the PDD ^{/1/} as required by the Clean Development Mechanism Project Standard ^{/22/}.

The incorporation of the option of performing measurements of CH₄ fraction in collected LFG by using a calibrated portable gas analyzer (only during temporary circumstances when the continuous CH₄ content gas analyzer unit is not available) in the monitoring plan does not affect the applicability or monitoring requirements of ACM0001 (version 4) either. As clearly stated in ACM0001 (version 4) "The

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fraction of methane in the landfill gas ($wCH_{4,y}$) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level, using calibrated portable gas meters and taking a statistically valid number of samples (...). The continuous methane analyzer should be the preferred option (...). Moreover, as part of the operation of the project activity KDM S.A. has historically followed (whenever needed) the applicable instructions of the internal documented working procedure for the whole project activity (*I-RSL-013 – Instructivo Sistema de Captacion y Abatimiento de Biogas* ^{/30/}) which also specifies that whenever the continuous CH_4 content gas analyzer is not functioning measurements of CH_4 fraction in collected LFG should be done by using a portable gas analyzer (with measurements being performed and recorded every 5 minutes).

Furthermore the related revision in the monitoring plan also includes addition of references to applicable guidance of the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements" (for determination of minimum sampling size and related calculation to address associated uncertainties). This guidance is applicable to ACM0001 (version 4).

The incorporation of the option of performing measurements of CH_4 fraction in collected LFG by using a calibrated portable gas analyzer (only during temporary circumstances when the continuous CH_4 content gas analyzer unit is not available) does not compromise the conservativeness of the monitoring process, including the related emission reduction calculations. This is also indicated in the revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/}.

4.8.4 Assessment of the impact of the changes in terms of compliance of the monitoring plan with applied monitoring methodology and/or level of accuracy of the monitoring when compared with requirements as per the registered monitoring plan

As further assessed in Section 4.8.3, the occurred and planned permanent changes in the project design and the proposed revision of the monitoring plan does not promote any impact over the level of accuracy and completeness in the context of monitoring requirements for the project activity as no previously existent monitoring requirement is excluded or modified as a result of these changes.

Furthermore, these changes do not adversely affects compliance of the monitoring plan with the applied monitoring methodologies ACM0001 (version 4) and ACM0002 (version 6) either.

It is important to note that the use of the portable CH_4 content gas analyzer is explicitly allowed by ACM0001 (version 4) and it was already part of the implemented project's monitoring system prior to the revision of the PDD (references to the use of this portable unit were missing on the earlier version of the PDD).

Thus, the level of accuracy of the monitoring when compared with the requirements contained in the applied monitoring methodologies are not affected by the changes under any circumstance. All these aspects are also indicated in the PDD (version 5.3 dated 2012-08-02) ^{/1/} as required by the Clean Development Mechanism Project Standard ^{/22/}.

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4.9 Assessment of performed text editing's in the PDD for addressing the changes

The revised versions of the PDD (version 5.3 dated 2012-08-02) ^{/1/} was made available by KDM S.A. to the GLC's assessment team (in both clean version and version with all changes being tracked) and it sufficiently describes the nature and extent of the occurred and planned changes.

Apart of addressing the permanent changes in the project design and the revision of the monitoring plan, the revised version of the PDD (version 5.3 dated 2012-08-02) ^{/1/} also includes substantial general text improvements/corrections that are not related to such changes. Corrections and text improvements not directly related to the project design were implemented in the revised version of the PDD ^{/1/}. This is deemed reasonable and acceptable. The following tables outlines in details all changes in texts made in each section of the original PDD. Changes and editing's were also made in the investment analysis spreadsheet ^{/22/} and spreadsheet with *ex-ante* estimations of emission reductions and are summarized in the table below.

Table 4-5: Assessment of modifications and editing's and modifications made in the PDD (as outlined in the revised version of the PDD (version 5.3 dated 2012-08-02)

PDD Section	Description of the performed modification / editing's	Validation opinion of the GLC's assessment team about the performed modification/editing's
A.1	Version number and date for the PDD were updated. Moreover, explanative disclaimers summarizing the changes in the PDD (in comparison with the earlier registered version of the PDD (version 4) ^{/2/}) were added. The texts in Section A.1 also refer to two footnotes that provide details, reasons and rationale for the occurred and planned (yet to be fully implemented) post-registration permanent changes in the project design.	OK. Editing's/modifications in Section A.1 are deemed correct and acceptable. Moreover, the use of footnotes for outlining complementary details, reasons and rationale for the changes in is deemed acceptable. That enhances transparency and it is in accordance with applicable CDM rules.
A.2	Minor wording changes and text temporal adaptations were made by considering the more recent issuance date of revised PDD (which is dated after the project's implementation and operation starting date). Changes in text attempts to reflect more accurately the present situation of the project. Minor typo mistakes were also corrected and details about the project design were also corrected. Relevant disclaimers were added as footnotes.	OK. Editing's/modifications performed in Section A.2 are deemed correct and acceptable. Text modifications in order to enhance transparency, correctness and completeness of project description in its current status are deemed reasonable. Inclusion of additional information for better understanding of the changes in the project as well as correcting typo mistakes are also reasonable and appropriate.

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A.3	Reference to the project participant "Urbaser S.A." was added.	OK. Editing's/modifications performed in Section A.3 are deemed correct and acceptable. Section A.3 is in accordance to the latest version of the completed MoC form.
A.4.1.4	Further details about location of the project were included (correct geographical coordinates).	OK. Editing's/modifications performed in Section A.4.1.4 are deemed correct and acceptable. The inclusion of additional project location information (incl. geographical coordinates) is deemed correct (as verified by the GLC's assessment team).
A.4.2	Reference to " <i>UNFCCC's sectoral scope</i> " instead of " <i>sectoral scope</i> " was added.	OK. Editing's/modifications in Section A.4.2 are deemed correct and acceptable.
A.4.3.	Details about the technical project description were updated and improved (as per the occurred and planned post-registration permanent changes in the project design). Further details about the implementation background of the gradual implementation of the project activity are also added as footnotes.	OK. Editing's/modifications in Section A.4.3 are deemed correct and acceptable. Updated information about the technical project description and project implementation background are deemed correct and complete.
A.4.4	Details about how the project promotes emission reductions were added. Details about baseline emissions were improved. Typo mistakes were corrected.	OK. The performed editing's/modifications in Section A.4.4 are deemed correct and acceptable.
A.4.4.1	<i>Ex-ante</i> estimations of emission reductions over the 7-year renewable crediting period were updated by taking into account the incremental amount of net electricity to be generated by the project activity and exported through the electricity grid.	OK. Editing's/modifications in Section A.4.4.1 are deemed correct and acceptable. The GLC's assessment team has assessed the spreadsheet with calculated <i>ex-ante</i> estimations of emission reductions to be achieved by the project activity ^{16/} . All related calculation revisions are deemed correct and acceptable.
A.4.5	No changes were made	-
B.1	References to the following methodological tools were added: <ul style="list-style-type: none"> - "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) - "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (version 2)" Justification about the appropriateness of the application of these methodological tool vis-à-vis related provisions of ACM0001 (version 4) were also added as a footnote.	OK. Editing's/modifications in Section B.1 are deemed correct and acceptable. Assessment of appropriateness of the application of these methodological tools is included in Section 4.1.3 and 4.2.

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B.1.1	Minor text improvements and corrections were made.	OK. Editing's/modifications performed in Section B.1.1 are deemed correct and acceptable.
B.2	<p>Minor text improvements and corrections were made. Moreover, in order to better substantiate the application of the applied baseline and monitoring methodologies ACM0001 (version 4) and ACM0002 (version 6), summaries of the occurred and planned implementation schedule for the first and sequential phases of the project's electricity generation component are added as a footnote.</p> <p>Justifications that occurred and planned permanent changes in the project design do not affect the applicability and application of ACM0001 (version 4) and ACM0002 (version 6) methodologies and neither the scale of the project activity were also added.</p> <p>In order to enhance completeness, available information about the project's compliance with applicable environmental licensing requirements dated of mid 2006 were complemented with applicable information dated June 2012 (which were added as a footnote).</p>	OK. Editing's/modifications in Section B.2 are deemed correct and acceptable.
B.3	<p>Minor text improvements/corrections were made. Moreover, the investment analysis is also revised. Further details about the performed revision in the investment analysis are described in Section 4.8.1.</p> <p>A statement was added confirming that occurred and planned post-registration permanent changes in the design of the project activity do not undermine the additionality for the project activity.</p>	OK. Editing's/modifications performed in Section B.3 are deemed correct and acceptable. The impact of occurred and planned permanent changes in the context of the additionality of the project activity is assessed under Section 4.8.1.
B.4	Minor text improvements and corrections were made.	OK. Editing's/modifications in Section B.4 are deemed correct and acceptable.
B.5	Details about the completion of baseline studies and its revisions were updated.	OK. Editing's/modifications performed in Section B.5 are deemed correct and acceptable.
C.1.1	Details about the project starting date (as per its definition in the UNFCCC's "Glossary of CDM Terms") was added: 07 February 2006 (which is date when purchase order of the first flare was issued and approved by KDM S.A.).	OK. Editing's/modifications in Section C.1.1 are deemed correct and acceptable. The complementary information regarding the project starting date (as per its definition in the UNFCCC's "Glossary of CDM Terms") is

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	As a complementary information, this date is regarded as the project starting date. This information was added as a footnote.	deemed correct.
C.1.2	No changes were made	-
C.2.1.1	No changes were made	-
C.2.1.2	No changes were made	-
C.2.2.1	No changes were made	-
C.2.2.2	No changes were made	-
D.1	<p>Minor text improvements and corrections were made. Updated and more recent information about the current compliance of the project with environmental licensing requirements was added as complementary information.</p> <p>Minor changes to reflect the present situation of the project have been included.</p> <p>References to the following methodological tools were added:</p> <ul style="list-style-type: none"> - "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) - "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (version 2)" 	OK. Editing's/modifications performed in Section D.1 are deemed correct and acceptable. Assessment of appropriateness of the application of these methodological tools is included in different sections of this Assessment Report.
D.2.	No changes were made	-
D.2.1.	No changes were made	-
D.2.1.1.	No changes were made	-
D.2.1.2.	No changes were made	-
D.2.1.3.	No changes were made	-
D.2.1.4.	No changes were made	-
D.2.2.	Minor text improvements and corrections were made. Monitoring information (data to be collected) was updated.	OK. Editing's/modifications performed in Section D.2.2 are deemed correct and acceptable. Further assessment about the revised monitoring plan is included different section of this Assessment Report.
D.2.2.1.	The description table for the monitoring plan was revised as outlined in different section of this Assessment Report.	OK. Editing's/modifications performed in Section D.2.2.1 are deemed correct and acceptable. Further assessment about the revised monitoring plan is included different section of this Assessment Report.
D.2.2.2.	No changes were made.	-
D.2.3.1.	No changes were made.	-
D.2.3.2.	No changes were made.	-
D.2.4.	Related descriptions and formulaes for the determination of baseline emissions and	OK. Editing's/modifications performed in Section D.2.4 are deemed correct and acceptable.

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	project emissions were revised as per the changes from the monitoring plan.	Further assessment about the revised monitoring plan is included different section of this Assessment Report.
D.3.	Information about QA/QC procedures has been updated as per the changes from the monitoring plan. Typo corrections were made and disclaimer about the use of portable CH ₄ content gas analyzer was added.	OK. The information regarding QA/QC procedures was correctly updated, changes are deemed acceptable and reasonable. Further assessment about the revised monitoring plan is included different section of this Assessment Report.
D.4.	Minor text improvements/corrections were made. Information about operation of the monitoring plan and management procedures were updated as per the changes from the monitoring plan. Disclaimer about the use of portable CH ₄ content gas analyzer was added.	OK. Editing's/modifications performed in Section D.4 are deemed correct and acceptable. Further assessment about the revised monitoring plan is included different section of this Assessment Report.
D.5	Details about the completion of monitoring plan and its revisions were updated.	OK. Editing's/modifications performed in Section D.5 are deemed correct and acceptable.
E.1.	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section E.1 are deemed correct and acceptable.
E.2.	Reference to the version of the applied methodology was added.	OK. Editing's/modifications performed in Section E.2 are deemed correct and acceptable.
E.3.	A disclaimer was add. The disclaimer indicates that project emissions are determined by direct measurements of electricity and/or fossil fuels consumption + determination of related CO ₂ emission factors.	OK. The performed editing's/modifications in Section E.3 are deemed correct and acceptable.
E.4.	No changes were made.	-
E.5.	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section E.5 are deemed correct and acceptable.
E.6.	Minor text improvements/corrections were made. Summary of <i>ex-ante</i> estimations of emission reductions was updated.	OK. Editing's/modifications performed in Section E.6 are deemed correct and acceptable. The GLC's assessment team has assessed the spreadsheet with calculated <i>ex-ante</i> estimations of emission reductions to be achieved by the project activity ^{16/} . All related calculation revisions are deemed correct and acceptable.
F.1.	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section F.1 are deemed correct and acceptable.
F.2	Updated information about valid environmental permitting regulations was	OK. Editing's/modifications performed in Section F.2 are deemed correct and acceptable.

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	included.	
G.1	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section G.1 are deemed correct and acceptable.
G.2	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section G.2 are deemed correct and acceptable.
G.3	Minor text improvements/corrections were made.	OK. Editing's/modifications performed in Section G.3 are deemed correct and acceptable.
Annex 1	Changes in the contact information of PP's have been made.	OK. Editing's/modifications performed in Annex 1 are deemed correct and acceptable.
Annex 2	No changes were made	-
Annex 3	Minor typo mistakes were corrected. In the table showing LFG Generation, Capture & Emissions Reduction data has been updated considering the changes explained in B.3.	OK. Editing's/modifications performed in Annex 3 are deemed correct and acceptable. Correction of minor typo mistakes is considered reasonable and acceptable. The assessment team was able to assess the changes shown in the updated table and it considers them as reasonable.
Annex 4	Minor text improvements/corrections were made. Information about design and operation of the monitoring plan was updated as per the changes from the monitoring plan.	OK. Editing's/modifications performed in Annex 4 are deemed correct and acceptable. Further assessment about the revised monitoring plan is included different section of this Assessment Report.
Emission reduction calculation spreadsheets enclosed to the PDD	The emission reduction calculation spreadsheets were updated by taking into account the new total electric capacity to be installed and the new timeline for the implementation.	OK. GLC was able to verify that the emission reduction calculation spreadsheet was appropriately revised by taking into account the changes in the project design.
Investment Analysis calculation spreadsheets enclosed to the PDD	A total of 2 calculations have been added to the original cash-flow IRR benchmark analysis spreadsheets enclosed to the PDD. One is the definite IRR and benchmark check calculation used for the demonstration of additionality. This calculation considers the actual engine sets in use for the power plant, its electric energy output, and the use of evidenced investment and operational costs, those incurred to date and those yet to be fully implemented, all according to the updated timeline for implementation. A second cash-flow IRR analysis is included, for the purpose of checking conservativeness	OK. Editing's/modifications performed in the original investment analysis spreadsheet are deemed correct and acceptable. GLC was able to verify that the revised IRR calculation spreadsheet correctly considered all post-registration changes. It was confirmed that only applicable key parameters were changed (those actually affected by the occurred and yet to be fully implemented permanent modifications to the project activity). It is also verified that the most conservative scenario was used, as KDM S.A. provided evidence for actual investment and related O&M

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	of the definite demonstration of additionality. This calculation considers using an <i>ex-ante</i> estimated costs relationship for the new electric energy output and implementation timeline, rather than using actual incurred costs.	costs (as presented in the support investment analysis spreadsheet).
Support investment analysis spreadsheet (with detailed breakdown of all related investment and O&M costs for the project's electricity generation component)	In order to enhance transparency and completeness, a support investment analysis workbook ^{15/} is enclosed to the revised PDD. This supporting workbook includes a detailed breakdown of all associated investments and O&M costs applicable for the revised project design and also includes the related adjustments of assumptions to price index of year 2006. Summarized figures applied in the revised version of the investment analysis spreadsheet (which is based on the original investment analysis spreadsheet enclosed to the registered version of the PDD (version 4)) are determined based on related detailed breakdown for investment + O&M costs as presented in the support spreadsheet.	It was verified that summarized values (as values determined in the support spreadsheet) are correctly calculated. All related evidences for actual investment and related O&M costs were made available the GLC's assessment team. By assessing such evidences, the GLC's assessment team was able to confirm that assumed input values for investment and O&M costs are deemed correct.

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5 VALIDATION OPINION / VALIDATION STATEMENT

Germanischer Lloyd Certification GmbH (GLC) was commissioned by KDM S.A. to perform the 4th verification of the CDM project activity "Loma Los Colorados Landfill Gas Project" (UNFCCC Project no. 0822) (monitoring period from 2009-09-01 to 2010-08-31). As part of its verification assessment, the GLC's assessment team confirmed the need to address via submission of a combined Post-registration change requests (under "Prior approval" process track) the following types of eligible changes:

- Permanent occurred and planned (yet to be fully implemented) changes in the design of the project's electricity generation component, which are summarized as follows:
 - Occurred and planned (yet to be fully implemented) gradual installation of electricity generation equipment fuelled by collected landfill gas (engine-generator sets) with higher energy conversion efficiency than as earlier assumed
 - Occurred and yet to be fully implemented installation of electricity generation equipment under a revised timeline/schedule
- Permanent changes from the monitoring plan encompassing:
 - More appropriate approaches and options for monitoring parameters associated with the determination of project emissions due to the consumption of electricity sourced from the grid and/or electricity sourced from a captive off-grid electricity generator (fuelled by diesel) by the project activity.
 - A more appropriate approach for monitoring parameters associated with the determination of project emissions due to the consumption of Liquefied Petroleum Gas (LPG) by the project activity.
 - Incorporation of the option of performing measurements of CH₄ fraction in collected LFG by using a calibrated portable gas analyzer (only during temporary circumstances when the continuous CH₄ content gas analyzer unit is not available) by following applicable monitoring and calculations requirements as per the "Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements".
- Corrections and improvements in information in the previous PDD which do not affect the project design (due existent minor errors and inconsistencies)

In the context of the verification assessment for the 4th verification of the project activity (monitoring period from 2009-09-01 to 2010-08-31), the above summarized changes were assessed by the GLC's assessment team as per the currently applicable procedure to address post-registration changes under the "Prior approval" process track. A revised version of Project Design Document (PDD) addressing these changes (PDD version 5.3 dated 2012-08-02) was made available by the project participant KDM S.A and assessed by the GLC's assessment team.

As part of its assessment, besides assessing all changes in the PDD, the GLC's assessment team also checked and verified all complementary data/documents and related information used by KDM S.A. to justify and substantiate the correctness and appropriateness of performed editing's/modifications in the

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PDD. A revised investment analysis spreadsheet and a revised spreadsheet with calculations of *ex-ante* estimations of emission reductions are enclosed to the revised PDD.

It is the GLC opinion that the revised version of the PDD (version 5.3) reflects in an appropriate and transparent manner the occurred and yet to be fully implemented permanent post-registration changes in the project design for the project activity. Moreover, the revision of the monitoring plan represents the adoption of more appropriate approaches for determining and monitoring project emissions due to the consumption of electricity and LPG by the project activity. The revision of the monitoring plan also allows applicable monitoring requirements of ACM0001 (version 4) for measuring CH₄ fraction in collected LFG being applied. Corrected information (including corrections of minor errors in the project description in PDD) accurately and correctly reflects the actual project information.

All explanations and justifications provided by KDM S.A. about information and assumptions added in the revised version of the PDD (version 5.3) are deemed reasonable, trustful, and acceptable.

The occurred and planned permanent changes and the revised monitoring plan correctly reflect the application of the approved CDM guidance regarding changes in the project design and monitoring plan as per the applicable provisions of the Clean Development Mechanism Project Standard. .

The GLC's assessment team was able to confirm during the performed on-site visit to the project site during the period from 2012-07-24 to 2012-07-27 (and also based on interviews with the project participants) that post-registration permanent changes in the project design indeed occurred and are planned to occur as earlier informed by the KDM S.A. prior to the start of the verification assessment.

As a conclusion it is the opinion of GLC that the post registration changes comply with the requirements established in the Clean Development Mechanism Project Standard and that the revised version of the PDD addresses such changes in a correct and transparent manner. GLC will thus recommend approval of the revised PDD as per CDM "prior approval track" procedure for addressing post-registration permanent changes in the project design of a registered CDM project activity.

Note: GLC highlights that its assessment and opinion for post-registration changes for the CDM project activity "Loma Los Colorados Landfill Gas Project" did not encompass any re-assessment of the earlier performed validation (e.g. including the application of the baseline and monitoring methodology and assessment and demonstration of additionality). The scope of the assessment performed by GLC is in accordance with applicable assessment requirements as per the CDM Validation and Verification Standard. Related validation assessment for the project activity vis-à-vis CDM requirements and criteria was earlier performed by the DOE responsible for the CDM validation of the project activity. The outcomes and opinion of the performed validation assessment are detailed in the Validation Report for the CDM project activity "Loma Los Colorados Landfill Gas Project" (dated 2006-12-18 and approved by UNFCCC).

Hamburg, 2012-08-20

A handwritten signature in dark ink, appearing to be 'G. J. ...', is written over a light blue horizontal line.

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Marco A. Ratton
Assessment team Leader

6 REFERENCES

The following table outlines the documentation reviewed and assessed by the GLC's assessment team as part of its assessment for post registration changes for the project activity.

Documents revised or assessed:

The following table outlines the documentation reviewed during the validation assessment:

Table 6-1 List of assessed and reviewed documents

Reference	Author: Title, version, date of issue
/1/	KDM S.A.: Project Design Document (PDD) for the CDM project activity "Loma Los Colorados Landfill Gas Project". Version 5.3. Dated 2008-08-02.
/2/	KDM S.A.: Project Design Document (PDD) for the CDM project activity "Loma Los Colorados Landfill Gas Project". Version 4.
/3/	KDM S.A.: Revised investment analysis spreadsheet for the CDM project activity "Loma Los Colorados Landfill Gas Project". Dated 2012-06-28 File name: " <i>LLC Econ and sensitivity LFG capture power gen 28jun2012 (Revised)</i> "
/4/	KDM S.A.: Investment analysis spreadsheet for the CDM project activity "Loma Los Colorados Landfill Gas Project". Dated year 2006 File name: " <i>LLC Econ and sensitivity LFG capture power gen 10dec06</i> "
/5/	KDM S.A.: Support spreadsheet (including breakdown calculations) for the investment analysis spreadsheet for the CDM project activity "Loma Los Colorados Landfill Gas Project". Dated 2012-06-28 File name: " <i>Analisis Financiero PDD KDM_rev34-08aug2012</i> "
/6/	KDM S.A.: Revised calculation spreadsheet with <i>ex-ante</i> estimations of emission reductions for the CDM project activity "Loma Los Colorados Landfill Gas Project". Dated 2012-06-28 File name: " <i>Loma Los Colorados LFG & CER estimation (Updated)_rev01</i> "

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Reference	Author: Title, version, date of issue
/7/	KDM S.A.: Approved internal equipment purchasing order N°349370. This purchasing order deals with acquisition and installation of equipment related to the 2 GE-Waukesha APG1000 series engine-generator sets. Purchasing order issued against Maestranza Diesel S.A. Dated 2008-09-25.
/8/	KDM S.A.: Approved internal equipment purchasing order No. 350119. This purchasing order deals with acquisition and installation of one LFG blowers manufactured by LFG Specialties. Purchasing order issued against LFG Specialties LLC. Dated 2008-11-03.
/9/	KDM S.A.: Approved internal equipment purchasing order No. 350256. This purchasing order deals with acquisition and installation of the related cooling system equipment for the 2 GE-Waukesha APG1000 series engine-generator sets. Purchasing order issued against Maestranza Diesel S.A. Dated 2008-11-11
/10/	KDM S.A.: Approved internal equipment purchasing order No. 600033. This purchasing order deals with acquisition and installation of the related transmission and control system equipment for the 2 GE-Waukesha APG1000 series engine-generator sets + testing services. Purchasing order issued against Maestranza Diesel S.A. Dated 2009-10-21.
/11/	Generadora Trasandina S.A.: Technical and commercial to KDM S.A. related to the gradual implementation of GE-Jenbacher J420 series engine-generator sets and ancillary equipment + operation of the power plant. Dated 2010-05-10.
/12/	Generadora Trasandina S.A.: Technical project's description – Central Loma Los Colorados 2 – CLLC-2. Revision A. Dated 2010-04-15.
/13/	DLP-ener Constructora Ltda.: Technical and commercial offer from DLP-ener Constructora Ltda. to KDM S.A. related to the civil construction of edifications and supplementary facilities for the power plant equipped with the GE-Jenbacher J420 series engine-generator sets. Dated 2010-10-26.
/14/	KDM S.A.: Approved internal equipment purchasing order No. 600234. This purchasing order deals with acquisition of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Alstom Grid Chile S.A. Dated 2010-10-14.
/15/	KDM S.A.: Approved internal equipment purchasing order No. 600420. This purchasing order deals with acquisition and installation of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Rhona S.A. Dated 2011-03-24.
/16/	KDM S.A.: Approved internal equipment purchasing order No. 600445. This purchasing

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Reference	Author: Title, version, date of issue
	order deals with assembly and installation of the power transformers and related equipment for the power plant equipped with GE-Jenbacher J420 series engine-generator sets. Purchasing order issued against Alstom Grid Chile S.A. Dated 2011-04-05.
/17/	Cruz y Davila Ingenieros Consultores: Oferta de Servicios por Administración y Inspección Técnica de Obras. (<i>Technical and commercial offer for service of administration and technical inspection for construction event</i>). Sistema de Generación Eléctrica con Biogás Central Loma Los Colorados II. Dated 2010-09-20.
/18/	KDM S.A.: Records of destruction and utilization of collected LFG by the project activity "Loma Los Colorados Landfill Gas Project" during the period from March 2007 to May 2012. File name: "File 200 - KDM CER's Production Report May 2012.xls". Dated June 2012.
/19/	KDM S.A.: Monitoring Reports for the CDM project activity "Loma Los Colorados Landfill Gas Project" for the 1 st , 2 nd and 3 rd verifications (verification periods from 2007-03-17 to 2007-06-17; from 2007-06-18 to 2008-03-12 and from 2008-03-13 to 2009-08-31 respectively). Available online: http://cdm.unfccc.int/Projects/DB/DNV-CUK1166695034.41/view
/20/	Det Norske Veritas Certification Ltd.: Validation Report for the "Loma Los Colorados Landfill Gas Project". Report No. 2006-0946. Revision No. 001. Dated 2006-12-18. Available online: http://cdm.unfccc.int/filestorage/X/0/Q/X0QCD90C5CY6FK79WCFKDDFWRF4UIW/Validation%20Report.pdf?t=Yk58bTVxOGFtDBJA2xKsgU1ahp4EDn-OFnN
/21/	UNFCCC / CDM-EB: Clean Development Mechanism Validation and Verification Standard (VVS). Version 02.0. EB65/Annex 5
/22/	UNFCCC / CDM-EB: Clean Development Mechanism Project Standard. Version 01.0. EB65/Annex 5.
/23/	UNFCCC / CDM-EB: Clean Development Mechanism Project Cycle Procedure. Version 02.0. EB66/Annex 64.
/24/	UNFCCC / CDM-EB: Tool to calculate baseline, project and/or leakage emissions from electricity consumption. Version 1

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Reference	Author: Title, version, date of issue
/25/	UNFCCC / CDM-EB: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion. Version 2
/26/	GE Energy Waukesha Gas Engines / Dresser Waukesha: Fact sheet (brochure) "Waukesha Engine Power Ratings" with general technical specifications for the full range of Waukesha engine-generator sets.
/27/	GE Energy Waukesha Gas Engines / Dresser Waukesha: Fact sheet (brochure) "L7042GL / VHP Series Gas Engine Extender Series" with detailed technical specifications for the Waukesha VHP L7042GL engine-generator set.
/28/	GE Energy Waukesha Gas Engines / Dresser Waukesha: Fact sheet (brochure) "Waukesha gas engines APG1000" with detailed technical specifications for the Waukesha APG1000 engine-generator set. Available online: http://www.dresserwaukesha.com/documents/8053_0811_APG1000_product_bulletin.pdf
/29/	GE Energy : Fact sheet (brochure) "Jenbacher type 4 (the new 4B version) / an efficiency milestone" with detailed technical specifications for the GE Jenbacher Type 4 Series engine-generator set. Available online: http://www.ge-energy.com/content/multimedia/_files/downloads/ETS_US_T4_10_screen_February2011.pdf
/30/	KDM S.A.: Working procedure <i>Instructivo Sistema de Captacion y Abatimiento de Biogas</i> (Instructions Biogas collection and abatement system). Document code: i-RSL-013. Revision 7. Dated 2009-07-06.
/31/	KDM S.A.: Internal company presentation titled "La Experiencia del Relleno Sanitario Loma Los Colorados em Captura de Biogás y Generación de Energía em el marco de proyectos MDL." (<i>Experience of Loma Los Colorados landfill within biogas capture and power generation in CDM projects</i>) Presentation material issued by Mr. Sergio Durandean. Dated Septiembre 2010.
/32/	Terraza, N. ; Willumsen, W.; Guimaraes, H. : Design vs. Actual Performance and the Future for CDM Projects. Sponsor Canadian International Development Agency / World Bank. Dated year 2007.

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Reference	Author: Title, version, date of issue
/33/	Makel Engineering, inc.: Landfill Gas-Fuelled HCCI Demonstration System. Dated September 2007.
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/35/	GE-Jenbacher AG.: Especificación técnica Grupo electrógeno JGS 420 GS-L.L. KDM Chile m. Sonderturbolader. Dated 2010-04-14.
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