Project design document form

(Version 11.0)

BASIC INFORMATION	
Title of the project activity	Olkaria I Units 4&5 Geothermal Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	043
Completion date of the PDD	027/0911/20120
Project participants	Kenya Electricity Generating Company Limited(KenGen)
Host Party	Kenya
Applied methodologies and standardized baselines	ACM0002, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 13.0.0) Standardized Baseline: Not Applicable
Sectoral scopes	Sectoral Scope 1: Energy Industries (renewable - /non-renewable sources)
Estimated amount of annual average GHG emission reductions	635,049 tCO_2e (tonnes)

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The objective of the Olkaria I Units 4&5 Geothermal Project~~,~~ is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity. ~~which~~ The ~~has been~~ proposed project by the Kenya Electricity Generating Company Limited (KenGen), is to add about 1,128,288 MWh per year of geothermal-generated electricity to the Kenya national grid system. The project is a greenfield renewable energy project which will utilise steam collected from geothermal wells for electricity generation. The following activities are to be undertaken as part of the implementation of the project activity:

i. Drilling of steam production wells and reinjection wells to provide adequate steam capacity for the 150.52~~40~~[1] MW power plant
ii. Constructing the steam gathering and reinjection pipeline networks and the associated infrastructure, such as access roads and new well pads
iii. Construction of power house, installing turbine, generator and its auxiliary equipment
iv. Construction of switchyard and double circuit 220 KV transmission line

Although Kenya has a geothermal potential of between 7,000 and 10,000 MW, about 200 MW of generation capacity from geothermal has been installed in the country[2].

The Kenyan national grid system, with an installed generating capacity of about 1,593 MW by end 2011 (according to the 2010/2011 KPLC Annual Report)[3], comprises both renewable and thermal generation sources. In 2011, KPLC purchased 7,424,137MWh of electricity to the grid which comprised of 19.45% from geothermal, 42.55% from hydro, 36.26% from thermal, 0.25% from wind, 0.43% from imports and 1.06% from biomass.

The renewable energy generated by the project will be sold under a Power Purchase Agreement to the Kenya Power and Lighting Company (KPLC). The project activity will reduce CO_2 emission through the displacement of electricity generated by fossil fuel fired power plants connected to the national grid. The baseline scenario for the project is as follows:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

In the project scenario, the renewable electricity generated from geothermal source will displace an equivalent amount of electricity currently generated by the grid-connected power plants.

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[1] The effective generation capacity of the Geothermal plant is being capped at 140 MW as per PPA and license to operate. However the design capacity of each~~the~~ turbogenerators is 75.26 MWh, thus overall capacity of project is 150.52 MW.

[2] http://oilprice.com/Alternative-Energy/Geothermal-Energy/Kenya-to-Investigate-Potential-of-Geothermal-Power.html and pages 114 to 115 of the KPLC Annual Report for 2010/2011 (http://www.kenyapower.co.ke/AR/Annual%2520Report%25202010%2520-%25202011.pdf)

[3] See http://www.kenyapower.co.ke/AR/Annual%2520Report%25202010%2520-%25202011.pdf

The project will result in greenhouse gas (GHG) emission reductions by displacing fossil fuel-based electricity generation in the Kenyan grid with clean geothermal power.

The project is estimated to generate an average of 635,049 tonnes of CER annually and a total of 4,445,343 tonnes over the crediting period.

The project will contribute to the sustainable development of Kenya in the following ways:

i. Renewable electricity – The proposed project will provide renewable and clean electricity to the national grid while also diversifying the electricity sources for the country and reducing fossil fuel imports. This will also result in considerable foreign exchange savings that can be committed to other economic activities.
ii. Employment - The proposed project activity will provide about 1,000 temporary jobs during construction and not less than 100 permanent jobs during operation. Increased power availability will create more opportunities for expanded rural electrification with far reaching impacts on job creation and improved livelihoods in the rural areas
iii. Local development - The project will stimulate market activity near the site, requiring support from several local businesses in the purchasing of consumables, operation and maintenance of equipment and subcontracting services.
iv. Technology transfer - The project will enhance the transfer of geothermal technology to the country and the neighbouring countries through the application and promotion of geothermal, accelerating the accumulation of experiences and absorption of this kind of technology.

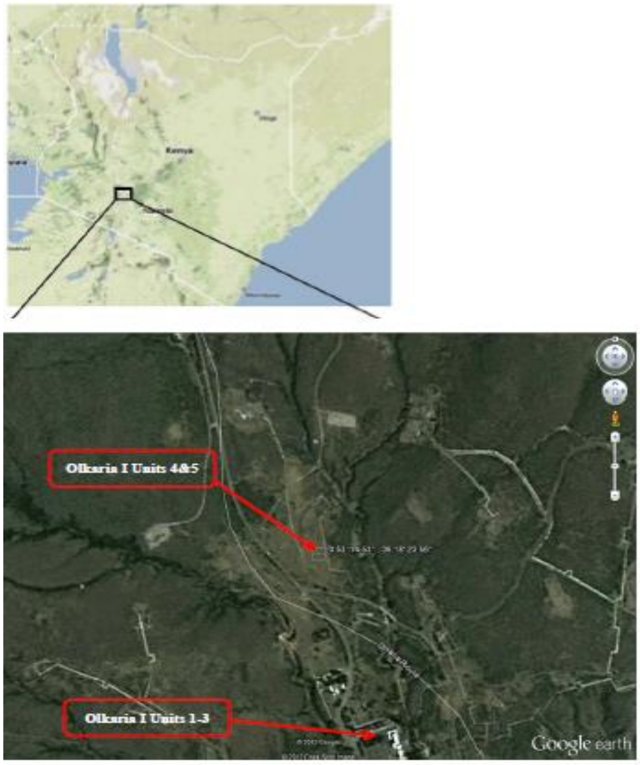
Social benefits- Under the corporate responsibility, the proposed project will allocate some funds to fund community projects aimed at improving the standards of the surrounding community.

A.2. Location of project activity

Naivasha, Nakuru County, Kenya
The proposed project site is located in the Hell's Gate National Park, approximately 132km northwest of Nairobi, near Naivasha Town on the floor of the southern segment of Kenya's Rift Valley. The Olkaria geothermal field occupies a circular area of about 80km^2.

The Olkaria geothermal I Units 4&5 is located about 2 km north east of existing Olkaria I power station. The coordinates for the site are: -0.887388, 36.3068900^{0} 53' 14.53"S and 36^{0} 18' 23.56" E.

Figure 1: General location of the Olkaria I Units 4&5 project



A.3. Technologies/measures

The purpose of the proposed project activity is to build and operate a 140[4] MW capacity greenfield geothermal power plant capable of exporting 1,128,288 MWh of clean electricity per year to the Kenya national grid. The electricity exported to the grid will displace the fossil fuel intensive electricity from the Kenya national grid. The 140 MW generation capacity project will involve the installation and operation of a geothermal power plant, consisting of a steam turbine, a generator switchyard and transmission line. The steam for the project will be provided by geothermal wells and the condensate will be re-injected to maintain groundwater supply. The plant is designed to have a typical lifetime of 25 years[5].

The baseline scenario is the provision of the electricity generated by the project by the additional provision of comparable capacity or electricity generation by the Kenya Power and Light Company, the national grid operator, which is the same as the situation existing before the project activity. The project scenario is the installation and operation of the geothermal plant with a total installed capacity of 150.52~~140~~ MW at the project site where presently there is no power generation at all.

[4] Although the rated capacity of the plant is 150.52 MW the effective generation capacity of the geothermal plant is capped at 140 MW as per PPA and license to operate.

[5] See page 145 of file “WB-KenGen-Olkaria-PhaseII-Final-FSR_text for printing_.pdf”

Since there is a significant proportion of thermal power generation in the Kenya national grid system, the establishment of the proposed project activity will lead to greenhouse gas (GHG) emission reductions as estimated following the baseline methodology below.

The Technology

The project will consist of two identical 75.26~~0~~ MW units with a design steam pressure and temperature of 4.8~~5~~ bar and 150.3~~1.7~~⁰C, respectively. The geothermal technology applied will consist of a single flash condensing turbine manufactured by Toshiba Power Systems Company[6] and a generator manufactured by Mitsubishi Corporation[7]. The management of the project including procurement, engineering and construction (EPC) has been contracted out to a Consortium of Hyundai Engineering Co. Ltd & Toyota Tsusho Corporation.

The main project equipment and their key parameters are shown in Table 1.

Table 1: Key Equipment and their Specifications

Equipment	**Parameter**	**Specification**
Plant cycle	-	Single Flash, Condensing
Turbine	No. of units	2 set
	Type	Single Casing, Double Flow, Impulse and/or Reaction, Condensing Type, Electro-hydraulic Governor
	Rated output	75~~0~~,26~~00~~0 kW
	Max. capacity	105 % Rated output
	Speed	3,000 rpm
	Steam pressure/temp.	4.8~~5.0~~ bar absolute / 150.3~~1.7~~ºC at interface point
Condenser	No. of units	2 set
	Type	Spray, Direct Contact type Condenser
Generator	No. of Units	2 set
	Type	3 phase, Horizontal cylindrical field, totally enclosed, self-ventilated, air-cooled, brushless type exciter
	Capacity	75~~0~~,26~~00~~0 kW
	Voltage/Frequency/Speed	11 kV/50/3000 rpm
Generator transformer	No. of Units	2 set
	Type	Outdoor use, oil-immersed, self-cooled type
	Capacity	87,500 kVA
	Primary voltage	11 kV (Delta), with on load tap changer (plus 10%, minus 10%)
	Secondary Voltage	220 kV (Star)
	Frequency/ Number of phases/ Rating	50Hz/3/ Continuous

The detailed technical specifications of the turbine/generator and auxiliaries are as contained in the Feasibility Study Report for New Units of the Optimization Project (Section 4.3)[8]

Although Kenya has installed close to 200 MW of geothermal power generation capacity, the proposed project activity offers significant technology transfer from Annex I party to

[6] http://www.toshiba.co.jp/worldwide/about/company/ps.html

[7] http://www.mitsubishicorp.com/jp/en/bg/machinery/

[8] See from page 108 of file "WB-KenGen-Olkaria-PhaseII-Final-FSR_text for printing_.pdf"

Kenya as it involves the application of more updated geothermal technology covering, steam exploration, well drilling and power plant construction and operation. Local installation, operation and maintenance staff will be trained by the equipment manufacturers.

The Process
The proposed project activity will draw its steam from new wells being drilled near and around the project site. Since location of steam wells is based on blocks, the proposed project will have separate and distinct steam sources, different from the other existing plants. The applicable Power Purchase Agreement (PPA) with KPLC will also be separate.

Steam collected from the production steam wells supplying the project activity, will be fed into the two 75.26~~0~~ MW turbines at 4.8~~5~~ bar pressure after brine separation. There are two main steam pipelines with their corresponding venturi meters for each unit (measuring main steam consumption) as well as two auxiliary steam pipelines with their corresponding venturi meters for each unit (measuring auxiliary steam consumption) The steam from the turbine will exhaust via a direct contact condenser, which uses a forced draught cooling tower for steam condensation. The returning condensate from the turbine and steam separator will then be collected and re-injected back into the geothermal field cold re-injection wells.

Generation will be at 11kV and will be stepped up to 220kV before being transmitted. The electricity generated from the project activity will be measured using two set of meters (one main meter owned by KenGen and one check meter owned by Kenya Power and Lighting Company respectively) for each unit. The meters are installed after the generator but before the substation to record electricity export and import. ~~one meter will be owned by KenGen (Main Meter) while the other by Kenya Power and Lighting Company (back-up Meter)). The two meters will be located at a sub-station located within the geothermal project site.~~ Electricity generated will be transmitted to Olkaria II sub-station where it will be stepped-up and subsequent export to the National Grid via a high voltage transmission line. The geothermal plant will be monitored and controlled at the central control room at the project site.

Although Kenya has installed close to 200 MW of geothermal power generation capacity, the proposed project activity offers significant technology transfer from Annex I party to Kenya as it involves the application of more updated geothermal technology covering, steam exploration, well drilling and power plant construction and operation. Local installation, operation and maintenance staff will be trained by the equipment manufacturers. It is important for the staff to understand both the steam resource and the turbine/generator technology. Technical training will be done as part of the installation programme. The manufacturers' turbine/generator training manuals will be used on site. Opportunities for additional ad- hoc training will be created as and when needed.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Kenya (host)	Kenya Electricity Generating Company Limited. (Private entity)	No

A.5. Public funding of project activity

Public funds from Annex I countries are involved in the proposed project activity. The project activity does not make use of Official Development Assistance (ODA), nor does it result in

the diversion of such ODA. Instead, the project is funded through equity and commercial loans.

A.6. History of project activity

The PP hereby confirms that:

(a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
(b) The proposed CDM project activity is not a project activity that has been deregistered.

Also the PP hereby declares that:

(a) The proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA;
(b) A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

Not Applicable

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

ACM0002, "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 13.0.0)

This methodology also refers to the latest approved version of the following tools:

i. Tool to calculate the emission factor for an electricity system, version 2.2.1, EB 63
ii. Tool for the demonstration and assessment of additionality, version 6.0.0, EB 65

B.2. Applicability of methodologies and standardized baselines

Applicability Requirement of ACM0002, Version 13.0.0	**Olkaria I Units 4&5 Geothermal Project**	**Applicability Met?**
Grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s)	The proposed project is a Greenfield grid-connected renewable power generation activity and the site where the project will be located has got no other power project	Yes
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit,	The proposed project is an installation of a new geothermal power plant	Yes

solar power plant/unit, wave power plant/unit or tidal power plant/unit		
In the case of capacity additions, retrofits or replacements (except for capacity addition projects for which the electricity generation of the existing power plant(s) or unit(s) is not affected): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation -of baseline emissions and defined in the baseline emission section, and no capacity addition or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity	The proposed project is a greenfield project (i.e. not capacity additions, retrofits or replacements).	Yes
In case of hydro power plants, at least one of the following conditions must apply: ▪ The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or; ▪ The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m^2; after the implementation of the project activity; or ▪ The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity.	Project is not a hydro power plant and the conditions do not apply	Yes
The methodology is not applicable to the following: ▪ Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; ▪ Biomass fired power plants; ▪ A hydro power plant that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the reservoir is less than 4 W/m^2	Project does: ▪ not involve switching from fossil fuels to renewable energy sources ▪ is not a biomass fired plant ▪ is not a hydro power plant	Yes
The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available.	The geographic and system boundary of Kenyan grid is clearly identifiable and information on the grid exits.	Yes

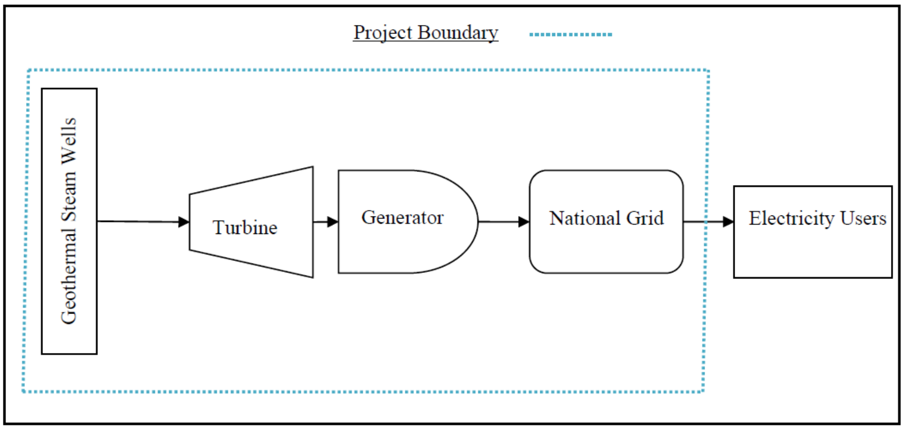
B.3. Project boundary, sources and greenhouse gases (GHGs)

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table below.

	Source	GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	CO_2	Yes
		CH_4	CH_4	No
		N_2O	N_2O	No
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.	CO_2	Yes	Main emission source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emission source
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	Yes	Main emission source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emission source

According to the methodology ACM0002 version 13.0.0 applied, and the proposed project being a grid connected geothermal power project, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to (i.e. Kenyan grid).

Figure 2: A schematic diagram of the project boundary



B.4. Establishment and description of baseline scenario

The proposed project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity. In accordance to the approved consolidated baseline and monitoring methodology ACM0002 version 13.0.0 the baseline scenario is defined as follows:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

B.5. Demonstration of additionality

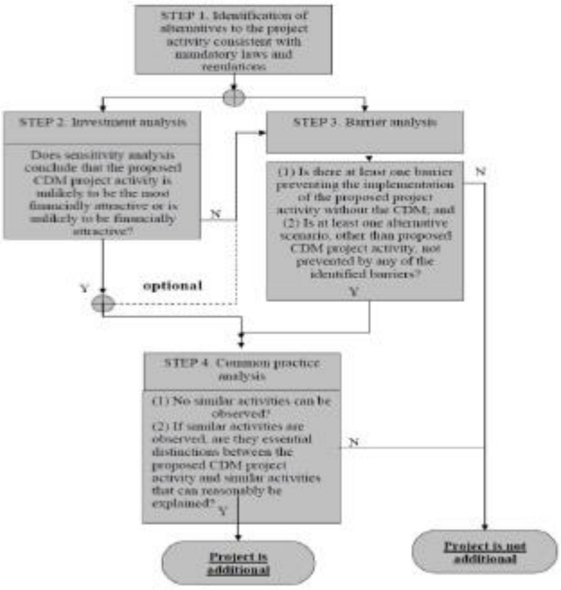
The table below demonstrates that real and actual actions took place in pursuit of the CDM project by KenGen

April 2005	Feasibility study commissioned KenGen and Westjec Olkaria Optimization Study
August 2009	Feasibility report finalised
04th September 2009	Board meeting decision on project investment
02nd December 2009	Board meeting decision on CDM
27th April 2010	General Procurement Notice Published
June 2010	Financial closure reached
15th Oct 10 & 25th Oct 10	'No objection' received for Tender Documentation for Lot B.2 & B.1 received respectively
23rd Feb 11	'No objection' received for Tender Documentation – Lot C
7th /15th April 11	Tender Documentation – Lot A 'No objection' received from WB/KfW
12th April 2011	Prior consideration for the project sent to UNFCCC and the Kenyan DNA Refer http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html
August 2011	Carbon Asset advisory services tender for the project issued
07th Nov 2011	Engineering, Procurement and Construction (EPC) contract signed
9th November 2011	Contract signed for Lot B : Power Plant
5th December 2011	Project construction started
6th December 2011	Contract signed for Lot C: HV Lines & Substation
February 2012	Negotiation completed in December 2011 and Contract Documentation sent to WB/KFW for Lot A: Steamfield Development
10th February 2012	Carbon Asset advisory services contract signed
March 02,2012	'No objection' received for Lot A Contract
4th April 2012	Contract signed for Lot A: Steam field Development

Since the project starting date (award of tender for Engineering Procurement & Construction on 7 Nov 2011) is after 02 August 2008, the UNFCCC was notified of the commencement of the project activity and of the intention to seek CDM status on 12/4/2011as per the "Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM"; (version 04.0), EB 62.

In order to demonstrate and asses additionality for this project, the "Tool for the demonstration and assessment of additionality"; version 06.0.0 (EB 65) is applied as per the requirements of the approved consolidated baseline and monitoring methodology, ACM0002 version 13.0.0.

The stepwise approach of the methodological tool for demonstration and assessment of additionality, as shown in the flow chart below, has been applied and is discussed below.



Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activity have been defined through the following Sub- steps:

Sub-step 1a: Define alternatives to the project

The following are the realistic and credible alternatives available to the project activity that provide outputs or services comparable with the proposed CDM project activity:

Alternative 1: The proposed project activity undertaken without being registered as a CDM project activity. This would entail the construction and operation of the project with the total generation~~installed~~ capacity of 140 MW, without being registered as a CDM project activity.

Alternative 2: Electricity generated by the operation of grid-connected power plants and by the addition of new generating sources. This is the continuation of the current situation and, according to ACM0002, is the identified baseline for the installation of a new grid-connected renewable power plant,

Alternative 3**:** A fossil fuel based power plant producing electricity with comparable quality, properties and application areas. This alternative, involving the construction and operation of a new fossil fuel power plant, is considered credible because fossil fuel based power plants have already been implemented in Kenya by Independent Power Producers (e.g. Tsavo Power, Iberafrica and Rabai). More recently, another IPP, Rabai Power, has commissioned a fossil fuel based power plant with a capacity of 90 MW. Plans are also underway by KenGen to develop a 300/600MW coal fired power plant in Mombasa.

Alternative 4: A power plant using another source of renewable energy and producing electricity with comparable quality, properties and application areas (e.g. hydro, biomass or wind). This alternative, involving the construction and operation of another renewable power

plant such as solar, wind, hydro or biomass, is considered credible because wind and hydro power plants have already been implemented by KenGen and Independent Power Producers in Kenya (Ormat Power and Mumias Sugar Company, respectively), although their capacities are far less than the proposed project. Solar power plants are not considered a credible alternative given the high investment costs involved.

Since there are no known renewable (wind, hydro and biomass) resources with electricity generation potential similar to the proposed project activity, alternative 4 is not feasible.

Sub-step 1b: Consistency with mandatory laws and regulations

Both the above alternatives to the project activity are consistent with the *Energy Act (2006)*[9] and the related mandatory and regulatory requirements[10], taking into account the enforcement in Kenya and EB decisions on national and/or sectoral policies and regulations.

The *Energy Act (2006)* allows for Independent Power Producers to supply electricity to the national grid through a Power Purchase Agreement with the Kenya Power and Lighting Company. There are no restrictions on types of power plants, and both fossil fuel based power plants and renewable energy power plants are allowed to deliver electricity to the grid.

Since the realistic and credible alternatives available to the project participants, as identified above, comply with all applicable laws and regulations, the project is additional under step 1.

Step 2: Investment analysis

Taking into account the *"Tool for the demonstration and assessment of additionality"; version 06.0.0* and *the "Guidelines on the Assessment of Investment Analysis",* version 05), this step has been used to determine that the proposed project activity is not economically or financially feasible, without the revenue from the sale of CERs.

The following Sub-steps have been used to conduct the investment analysis.

Sub-step 2a: Determine appropriate analysis method

The "*Tool for the demonstration and assessment of additionality";* version 06.0.0 provides for any of the following three investment analysis methods:

(i) Simple cost analysis (Option I),
(ii) Investment comparison analysis (Option II)
(iii) Benchmark analysis (Option III).

As per the "*Tool for the demonstration and assessment of additionality";* version 06.0.0, and since, the proposed project activity will generate financial and economic benefits (sale of electricity to the state utility) other than CDM related income, the simple cost analysis (Option I) cannot be applied.

The baseline scenario identified in accordance to the approved consolidated baseline and monitoring methodology, ACM0002, is the supply of electricity from the grid. This baseline does not necessarily require investment and is not within the control of the project developer

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[9] http://www.erc.go.ke/energy.pdf accessed 15/12/2011

[10] http://www.erc.go.ke/erc/regulatory_instruments/?ContentID=16 accessed 15/12/2011

(the project activity could be implemented by entities other than the project proponent). Benchmark analysis (Option III) is therefore selected as the most appropriate method of financial analysis for this project.

Given that the project has dual revenue streams, electricity for sale to the national grid and certified emission reductions, from the definition of alternatives in Sub-step 1a above, we are restricted to the proposed project activity not undertaken as a CDM project.

Sub-step 2b: Option III. Apply benchmark analysis

The Internal Rate of Return (IRR) is the most commonly used financial indicator by Bankers and Investors to assess the intrinsic viability of a project. It is also the financial indicator used by the Kenya Government to assess the intrinsic viability of a project. The IRR thus computed, has to be compared with a benchmark indicator. The Project IRR has therefore been chosen as the relevant financial indicator for the investment analysis of the proposed project and has been calculated on a pre-tax basis as per the “Tool for the demonstration and assessment of additionality”, Version 06.0.0. The Project IRR has been chosen since this is a long term project with negative and positive cash flows and because Project IRR is not affected by subjective inputs (NPV for example is affected by the discount rate applied in the analysis).

As per page 3 of the “Guideline on Assessment of Investment Analysis”, vers 05 (EB 62, Annex 5), in case where a benchmark approach is used, the applied benchmark shall be appropriate to the type of IRR calculated. The government of Kenya issued guidelines on the minimum required rate of return for all government projects. This minimum return rate specified by the Kenya Government in the Treasury Circular No 1/2007 dated 3rd Jan 2007, paragraph 2.3, page 4 (See sent file “Ministry of Finance_Treasury Circular_1_2007”) has been applied as the benchmark.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III)

The main data used in calculating the project IRR are shown in the table below.

Olkaria I Units 4&5 Geothermal Project Data			
Item	**Value**	**Units**	**Source**
Installed Power	140.0[11]	MW	Page 7 of Feasibility Study Report for New Units of the Optimisation Project (Ref file “WB KenGen-Olkaria-PhaseII-Final-FSR_text for printing_.pdf”)
Technical lifetime of turbines	25	Years	See page 128 of file “WB-KenGen-Olkaria Phase II-Final-FSR_text for printing_.pdf”
Net generation/export	1,128,288	MWh/year	Calculated
Hours in a year	8,760	Hours	Based on Feasibility Study Report
Plant load factor	92%		Based on Feasibility Study Report (Page 127)

[11] The effective generation capacity of the geothermal plant is being capped at 140 MW as per PPA and license to operate. However the design capacity of the turbogenerators is 150.52 MWh. The comparison of financial parameters is based on the effective generation capacity of 140 MW.

Investment Cost	$523,700,000		See page 14 of the Feasibility Study Report for New Units of the Optimisation Project (Ref file "WB-KenGen-Olkaria-PhaseII-Final-FSR_text for printing_.pdf")[12]
Selling Price Electricity (Tariff)	$0.0819	per kWh	PPA signed with Project developer and Power utility
CER Sales Price	$11.20	CER	Based on carbon market price at time of investment decision.
Fixed Operating Cost	65.18	US$/kW/yr	Calculated as per KenGen policy (See Excel spreadsheet)
Variable Operating Cost	0.01161	US$/kWh	Calculated as per KenGen policy (See Excel spreadsheet)

The Project IRR has been calculated as detailed in the attached financials spread sheet. The Project IRR works out to 10.48% (without CDM) and 11.69% (with CDM). The key parameters and assumptions are explained below.

With reference to the *"Guidelines on the Assessment of Investment Analysis"*, version 05, a technical lifetime of 25 years has been applied. This is considered typical of most Geothermal plants (See page 127 of file "WB-KenGen-Olkaria-PhaseII-Final-FSR_text for printing_.pdf"). As per the guidelines, a fair value of the project assets at the end of the assessment period has been considered as zero in the final year.

The electricity revenue has been calculated using the expected generation (1,128,288MWh) and the government approved sealing feed-in-tariff for geothermal-generated electricity (0.0819US$/kWh)[13]. A plant load factor of 92% (from the Feasibility Study Report; "WB-KenGen-Olkaria-PhaseII-Final- FSR_text for printing_.pdf") has been applied.

The basis for operating cost calculations are as follows;

- Fixed Operating Cost at 65.18 US$/kW/yr
- Variable Operating Cost at 0.01161US$/kWh

Both the above parameters have been calculated as per the applicable KenGen policy (See details in the Excel Spreadsheet for Investment Analysis). The Total Fixed O&M cost (USD/kw/year) includes a 4% per annum (straight line) depreciation included in the component called "Other Fixed Costs.

From the calculations above, the Project IRR at 10.48% (without CDM) is less than the benchmark rate of 15%. A comparison of the Project IRR with the benchmark reveals that the project is not feasible for KenGen on a commercial basis.

Sub-step 2d: Sensitivity analysis (only applicable to Options II and III):

The robustness of the conclusion drawn above has been tested, by subjecting the critical assumptions to reasonable variations as per the "*Guidelines on the Assessment of Investment Analysis"*, version 05 which state that:

[12] In the Feasibility Report, the investment cost has provision for Well Drilling incl rig mobilization. However, in the analysis, these costs are not included because they were covered separately.

[13] http://www.erc.go.ke/erc/tarrifs/?ContentID=6 or http://www.erc.go.ke/erc/fitpolicy.pdf accessed on 20/04/2011

"Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude), and the results of this variation should be presented in the PDD and be reproducible in the associated spread sheets".

The initial objective of a sensitivity analysis is to determine in which scenarios the project activity would pass the benchmark or become more favourable than the alternative.

Based on the guidelines, the Project Proponent has identified the critical parameters as:

1. Investment cost
2. Operating cost
3. Net generation/export
4. Selling Price Electricity (Tariff)

Accordingly, the critical assumptions have been subjected to a goal seek sensitivity analysis. The outcome of the sensitivity analysis is given in the table below.

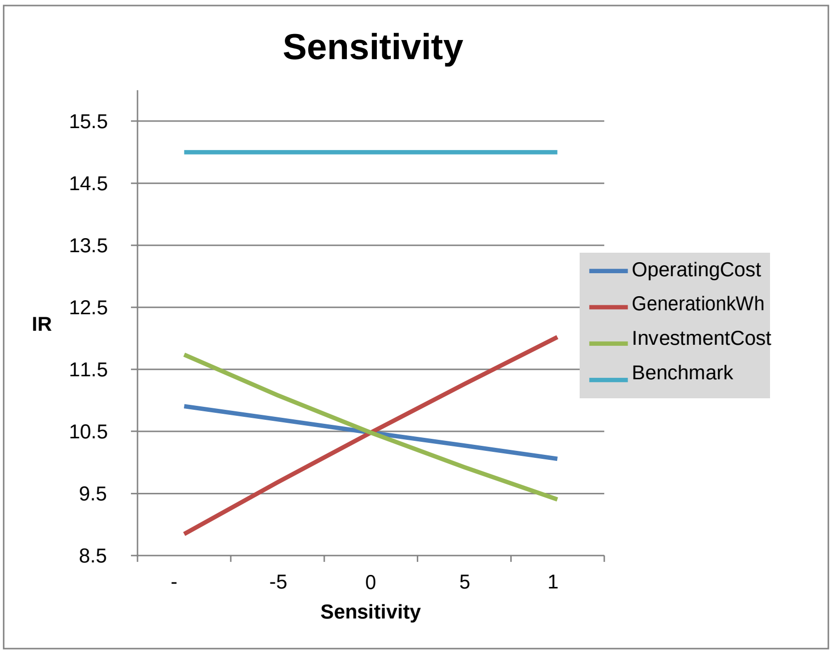
Parameter	Value to Benchmark	
Investment Cost	70%	Decrease of 30%
Operating Cost	10%	Decrease of 90%
Net generation/export	131%	Increase by 31%
Selling Price electricity (Tariff)	131%	Increase by 31%

From the table above, it is evident that for the Project IRR to reach the benchmark value of 15%, one of the following is necessary:

1. The investment cost has to decrease by 30% while the other parameters remain constant
2. The operating cost has to decrease by 90% while the other parameters remain constant or
3. The generation has to increase by at least 31% while the other factors remain constant.
4. The electricity sale price/tariff has to increase by at least 31% while the other factors remain constant.

It is evident that the project IRR remains low even with the favourable variations above.

The benchmark and sensitivity analyses (under step 2) show that the project activity is not financially viable without the CER revenue (Project IRR of 10.48% against a benchmark of 15%) and the CER revenue helps to improve the Project IRR to 11.69%. The sensitivity analysis is shown in the figure below:



* Tariff sensitivity has not been shown on the chart as it is exactly identical to Generation.

Although carbon revenues help to improve the financial performance of the project, it does not achieve the 15% benchmark and the project has to be further justified on socio-economic grounds as required by the Government of Kenya. In accordance with the Kenya Government Treasury Circular No 1/2007 dated 3rd Jan 2007, paragraph 2.3, page 4 (See file "Ministry of Finance_Treasury Circular_1_2007"), where the rate of return is less than 15%, adequate justification for the proposed project has to be presented in terms of socio-economic impact of the proposal. The socio-economic impacts of geothermal development has been independently presented in a study by AFREPEN entitled "The Socio-Economic and Environmental Impact Of Geothermal Energy On The Rural Poor In Kenya" (See file "AFREPEN Study Report.pdf"; http://www.afrepren.org/adb_finesse/Task%203/Background%20Material/AFREPREN%20O Paper%2012.pdf) and "Environmental & Socio-Economic Study" (See file "Environmental & Socio-Economic Study by Martin Mwangi.pdf"; http://www.geothermal.org/10MarApril24.pdf

The proposed project is therefore additional up to step 2.

Step 4: Common practice analysis

This section provides the "Common practice analysis" as per Paragraph 47 of the *"Tool for the demonstration and assessment of additionality"*, version 06.0.0, EB 65

Step 1. Output Range

The proposed project has a capacity of 140 MW consisting of 2 steam turbines of 70 MW each. Going by the guideline of +/-50%, the applicable output range for the project is 70 MW to 210 MW.

Step 2. Applicable Geographical Area

The applicable geographical area for the proposed project covers the entire host country (Kenya) as the default area specified in the guideline. The projects within the host country and the output range that have started commercial operation before the start date and are connected to the national grid system are shown in the table below.

Emergency supply projects that have been brought intermittently between 2006 to date due to poor hydrology have not been included in this table (See http://www.kplc.co.ke/fileadmin/user_upload/1Report_Pages.pdf):

Plant	Technology Type	Year of Commissioning	Capacity MW	Remarks
Rabai -Petrothermal	Thermal – Automotive Gas Oil	Sept 09	90	
Olkaria 2	Geothermal	2003-2009	70	CDM registered
Kipevu Diesel 1-Petrothermal	Thermal –Heavy Fuel Oil	Oct 99	75	
Tsavo-Petrothermal	Thermal-Heavy Fuel oil	June 01	74	
Kamburu	Hydro	1974-76	94.2	
Kiambere	Hydro	1988	144	
Turkwel	Hydro	1991	106	
Kipevu III	Thermal –Heavy Fuel Oil	2011	115	

The total number N_{all}, which excludes the CDM-registered projects, is 7.

Step 3. Applicable Technology

Other than the CDM-registered Olkaria2, none of the plants listed in step 2 above apply geothermal energy technology. N_{diff} is therefore the same as N_{all} (7).

Step 3. Calculation of factor F

$F = 1-N_{diff}/N_{all}$

Factor F is therefore 0. There are therefore no plants using similar technology to the technology used in the proposed project activity. Also, since N_{all} is equal to N_{diff}, then the $N_{all}-N_{diff} = 0$.

Since factor F is 0 and $N_{all}-N_{diff}$ is also 0, the proposed project activity is not a common practice as per the guidelines. The proposed project activity is therefore additional under common practice analysis

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Project Emissions

The project activity involves operation of new geothermal power plant and in accordance with ACM0002 (Version 13.0.0) emission due to the release of non-condensable gases is

accounted for under project emissions. Project emissions are accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (1)$$

Where:

PE_y	Project emissions in year *y* (tCO_2e)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO_2)
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e)

Fossil fuel combustion ($PE_{FF,y}$)

$PE_{FF,y}$ is calculated as per the latest version of the Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion version 02.

As per the tool, CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels. For this project, $PE_{FC,j,y}$ is equal to $PE_{FF,y}$. Where $PE_{FC,j,y}$ is calculated as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (1)$$

Where:

$PE_{FC,j,y}$	=	Are the CO_2 emissions from fossil fuel combustion in process j during the year *y* (tCO_2/yr);
$FC_{i,j,y}$	=	Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/yr);
$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
i	=	Are the fuel types combusted in process *j* during the year *y*

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using Option B, i.e. The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad (4)$$

Where:

$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type i in year *y* (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
i	=	Are the fuel types combusted in process *j* during the year *y*

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$)

Since the project activity is a geothermal project, fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam is counted for. As a conservative approach, this methodology assumes that all non-condensable gases entering the power plant are discharged to atmosphere via the cooling tower. Fugitive

carbon dioxide and methane emissions due to well testing and well bleeding are not considered, as they are negligible. $PE_{GP,y}$ is calculated as follows:

$$PE_{GP,y} = \left(w_{steam,CO2,y} + w_{steam,CH4,y} \cdot GWP_{CH4}\right) \cdot M_{steam,y} \quad (2)$$

Where:
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
$w_{steam,CO2,y}$ = Average mass fraction of carbon dioxide in the produced steam in year *y* (tCO_2/t steam)
$w_{steam,CH4,y}$ = Average mass fraction of methane in the produced steam in year y (tCH4/t steam)
GWP_{CH4} = Global warming potential of methane valid for the relevant commitment period (tCO_2e/tCH_4)
$M_{steam,y}$ = Quantity of steam produced in year *y* (t steam)

Baseline emissions

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (6)$$

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants in the grid that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

Where:
BE_y = Baseline emissions in year *y* (tCO_2)
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the .Tool to calculate the emission factor for an electricity system. (tCO_2/MWh)

Since the project is a Greenfield renewable energy power plant, the quantity of electricity generated is calculated as per the formula below:

$$EG_{PJ,y} = EG_{facility,y} \quad (7)$$

Where:
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh)

Emission Factor of the grid (*$EF_{grid,CM,y}$*)

The baseline emission factor (EF_y) is calculated as a combined margin ($EF_{grid,CM,y}$), consisting of the combination of operating margin ($EF_{grid,OM,y}$) and build margin ($EF_{grid,BM,y}$) factors in accordance with the latest "Tool to calculate the emission factor for an electricity system, version 02".

Calculations of the combined margin emission factor of the grid will be done ex-post based on dispatch data from an official source (Kenya Power and Lighting Company Limited (KPLC), www.kplc.co.ke and Energy Regulatory Commission, http://www.erc.go.ke/ctariff.pdf). KPLC does not post the dispatch data on its website, so the data has been obtained from KPLC on a disc.

Step 1: Identify the relevant electricity systems

As per the project boundary selected and in determining the electricity emission factors, the spatial extent of the project boundary includes the Kenyan grid system, which is physically connected to the project activity through transmission and distribution lines. All power plants considered in the baseline are connected to this grid system and the project activity will export power to this grid system and displace electricity within it.

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

Off-grid power plants are not included in grid emission factor determination (option I).

Step 3: Select a method to determine the operating margin (OM)

The tool to calculate the emission factor for an electricity system version 02 offers the following optional methods to calculate the Operating Margin emission factor(s), $EF_{grid, OM,y}$:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

The Dispatch Data Analysis method has been used to calculate $EF_{grid,OM,y}$.

The Operating Margin emission factor $EF_{grid,OM}$ will therefore be updated annually (ex-post) for the year in which actual project electricity generation and associated emissions reductions occur.

The baseline calculation for the PDD, however, is based on ex-ante data vintage using the most recent year (January – December 2011) which data was made available (See attached ER calculation spreadsheet).

Step 4: Calculate the operating margin emission factor according to the selected method

(c) Dispatch data analysis

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

As per the methodological tool, the dispatch emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad (10)$$

Where:

$EF_{grid,OM-DD,y}$	Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{PJ,h}$	Electricity displaced by the project activity in hour h of year y (MWh)
$EF_{EL,DD,h}$	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh)

$EG_{PJ,y}$	Total electricity displaced by the project activity in year y (MWh)
h	Hours in year y in which the project activity is displacing grid electricity
y	Year in which the project activity is displacing grid electricity

The hourly emission factor is calculated as follows:

$$EF_{EL,DD,h} = \frac{\sum_{n} EG_{n,h} \times EF_{EL,n,y}}{\sum_{n} EG_{n,h}}$$

Where:

$EF_{EL,DD,h}$	CO_2 emission factor for grid power units in the top of the dispatch order in hour h in year y (tCO_2/MWh)
$EG_{n,h}$	Net quantity of electricity generated and delivered to the grid by grid power unit n in hour h (MWh)
$EF_{EL,n,y}$	CO_2 emission factor of grid power unit n in year y (tCO_2/MWh)
N	Grid power units in the top of the dispatch (as defined below)
h	Hours in year y in which the project activity is displacing grid electricity
y	Year in which the project activity is displacing grid electricity

By using the dispatch data available from Kenya Power and Lighting Company (the power utility company), the dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) of the Kenyan grid system is calculated to be **0.633 tCO_2/MWh** (See ER calculation spreadsheet)

Step 5: Calculate the build margin (BM) emission factor

In terms of vintage of data, the Build Margin is calculated as per **Option 1**, where the first crediting period, the build margin emission factor is calculated *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.

The sample group of power units *m* used to calculate the build margin was determined as per the following procedure, consistent with option 1 of data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);
b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh);
c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

The set of power capacity additions in the electricity system that comprise 20% of the system generation ($AEG_{SET-\geq 20\%}$, in MWh) and that have been built most recently constitute the larger annual generation and therefore has been used in calculating the BM.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which electricity generation data is available, calculated as follows:

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (13)$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$FE_{EL,m,y}$	CO_2 emission factor of power unit *m* in year y (tCO_2/MWh)
m	power units included in the build margin
y	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) has been determined as per the guidance in Step 4 (a) for the simple OM of the tool, using options A1, using for year *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Using the available data, the Build Margin Emission Factor ($EF_{grid,BM,y}$) is calculated to be **0.625 tCO_2/MWh**.

Step 6: Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM} \qquad (14)$$

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emission factor (%)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor (tCO_2/MWh)
W_{BM}	Weighting of built margin emission factor (%)

The project applies the following default weight values, w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period and for subsequent crediting periods.

Therefore, combined margin will be:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * 0.5 + EF_{grid,BM,y} * 0.5 = 0.629$$

Leakage
No leakage emissions are considered.

Emission reductions
Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (11)$$

Where:

ER_y = Emission reductions in year y (tCO_2e)

BE_y = Baseline emissions in year y (tCO_2e)

PE_y = Project emissions in year y (tCO_2e)

B.6.2. Data and parameters fixed ex ante

Data/Parameter	***GWP_{CH4}***
Data unit	tCO_2/tCH_4
Description	Global warming potential of methane valid for the relevant commitment period.
Source of data	IPCC
Value(s) applied	2~~1~~5
Choice of data or measurement methods and procedures	Default value for the ~~first~~ second commitment period
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2e/MWh
Description	Build margin CO_2 emission factor in year y
Source of data	KPLC Dispatch Centre and IPCC default factors
Value(s) applied	0.6250
Choice of data or measurement methods and procedures	Calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Purpose of data	Calculation of baseline emissions
Additional comment	Calculated ex-ante for the first crediting period, and again once ex-ante at the start of second crediting period.-

B.6.3. Ex ante calculation of emission reductions

Project Emissions

Fossil fuel combustion ($PE_{FF,y}$)

Although combustion of fossil fuel is a potential source, the project proponent chose to neglect the emission from an installed ~~facility such as~~ emergency diesel generator as provided by version 13.0.0 of the methodology which states that the use of fossil fuels for the back up or emergency purposes (e.g. diesel generators) can be neglected.~~, to combust fossil fuel will not be installed in the project activity,~~ ~~T~~therefore, the emission is considered Zero (0)

$PE_{FF,y}$ = 0.

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$)

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

$$PE_{GP,y} = \left(w_{steam,CO2,y} + w_{steam,CH4,y} \cdot GWP_{CH4}\right) \cdot M_{steam,y} \quad (2)$$

Calculation of fugitive emissions from non-condensable gases (NCG):

The NCG composition of the wells on-site was studied by the Kenya Electricity Generating Company Ltd (KenGen) during the normal monitoring. The latest monitoring results are from ~~26~~19 production wells which will supply steam to Olkaria I Units 4&5 power station.

The analysis determined the percentage of NCG's in the produced steam and the composition of those NCGs. The average readings of the wells is used to estimate project emissions, but monitored data of the steam coming from all producing wells will be used ex-post. From the results from the analysis is detailed below:

Fraction of NCG's in the produced steam	0.008820
Average CO_2 (%) in NGC	89.28%
Average CH_4 (%) in NCG	0.07209%
W_{steam, CO_2}	0.7875%
W_{steam, CH_4}	0.0006359%

$PE_{GP,y}$ = (0.7875%+ (0.0006359%* 21)) * 9,320,640.00 tons/yr = 74,644 tCO_2e per year

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (1)$$

(a) = *0 +74,644 + 0*
= 74,644 tCO_2e

Baseline emissions

The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

= 1,128,288 MWh/yr * 0.629 tCO_2/MWh

= 709,693 tCO_2e

Since the project is a Greenfield renewable energy power plant, the project electricity quantity is as below:

$$EG_{PJ,y} = EG_{facility,y}$$
= 1,128,288 MWh

Leakage

No leakage emissions are considered zero (0).

Emission reductions

$$ER_y = BE_y - PE_y \quad (11)$$

= 709,693 - 74,644 – 0
= 635,-049 tCO_2e

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions ($t CO_2e$)	Project emissions ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions ($t CO_2e$)
~~01/07/2014 – 31/12/2014~~	~~354,847~~	~~37,322~~	~~0.00~~	~~317,525~~
2015	709,693	74,644	0.00	635,049
2016	709,693	74,644	0.00	635,049
2017	709,693	74,644	0.00	635,049
2018	709,693	74,644	0.00	635,049
2019	709,693	74,644	0.00	635,049
2020	709,693	74,644	0.00	635,049
~~01/01/2021 – 30/06/~~2021	709,693~~354,846~~	74,644~~37,322~~	0.00 ~~0.00~~	635,049~~317,524~~
Total	**4,967,851**	**522,508**	**0.00**	**4,445,343**
Total number of crediting years	7			
Annual average over the crediting period	709,693	74,644	0.00	635,049

* Crediting period start in 01/01/2015~~July 2014~~ and ends in 31/12/~~June~~ 2021.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Source of data	Electricity meters

Value(s) applied	1,128,288
Measurement methods and procedures	The following parameters shall be measured: (i) The quantity of electricity supplied by the project plant to the grid; and (ii) The quantity of electricity delivered to the project plant from the grid The difference of electricity export and Import from the grid gives the value of net electricity generation supplied by the project plant/unit to the grid
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	Net Eelectricity supplied by the project activity to the grid will be double checked from Data Capture sheets which is an attachment of the by receipt of electricity sales invoice.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Source of data	KPLC Dispatch Centre and IPCC default factors
Value(s) applied	0.629
Measurement methods and procedures	As per the .Tool to calculate the emission factor for an electricity system.
Monitoring frequency	As per the .Tool to calculate the emission factor for an electricity system.
QA/QC procedures	As per the .Tool to calculate the emission factor for an electricity system.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$FC_{i,m,y}$
Unit	Mass or volume
Description	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*
Source of data	KPLC and Energy Regulatory Commission
Value(s) applied	Please refer GEF Sheet
Measurement methods and procedures	This will be calculated based on specific fuel consumption (ton/MWh) data provided by the Energy Regulatory Commission for each power plant on annual basis
Monitoring frequency	Annually for Dispatch data OM; For BM, once ex-ante for the first crediting period and once ex-ante at start of the second crediting period.
QA/QC procedures	Internal validation check should be performed contrasting historical data for existing plants and their fuels.
Purpose of data	Calculation of baseline emissions
Additional comment	Applicable in the following cases: (a) Calculation of power unit emission factor $EF_{EL,m,y}$ as per equation (3), “Tool to calculate the emission factor for an electricity system.” (b) Calculation of the hourly emission factor of plants in the top of the dispatch as per equation (9), “Tool to calculate the emission factor for an electricity system.”

Data / Parameter	$NCV_{i,y}$
Unit	TJ/mass or volume
Description	Net Calorific value (energy content) of fossil fuel type i in year y

Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.2, p.1.18-1.19 IPCC default values at the lower limit of the uncertainty at a 95% confidence interval have been applied
Value(s) applied	Automotive Gas Oil (AGO): 42.50 TJ/10^3 tons; Diesel: 41.403 TJ/10^3 tons; Fuel Oil: 39.80 TJ/10^3 tons; and Kerosene: 42.40 TJ/10^3 tons
Measurement methods and procedures	-
Monitoring frequency	Annually for Dispatch data OM; For BM, once ex-ante for the first crediting period and once ex-ante at start of the second crediting period.
QA/QC procedures	Internal validation check should be performed contrasting historical data for existing plants and their fuels.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.4, p.1.23 IPCC default values at the lower limit of the uncertainty at a 95% confidence interval have been applied
Value(s) applied	Automotive Gas Oil (AGO): 67.5; Diesel:72.6; Fuel Oil: 75.5; and Kerosene: 70.8 Default values at the lower limit of the 95% confidence intervals have been used.
Measurement methods and procedures	-
Monitoring frequency	Annually for Dispatch data OM; For BM, once ex-ante for the first crediting period and once ex-ante at start of the second crediting period.
QA/QC procedures	Internal validation check should be performed contrasting historical data for existing plants and their fuels.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{n,h}$ and $EG_{m,y}$
Unit	MWh
Description	Net electricity generated and delivered to the Kenyan grid by power plant/unit *n* in hour *h* and *m* in year *y*
Source of data	KenGen and KPLC Dispatch Centre
Value(s) applied	Refer GEF Sheet
Measurement methods and procedures	Actual net generation and export to the grid by each power unit will be measured and recorded.
Monitoring frequency	Hourly for Dispatch data OM; For BM, once ex-ante for the first crediting period and once ex-ante at start of the second crediting period.
QA/QC procedures	-.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{PJ,h}$
Unit	MWh
Description	Electricity displaced by the project activity in hour *h* in year *y*

Source of data	KPLC Dispatch Centre
Value(s) applied	Refer GEF Sheets
Measurement methods and procedures	Electricity displaced by the project activity will be measured every hour and recorded.
Monitoring frequency	Hourly
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$w_{steam,CO2,y}$
Unit	tCO_2/t steam
Description	Average mass fraction of carbon dioxide in the produced steam in year *y*
Source of data	Project site activity. Measured by KenGen
Value(s) applied	0.00787494
Measurement methods and procedures	Non-condensable gases sampling is carried out at the steam field-power plant interface or at the production wells using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid/ ASTM E947 Standard Specifications for Sampling Single Phase Geothermal Liquid or Steam for Purposes of Chemical Analysis. In production wells/ Plant interface, the CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line using evacuated giggenbach gas flasks, containing 50ml of 25% sodium hydroxide solution. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) will react with the solvent while the headspace will be occupied by Methane (CH_4) and other non-condensable gases. CO_2 and H_2S are analysed using titration process.Non-condensable gases sampling is carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO2 and CH4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H2S) and carbon dioxide (CO2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analysed using gas chromatography to determine the content of the residuals including CH4. All alkanes concentrations are reported in terms of methane.
Monitoring frequency	The NCG sampling and analysis should be performed every 3 months(quarterly)
QA/QC procedures	Sampling will be performed in accordance to established Quality management procedures as specified by the applicable standards. Where a nonconformance is detected, the procedure for corrective action shall be implemented to ensure conformance to the sampling procedure.Sampling will be performed to correct specifications and re-sampled, should a sample be abnormal.
Purpose of data	Calculation of project emissions
Additional comment	-

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Data / Parameter	$W_{steam,CH4,y}$
Unit	tCH_4/t steam
Description	Average mass fraction of methane in the produced steam in year *y*

Source of data	Project site activity. Measured by KenGen
Value(s) applied	0.000006359
Measurement methods and procedures	Non-condensable gases sampling is carried out at the steam field-power plant interface or at the production wells using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid/ ASTM E947 Standard Specifications for Sampling Single Phase Geothermal Liquid or Steam for Purposes of Chemical Analysis. In production wells/ Plant interface, the CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line using evacuated giggenbach gas flasks, containing 50ml of sodium hydroxide solution. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) will react with the solvent while the headspace will be occupied by Methane (CH_4) and other non-condensable gases. The gas portion is then analysed using gas chromatography to determine the content of the residuals including CH_4. All alkanes concentrations are reported in terms of methane.Non-condensable gases sampling is carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO2 and CH4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H2S) and carbon dioxide (CO2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analysed using gas chromatography to determine the content of the residuals including CH4. All alkanes concentrations are reported in terms of methane.
Monitoring frequency	The NCG sampling and analysis should be performed every 3 months(quarterly)
QA/QC procedures	Sampling will be performed in accordance to established Quality management procedures as specified by the applicable standards. Where a nonconformance is detected, the procedure for corrective action shall be implemented to ensure conformance to the sampling procedure.Sampling will be performed to correct specifications and re-sampled, should a sample be abnormal.
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	$M_{Steam,y}$
Unit	t steam
Description	Quantity of steam produced in year *y*
Source of data	Project site activity. KenGen
Value(s) applied	9,320,640
Measurement methods and procedures	The steam quantity discharged from the geothermal wells is measured with a venture flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the venture meter is required to define the steam properties. The calculation of steam quantities is done on a continuous basis and is based on international standards. The measurement results are summarized transparently in regular production reports There will be two main steam pipelines with their corresponding venturi meters (measuring main steam consumption) for each unit as well as two auxiliary steam pipelines with their corresponding venturi meters (measuring auxiliary steam consumption). Quantity of steam measured

	by the main venturi meters and the auxiliary meters will be used to determine the quantity of steam produced in year y.
Monitoring frequency	Daily
QA/QC procedures	Data is read continuously and logged. Data will be entered into CDM monitoring workbook every day and will be checked for consistency when entered. Meters will be maintained and periodically verified according to manufacturer specifications to ensure accurate readings; they will be recalibrated within the schedule recommended by the manufacturer.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

B.7.2. Sampling plan

All data is monitored and there is no sampling plan to be undertaken.

B.7.3. Other elements of monitoring plan

The monitoring of the parameters will form part of the overall production monitoring at the geothermal facility. The responsibility of calculation of the emission reduction will be the responsibility Climate Change Services Officer working under the Environment and Sustainable Development ManagerDM Manager. Review of the calculations will be the responsibility of the plant manager. Data will be stored electronically onsite, with archiving at KenGen. All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. All measurements will be conducted with calibrated measurement equipment according to relevant industry standards.

The monitoring by the project will involve monitoring the following the following parameters:

1. Electricity generated and exported into the grid by the project.
2. Steam generation and use by the project
3. Sampling and analysis of steam parameters (i.e. Non-condensable gases (NCGs))
4. Grid Emission Factor

1. Electricity

Net electricity export to the national grid by the project activity will be metered by the project proponent and Kenya Power and Lighting Company (KPLC). Two sets of meters (one main and one check meter) for each unit will be installed to record the net export and import, i.e. main meter and check meter for invoicing. The meters will be installed after the generator but before the substation to record electricity export and import. All the four meters are located at same point. Monthly readings will be performed jointly at end of each month where the readings from both main meters and the check meters will be taken and compared for consistency. The main meter readings will then recorded be used as the net export for invoicing. The difference of export and import gives the net power generation and which will be used to calculate baseline emission.for records and invoicing. The meters will be calibrated as per the industry standards and by each respective owner.

Electricity meters to be installed will meet the relevant local standards at the time of installation and will undergo calibration as per the relevant requirement and also as outlined in the Power Purchase Agreement signed between the two companies. Electricity measurements will be taken in accordance with signed between KenGen and KPLC.

2. Steam generation

Steam meters will be installed to continuously measure the quantity of steam produced during the year at the power plant. Two sets of venture meters (one main and one auxiliary) will be installed for each unit to measure the main steam consumption and the auxiliary steam consumption respectively. Quantity of steam measured by the main venturi meters and the auxiliary meters will be used to determine the quantity of steam produced in year y (refer to the metering diagram below). in the production wells. The meters will have the integration and their readings will be relayed and be displayed in the SCADA. Daily log will be kept electronically. At the end of each month, the records will be retrieved by the Climate Change DM team leader and be arranged in right format for use.

3. Non-Condensable gases (NCGs)

As per the methodology requirement, the sampling and analysis of NCGs will be done quarterly. The sampling will be done as per the set out requirement and the sampling team will be trained on how to take the samples. The following gases will be analysed: Methane (CH_4) and Carbon dioxide (CO_2)

4. Grid Emission factor

The Operating Margin grid emission factors will be monitored and be calculated as per the latest tool to calculate the emission factor of the electricity system. On the other hand, the Build Margin emission factor has been fixed ex-ante.

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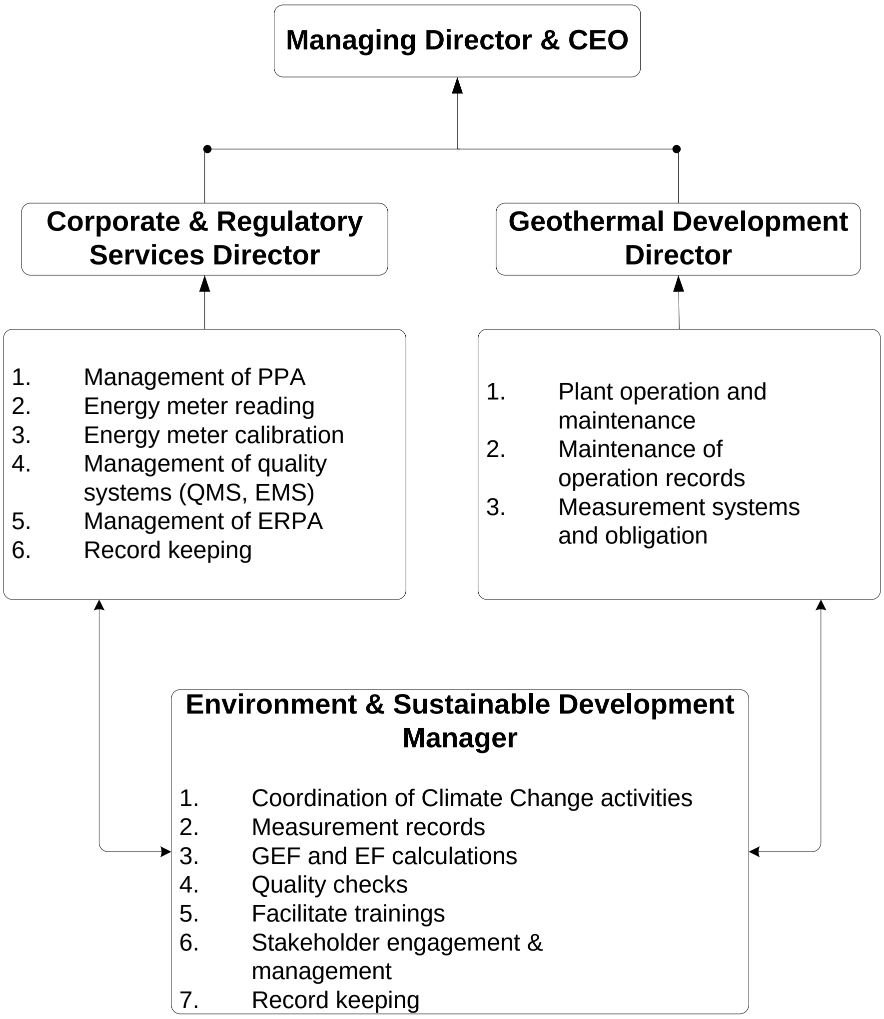
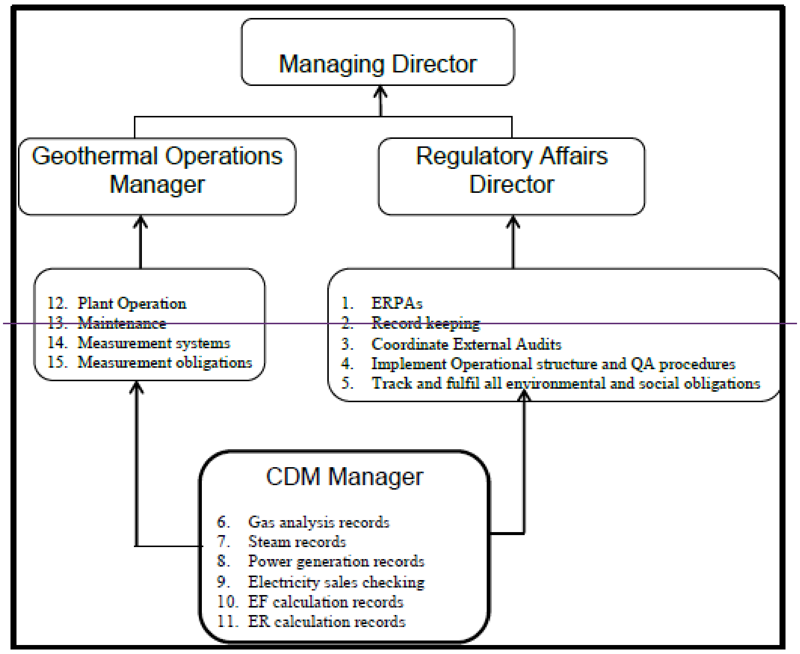
5. Operational and Management structure

The diagram below provides an overview of the general management structure of project proponent as it will directly affect the implementation of the proposed project.

Monitoring Structure





The project proponent will designate a staff (Climate Change Services Officer~~DM Manager~~) under the Environment and Sustainable Development Department ~~who will~~ be in charge of CDM activities. The Climate Change Services Officer ~~CDM Manager~~ will be in charge of ensuring that all the monitoring is done as per the requirements of the methodology and the PDD.

6. Monitoring Equipment Installation

Metering of Electricity Supplied to the Grid

Meter for reading electricity supplied to the grid will be located after the generator but before~~at~~ interconnection point at the sub-station~~-on site~~. The Main meter will be owned by KenGen while the check meter will be owned by KPLC. Both meters will be located at same point.

Metering of Geothermal Steam Flow

~~All steam wells will have a flow meter to measure the amount of steam generated by each well.~~There will be two main steam pipelines with their corresponding venturi meters (measuring main steam consumption) for each unit as well as two auxiliary steam pipelines with their corresponding venturi meters (measuring auxiliary steam consumption). Quantity of steam measured by the main venturi meters and the auxiliary meters will be used to determine the quantity of steam produced in year y. The venturi ~~flow~~ meters will be linked to the SCADA system where they will be read in the control room. Periodic recording will be done both in hard copy and soft copy.

Steam Sampling and Analysis

Quarterly steam sampling will be carried out where each well will be sampled. The sample will be analysed at the Olkaria laboratory and lab analysis results will be submitted to the Climate Change Services Officer ~~CDM manager~~ for review and archiving and use for calculation of CERs.

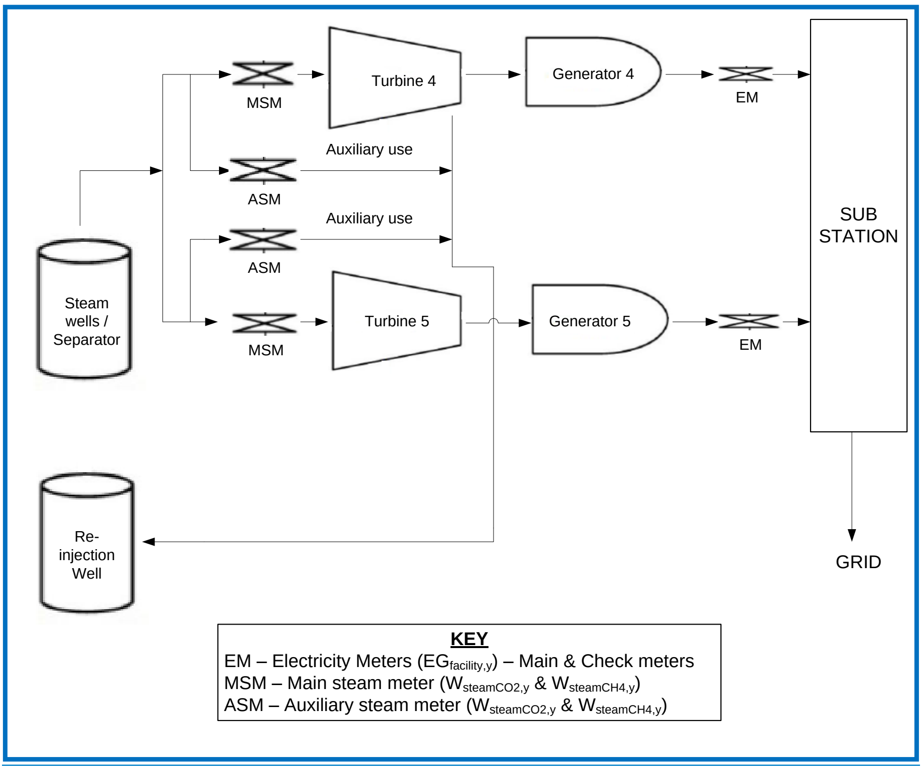


Figure 34: schematic diagram of electricity and steam metering points

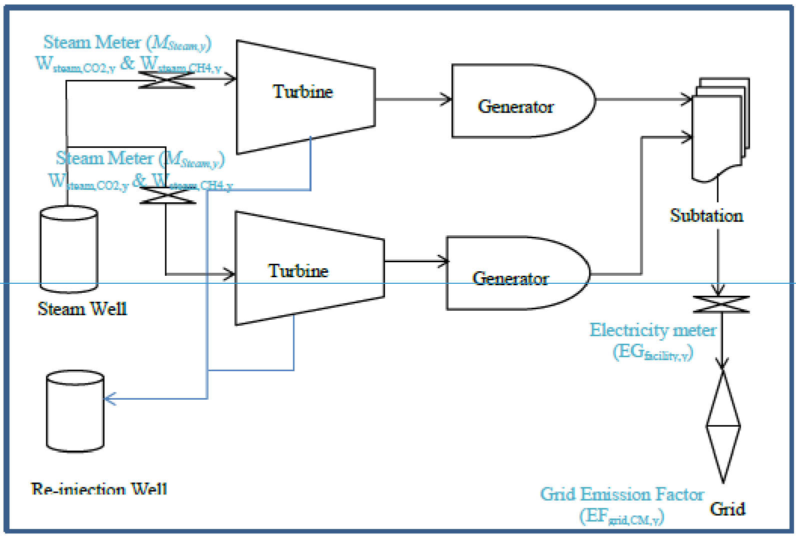


Figure 3: Schematic diagram, of metering points

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

07th Nov 2011, the date when the EPC contract was awarded.

C.2. Expected operational lifetime of project activity

25 years, 0 Months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

The project has chosen a renewable period. This is the first renewable period.

C.3.2. Start date of crediting period

01/017/201~~5~~4 ~~or the date of registration of the project with UNFCCC, whichever is later~~

C.3.3. Duration of crediting period

7 Years and 0 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

A full Environmental Social Impact Assessment (ESIA) study was carried out by the consultant Gibb Africa Ltd. The report was prepared in 2010 in accordance with the

Environmental (Impact Assessment and Audit) Regulations of 2003. It is also guided by the World Bank's requirements for industrial projects and IFC's EHS Guidelines for Geothermal Projects. Its findings were reported in *Environmental and Social Impact Assessment (ESIA) Report for Olkaria I Units 4&5 Geothermal Project in Naivasha District.* GIBB Africa Ltd, April 2010.
The study methodology comprised the following activities:

- Preliminary meetings;
- Data collection and Document review;
- Site inspection and discussions with site personnel;
- Air and Noise Dispersion Modelling;
- Ecological Assessment;
- Landscape Survey;
- Social Impact Assessment; Community Resources Mapping;
- Meeting with stakeholders;
- Public Consultation;
- Data Analysis;
- Reporting.

D.2. Environmental impact assessment

From the report, the identified impacts stem from release of Non-condensable gases, noise pollution and waste water discharges. Release of Hydrogen Sulphide was considered and measurements from existing power plant were used to predict the likely trend from the proposed project since they use the same technology. The report pointed out that measurements form the existing plants shows H_2O emissions way below the WHO guidelines. However, since these concentrations are low, their effect will be reduced further through air dispersion.

Noise pollution was also identified, although this is limited to during construction period, through well drilling and testing. During operation, the level of noise is much lower. During operation, the impact will be monitored and be mitigated through use of appropriate safety gears.

Waste water from steam will be re-injected and this will reduce surface water contamination. The re- inject will reduce the acidification of surface water from brine. The power plant also uses fresh water drawn from the Lake Naivasha. However, since the quantities used are low, the project will not have an effect on the hydrology of the lake.

In addition, since the project developer is already operating other geothermal power plants, the company has in place an environment and social management plan prepared to cover all the phases of the project life: design, construction, operation and maintenance. The plan describes each of the main mitigation measures to be implemented, their frequency, and who should be responsible during and after construction. Environmental and social monitoring, as integral parts of the environmental management plan, has also been included.

KenGen has also established Environmental Management systems as in integral component of its business planning since the company was established. Through the certified EMS system, KenGen has identified and documented its significant environmental aspects and impacts on the environment and set in place interventions to manage these aspects.

To successfully sustain the good environmental practices, KenGen has set up a fully-fledged Environmental and Social Department at Olkaria to undertake the implementation of environmental and social management plans of the existing Olkaria I and Olkaria II Power Plants and carry out monitoring of various parameters.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Consultative meetings at district and local levels included discussions with the provincial administration, village elders, KenGen staff, specialists and key informants were done.

Consultative meetings at district and local levels included discussions with the provincial administration, village elders, KenGen staff, specialists and key informants were done.
The consultations was done in plenary meeting where the stakeholders were given chance to air their views and comments. The consultation was held on 8th March 2012 at KenGen Social hall.

The consultations were invited through letters, word of mouth and through use of village elders who were tasked with announcing to their people about the meetings.

E.2. Summary of comments received

A good number (99%) of the respondents admitted that they were aware of the project and the activities under the Project. The information had been disseminated through KenGen officials and through those who were employed during the drilling of the exploration wells meant for the project within the area.

Other issues which were raised during consultations include:

i. The need for electricity supply in Olkaria Cultural Centre and Suswa Centre
ii. Locals to be given first priority in employment during construction and operation
iii. Measures be taken to ensure safety of the public from electrocution through exposure to the high voltage lines
iv. The need for supply of electricity to a local Radio station at Maili Moja town in Narok District
v. Encourage KenGen and KPLC to be involved in corporate social responsibility activities especially in Narok District.

E.3. Consideration of comments received

KenGen has in place Environmental Management system which guides their operations in order to ensure that the impacts of geothermal development are minimal. As part of the plan, relocation and sharing of projects benefits is included. The comments received during the consultation focused more on sharing of project benefits.

KenGen through their department of Corporate Social Responsibility will be helping the locals with funds which they will use for projects the community will identify.

On employment, the project will consider offering jobs to the locals based on skills needed and availability. In cases where the skills available matches those required, they will be considered.

SECTION F. Approval and authorization

The project has received the Letter of Approval at the time the project was submitted to the DOE.

Appendix 1. Contact information of project participants

Organization name	Kenya Electricity Generating Company Limited (KenGen)
Country	Kenya
Address	Stima Plaza, Kolobot Road, P.O Box 47936-00100, Nairobi
Telephone	254-20-3666000
Fax	-254-20-3745250
E-mail	sngure@kengen.co.ke
Website	http://www.kengen.co.ke
Contact person	Simon Ngure

Appendix 2. Affirmation regarding public funding

There is Annex I public funding involved in the proposed project. The project does not make use of Official Development Assistance (ODA). The project is debt financed by the World Bank, KfW Bankengruppe and Japan International Cooperation Agency.

Appendix 3. Applicability of methodologies and standardized baselines

See section B. 2 above

Appendix 4. Further background information on ex ante calculation of emission reductions

The Kenyan electricity system consists of one national grid system which serves the entire country. All the generating companies feed their power into the national grid. The grid is owned and operated by the Kenya Power and Lighting Company (KPLC), the sole power distribution and retailing company.
However, not all parts of the country are served by this grid some parts of the country are served by isolated fossil fuel generators owned by KPLC.

The Kenyan electricity system comprises of around 1,593MW of installed capacity, with an effective capacity of 1,479MW.

As per the dispatch data obtained from KPLC and which has been applied in the calculation of emission factor of the grid, KPLC in 2011 purchased 7,424,137 MWh of electricity into the national grid system. The grid mix contained more renewable source than non-renewable generated electricity. The table below shows the grid composition from power dispatched to the grid in 2011.

Grid Composition		
Plants	**MWh**	%
Hydro	3,158,707	42.55%
Wind	18,910	0.25%
Biomass	79,002	1.06%
Thermal	2,691,739	36.26%
Geothermal	1,444,124	19.45%
Imports	31,655	0.43%
Totals	**7,424,137**	**100.00%**

The table below shows power plants which are connected to the Kenya grid in the year 2011.

Power Plant	**Electricity Purchased 2011 (MWh)**
Wanji-Hydro	43,064
Tana-Hydro	77,535
Masinga-Hydro	155,008
Kamburu-Hydro	364,931
Gitaru-Hydro	722,403
Kindaruma-Hydro	146,083
Kiambere-Hydro	758,755
Imenti Tea (feed in plant)	664
Sagana-Hydro	8,081
Sosiani-Hydro	1,140
Gogo-Hydro	5,816
Sondu-Hydro	371,495
Turkwel-Hydro	503,734
Ngong Wind- Wind	18,910
Mumias-Biomass	79,002
Orpower4 Steam-Geo	366,702
Olkaria 1-Geo	232,906

Olkaria 2-Geo	844,516
Kipevu Diesel 1- Petrothermal	235,504
Kipevu III-Petrothermal	594,412
Tsavo-Petrothermal	387,874
Rabai-Petrothermal	387,529
IberAfrica 1-Petrothermal	381,904
IberAfrica 2-Petrothermal	383,888
Aggreko 4-Petrothermal	165,343
Aggreko embakasi5-Petrothermal	81,625
Aggreko embakasi6-Petrothermal	27,493
Aggreko embakasi7-Petrothermal	29,057
Aggreko muhoroni-Petrothermal	17,108
UETCL-Import	31,655
Total	**7,424,137**

Appendix 5. Further background information on monitoring plan

Monitoring will be undertaken as per steps outlined in Section B.7.2. above. The monitoring will be done as follows:

- Total net electricity generation exported to the grid by the project activity will be metered by KenGen and KPLC, and readings of meters will be done jointly. The Readings will be cross- checked with Data Capture sheets which appears as an attachment ~~receipts~~ of sales invoices ~~for consistency~~.
- Sales invoices and meter readings (part of the attachment to the invoice as data capture sheets) will be cross checked to ensure data integrity and consistency;
- Sampling of non-condensable gases will be undertaken by KenGen at least every 3 months (quarterly). The samples will be taken to the laboratory for analysis of average mass fraction of carbon dioxide and methane in the produced steam.
- Quantity of steam produced during the year in the production wells will be measured daily using a venturi ~~flow~~ meter~~/integrating meter~~. Measurements will be recorded regularly in production reports and also can be generated electronically.

CDM Monitoring System Procedures

Procedure name	Description	Scope
Procedures identified for training of monitoring personnel	This procedure outlines the steps to ensure that staff will acquire adequate training to collect and archive complete and accurate data necessary for CDM monitoring.	KenGen is ISO 9001 certified for all their plants in Kenya. Procedures for training have been incorporated as part of ISO 9001.
CDM data and record keeping arrangements	This procedure provides details of the site data and record keeping arrangements. The arrangements ensure that complete and accurate records are retained within the quality control system.	All data and records should be managed following this procedure. The staff is responsible for ensuring that any data or records are dealt with according to this procedure. Data and records will be stored and archived according to this procedure.
Data collection	This procedure describes how to collect data for all of the monitored variables in the PDD.	This procedure will outline the steps to collect the data from the electricity meter, venturie meters~~steam flow meters~~, and sample steam for NCG analysis.
CDM data quality control and quality assurance	This procedure covers all measured and/or calculated variables.	Data and records will be checked prior to being stored and archived. Data from the project will be checked to identify possible errors or omissions. All records will be checked for completeness.
Equipment maintenance	This procedure outlines the steps to provide regular maintenance to the electricity meters and steam flows meters.	This procedure should be followed by all staff involved in checking and maintaining the on site meters

Equipment calibration	This procedure details the process of organising and managing the calibration of measuring and monitoring equipment.	The calibration of measurement and Monitoring equipment is carried out in accordance to local, international or manufacturer's standards/ specifications by an approved entity. ~~The calibration of measuring and monitoring equipment the electricity meters will be conducted by a suitable company and/or internally in according to local, international or manufacturer's the ASTMMstandards/specifications.~~ The relevant Scientist/Engineer in charge is responsible for organizing the calibration and ensuring that records are retained.
Internal audits of GHG project compliance with operational requirements	This procedure details the internal audits for compliance with operational requirements.	An internal quality audit team is available within KenGen and this will be tasked to include the audit of the GHG project compliance. KenGen has ISO 9001 certification and will be extending this to include the proposed project.
Project performance reviews before data is submitted for verification, internally or externally	This procedure is for project performance reviews before data is submitted for verification, internally or externally.	The KenGen internal quality audit team will be tasked with the review of data before submission for verification.
Corrective action to provide for more accurate future monitoring and reporting	This procedure details the corrective action in order to provide for more accurate future monitoring and reporting.	Any requirement for more accurate reporting will be identified by the quality audit team and will be discussed and resolved by the entire management team.
Corrective Actions	Details how corrective actions of errors will be taken care of, if necessary.	Any corrections in the source data are marked, and the type of correction is documented in the spreadsheet. The original source data are stored next to the corrected data.

Appendix 6. Summary report of comments received from local stakeholders

Please refer section E of the PDD.

Appendix 7. Summary of post-registration changes

The following corrections have been done in the registered PDD and is submitted for post registration changes:

1. Section A.2, location of the project activity, the coordinates of the project have been changed as per Geographic with decimals units.

2. Section B.6.2. of the revised PDD GWP_{CH4}, Global warming potential of methane valid for the relevant commitment period, the default value for the second commitment period has been updated to 25 tCO_2/tCH_4.

3. EFgrid,BM,y (Build margin CO2 emission factor in year y). It is now included in the PDD section B.6.2., since the BM EF was calculated ex-ante and fixed in the registered PDD. A value of 0.6250 tCO_2/MWh for the BM has been stated in the revised PDD.

4. Section B.6.3., ex ante calculation of emission reduction The project proponent chose to neglect the emission from an installed emergency diesel generator as provided by version 13.0.0 of the methodology which states that the use of fossil fuels for the back up or emergency purposes (e.g. diesel generators) can be neglected. This issue is better explained in the revised PDD, the project emissions still being zero.

5. B.6.4 and C.3.2, Starting date of the crediting period The date of the starting date of the crediting period has been updated to 01/01/2015 as UNFCCC website, since the PP already made a previous notification to UNFCCC Team.

The following proposed permanent changes in the registered PDD are being requested as part of the Post Registration Changes:

1. $EG_{Facility,y}$ Quantity of net electricity generation supplied by the project plant, the measurement procedure has been changed to include the difference of electricity export and import from the grid gives the value of net electricity generation supplied by the project plant/unit to the grid. Also the double check has been updated with the current document that it is used for crosschecking purpose. The location and number of electricity meters has been updated in the revised PDD. The meters are installed after the generator but before the substation to record electricity export and import. All the four meters are located at same point.

2. The OM EF is calculated ex post, the addition of the monitored parameters in accordance of the tool have been updated in the revised PDD, which are as follows $FC_{i,m,y}$, $NCV_{i,y}$, $EF_{CO2,I,y}$, $EG_{n,h}$, $EG_{m,y}$, $EG_{PJ,h}$.

3. The parameters $W_{steam,CO2,y}$ average mass fraction of carbon dioxide in the produced steam in year y and $W_{steam,CH4,y}$ average mass fraction of methane in the produced steam in the year y, the measuring methods have been updated. The non- condensable gases sampling is carried out at the steam field power plant interface or at production wells using ASTM Standard Practice E1675 for Sampling Two phase Geothermal fluid / ASTM E947 Standard Specifications for sampling single phase Geothermal liquid or steam for purposes of Chemical Analysis. There are 19 points for sampling, not all of them are available every quarter, therefore in order to be an accurate reflection of actual project operation the sampling is being made at steam field power plant interface or at the production wells. Also the $W_{Steam,CO2,y}$ is determined with the titroprocessor instead of chromotograph equipment. And the quality assurance has been updated to be in accordance with the actual Quality management procedures.

4. $M_{Steam,y}$ Quantity of steam produced in year y, the location and number of venturi flow meters has been updated in the revised PDD. There are two steam pipelines with their corresponding venturi meters (measuring main steam consumption) for each unit as well as two auxiliary steam pipelines with their corresponding venture meters (measuring auxiliary steam consumption). Quantity of steam measured by the main venturi meters are being used to determine the quantity of steam produced in year y.

5. The description of the monitoring system and organizational chart, responsibility of calculation of emission reduction have been updated. Also a new schematic diagram of the metering points has been included to update the metering location of the main monitoring parameters.

6. Appendix 7 of the revised PDD has been updated with the above changes.

The following changes in the project design are being requested as a part of Post Registration Changes and are as follows:

Section A.1 & Section A.3 Purpose and general description of the project activity and technologies: The installed capacity of geothermal project consists of two identical turbines and generators of 75.260 MW units. Therefore the total installed capacity of the turbines and generators has been updated in the revised PDD to 150.52 MW, but the geothermal project still has a total generation capacity of 140 MW, as per the registered PDD.

Section A.3, technologies/measures the location and number of electricity meters and the venture meters has been changed. There are four steam pipelines, 2 main pipelines and 2 auxiliary pipelines with respective steam meters at each pipelines. The electricity meters are located after the generator but before the substation to record electricity export and import. All the four meters are located at the same point.

In accordance with CDM project standard for project activities Version 02.0 paragraph 242, the impacts of the changes to the to the registered CDM project activity on the key project parameters have been explained below:

Criteria	**Impact of the change in CDM project activity**
The applicability and application of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents with which the project activity has been registered;	The design change in the CDM project activity (change in installed capacity from 140 MW to 150.52 MW) does not impact the applicability of the methodology, the applied standardized baselines – hence the methodology along with methodological regulatory documents is still applicable to this project.
The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents	The change in the CDM project activity (project monitoring plan) does not impact the compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents - the monitoring methodology follows the ACM0002 definition, which states that “the monitoring shall consist of metering the

	electricity generated by the renewable energy technology.", after change to the project activity, the monitoring still consist of metering the electricity generated by the renewable energy technology.
The level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan	The change in the CDM project activity does not impact the level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan – the change in the CDM project activity includes change in calibration frequency of monitoring equipment, but it is in accordance with the national regulation of host country and manufacturer's specification, so the level of accuracy and completeness in the monitoring of the project activity maintained in the monitoring plan after change in the CDM project activity
The additionality of the project activity	The additionality demonstration of the project remains unaffected since the maximum generation capacity of the project is being capped at earlier approved 140 MW. Thus it can be concluded that the change in CDM project design does not impact the additionality of the project activity
The scale of the project activity	Project installed capacity after the change is 150.52 MW - hence the project falls in the category of large-scale project and it was a large scale before the change as well, so the design change in project activity does not impact the scale of the project activity

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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