PROGRAMME DESIGN DOCUMENT FORM FOR SMALL-SCALE CDM PROGRAMMES OF ACTIVITIES (F-CDM-SSC-PoA-DD) Version 02.0

PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)

PART I. Programme of activities (PoA)

SECTION A. General description of PoA

A.1. Title of the PoA

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The program to improve energy independence of public sewerage system through biogas increased efficiency in Korea
Version: 18.0
Date: 13/10/2014

A.2. Purpose and general description of the PoA

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Public sewerage system is generally distributed to local areas in Republic of Korea (hereafter "Korea") and about 89.4% of households are using public sewerage system.[1] Higher sewerage system distribution rate along with population growth has led to more energy consumption in public sewerage plants which emit 1,944,728tCO_2/yr and consume 395,121 toe (ton of oil equivalent)/yr (at 2007). However, energy independence rate of public sewerage system of Korea is only 0.8% and 99.2% is supplied from grid and fossil fuel[2]. In this situation, Ministry of Environment of Korea (MOE) set up a plan to enhance the energy independence rate of public sewerage system and reduce GHG emissions. The plan has a goal to improve the energy independence rate of public sewerage system to 18% by 2015, 30% by 2020 and 50% by 2030.[3]

To achieve this goal, MOE and Korea Environment Corporation (referred to later on as "KECO") planned and promoted "the program to improve energy independence of public sewerage system through biogas increased efficiency in Korea" (later on referred to as "PoA"). This PoA will support the small scale or micro scale projects, whose total energy generation capacity (thermal and/or electrical) of the project equipment does not exceed 45 MW thermal, to produce heat and/or electricity by using boiler(or burner etc.) or biomass based co-generation[4] in public sewerage treatment plants throughout Republic of Korea using biogas captured from anaerobic digestion system.

[1] Statistics of sewerage (2009), Ministry of Environment of Korea

[2] "Feasibility study on improving energy independence of public sewerage system", Ministry of Environment of Korea, 2008

[3] This policy goal is described in "Basic plan for improving energy independence" by Ministry of Environment of Korea.

[4] Biomass-based cogeneration systems are included in this category. For the purpose of this methodology "cogeneration" shall mean the simultaneous generation of thermal energy and electrical energy in one process. This methodology however does not preclude production of heat and power from the same heat generating equipment, for example a portion of steam produced in a boiler is used for process heat and another portion of steam from the same boiler is used for electricity production. Project activities that produce heat and power in separate element processes (for example heat from a boiler and electricity from a biogas engine) do not fit under the definition of cogeneration project.

Policy/measure or stated goal that the PoA seeks to promote

The objective of the PoA is to generate thermal and/or electrical energy using biogas at local sewerage treatment plants in Republic of Korea. Currently, some of public sewage treatment facility is implementing biogas recovery and utilization system but the amount is very small. Thus, Ministry of Environment of Korea promotes biogas utilization projects, through reducing sludge by retrofitting of sludge treatment facility and increasing biogas production. It will produce heat and /or electricity by using biomass through boiler(or burner etc.) or biomass based co-generation.

In this way, fossil fuel that would have been used in the absence of the PoA will be partly or totally substituted by biogas. Therefore, the PoA will reduce GHG emissions and help to improve the energy independence of the sewerage treatment plants.

Framework for the implementation of the proposed PoA

The PoA is operated and implemented by KECO. KECO is the "Coordinating/Managing Entity" (hereinafter referred to as "CME"). There is no other project participant of the PoA. KECO will promote to introduce this program to local sewage treatment plant and will act as the focal point with the CDM Executive Board in all the aspects relating to validation, verification, registration and issuance of carbon credits generated by the PoA. Each CPA is in charge of constructing operating and managing its energy generating facility.

As per SECTION C, for monitoring data recording and archiving system, KECO as CME is responsible for collecting data from each CPA regularly and providing CPA implementers with proper guidance for on-site monitoring. CPA(s) shall report all the CDM relating data and documents to CME periodically or when it's necessary. Local authorities as well as private entities that meet the criteria outlined in this PoA may also be participated as a CPA implementer under the agreements with CME. The agreements between CME and CPA implementer may include each party's responsibilities and duties. To avoid double counting and operate PoA effectively, each CPA shall be issued its own ID by CME.

In this POA project, CPA(s) is scheduled to the 1st progress in municipal communities of Chuncheon (ID: Korea environment corporation-0001), Suwon, Changwon. And the 2nd progress is schedule to progress in the municipal communities of Bucheon, Ansan, Asan, Gunsan and Mungyeong. Each projects will receive ID according to priority. After that, additional 18 CPAs located within the geographical boundary of Republic of Korea are expected to be included in the PoA. Below is the timeline of CPA(s) project. Also possible projects besides 26 projects which are mentioned above will progress additionally.

Date	Timeline
25/11/2010	Holding the workshop for the program to improve energy independence of public sewerage system and presentation on P-CDM related to the program
17/12/2010	Presentation of the P-CDM related to the program at the workshop for Environmental infrastructure carbon-neutral program
29/04/2011	MOU ceremony of The 1st progressing municipal communities (Chuncheon, Suwon, Changwon)
30/05/2011	Prior Consideration for UNFCCC and DNA was submitted.
08/2011	Solicitation of comments from local stakeholders through the KECO website
10/2011	SGS-UK selected as the DOE
20/04/2012	Workshop of The 2nd progressing municipal communities (Bucheon, Ansan, Asan, Gunsan, Mungyeong)

Confirmation that the PoA is a voluntary action by the CME

Biogas recovery from sewage & renewable energy generation using biogas is an activity to transform waste to resource; it is defined as a renewable energy generation. Equipment used for renewable energy generation can get a certification[5] and be introduced by public institute, but they are just encouraged, optional and not mandatory.[6] National and local government can install a facility for transforming waste to resource, but it is also encouraged, optional and not mandatory too[7]. There is no incentive/regulation to introduce equipment for biogas recovery from sewage & power generation. Under this circumstance, MOE promotes a voluntary program to improve energy independence of public sewerage system and achieve their own goal. KECO will voluntarily operate CDM projects as public entity with technical support to fulfil successful energy independence of public sewerage system and promote biogas utilization.

Contributions to sustainable development

Social aspect
Local society can accumulate experiences about transforming sewage to energy at sewage treatment plant and its technology would be developed through this PoA. This PoA will be a benchmark practice to transform waste to energy resource and vitalize other similar sustainable activities in Korea.

Environmental aspect
The PoA will reduce GHG emissions; more efficient biogas recovery system helps to reduce direct GHG emission reduction from sewage; displacing fossil fuel consumption by using increased biogas also brings direct GHG emissions reduction from fossil fuel use; generating electricity using increased biogas will substitute for grid electricity use and contribute to indirect GHG emission reduction from grid electricity use.

Economic aspect
The PoA promotes the use of a cleaner, more efficient and more environmentally friendly technology, which utilizes biogas, an indigenous fuel source. It displaces the use of the imported fossil fuels, helps to decrease the Korea's current account deficit, and helps promote the increased usage of renewable energy. The CPA(s) under the PoA will bring additional investments to plants which might offer employment opportunity.

A.3. CMEs and participants of PoA
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1. Coordinating/managing entity of PoA
- Korea Environment Corporation (KECO) is public entity and the Coordinating/Managing Entity(CME)

2. Project participants of the proposed PoA
- Korea Environment Corporation (KECO) is public entity and the Coordinating/Managing Entity(CME) and participant of PoA. Municipal Communities, which meet the eligibility criteria can be a part of the PoA. The municipal communities included later in the PoA, will become CPA implementer and will perform possession, operation and management of their facilities.

[5] Renewable equipment certification of KEMCO (Korea Energy Management Corporation) Renewable Energy Centre etc.
[6] This policy is described in "Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy".
[7] This policy is described in "Act on the Promotion of Saving and Recycling of Resources".

A.4. Party(ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea(host)	Korea Environment Corporation (Public entity)	No

A.5. Physical/ Geographical boundary of the PoA

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The PoA will be implemented within the Geographical boundary of Republic of Korea. National and sectoral policies in the relevant sector are the same within the geographical boundaries of Republic of Korea. With regard to this PoA, there are no differences in the national or sectoral policies between regions or provinces.

<Figure 1.Geographical boundary of the PoA>

A.6. Technologies/measures

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The purpose of this project is producing thermal energy and/or electricity through renewable energy technology from biogas which is generated from sewage treatment facility. To do so biogas production rate is increased by retrofitting existing sewage treatment facility through sludge thickener improvement, digester dredging, replacing the digester mixing facilities, and digester heating system replacement. The increased biogas displaces fossil fuel. The biogas used by the SSC-CPA under this PoA will be in compliance with "Definition of Renewable Biomass"(EB23, Annex18) and Glossary of CDM Terms (EB 70, Annex 7, version 07). The project activity includes thermal energy and/or electricity generation by biogas displacing fossil fuel. The exact type, quantity and other specifications of the renewable biogas utilized by each CPA will be described in each specific CPA-DD.

Description of the System/Technology;
The SSC-CPA under the PoA will include any/all of the following project options to provide thermal energy and/or electricity energy that displace fossil fuels.

Project Option	Description
Option 1	Suppling heat to facilities through fuel substitution from fossil fuel to biogas by retrofit of existing heat generating facility
Option 2	Displacing electricity by installing a new biomass co-generation system

Option 1: The purpose of option 1 is supplying heat to facilities from fossil fuel to biomass. To achive this, modification including retrofit of existing heat generating facilities is considered so that solid, liquid and gaseous fossil fuels can be switched to biomass fuels.

The combustor or the furnace part may be modified to suit the characteristic or the properties of biomass fuel to be used. The fuel feeding system may need to be modified.. Heat generation equipment retrofitted in the project is boiler and burner. Detailed technical specification of the heat generating system (e.g. heater, boiler) is provided in each CPA-DD.

Option 2: The technology of the proposed project activity including a new biomass based co-generation system for production of both heat and electricity involves an installation of a boiler capable of firing renewable biomass.

Biogas generated from the digester will be refined and sent to micro gas turbine (hereafter MGT). MGT biogas will be combusted and convert to electric energy. During energy conversion process, thermal energy will be recovered from exhaust gas through waste heat exchanger. But emission reduction from electricity will be only considered as CER in this option 2. Electricity generated from the co-generation will be exported to the national grid and/or used on-site consumption. And this will be decided by detailed technical specification of the co-generation system which is provided in each CPA-DD.

A.7. Public funding of PoA
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The proposed PoA will not receive any public funds resulting from official development assistance from Parties included in Annex I.

SECTION B. Demonstration of additionality and development of eligibility criteria
B.1. Demonstration of additionality for PoA
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The additionality for the SSC-CPA is demonstrated by Approach 1 (Micro-scale) or Approach 2 (Small-scale) applicable for the project activity.

(a) Approach 1(Micro-scale)
As the PoA consists of one or more micro-scale projects as CPAs, the additionality is demonstrated at the CPA level using eligibility criteria derived by "Guidelines for demonstrating additionality of microscale project activities"(EB 73, Annex 13, version 5.0.0).

(b) Approach 2 (Small-scale)
As the PoAs that consists of one or more small-scale projects as CPAs, the additionality is demonstrated at the CPA level using eligibility criteria derived by "Guidelines on the demonstration of additionality of small scale project activities (EB 68, Annex 27, version 09.0).

B.2. Eligibility criteria for inclusion of a CPA in the PoA

The eligibility criteria for inclusion of a CPA in the PoA are defined according to CDM EB 74 Annex 5 (version 03.0) standard ”Demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programmes of activities”

<Table 1 - Eligibility criteria for CPA inclusion >

NO.	Eligibility criteria
1	The CPA is performed within the geographical boundary of Republic of Korea.
2	The CPA is not involved in another project that is registered or under validation as a CDM project activity or as a CPA under another PoA or as other GHG reduction projects. Also, to avoid double counting and operate PoA effectively, each CPA shall be issued its own ID by CME.
3	• Each SSC-CPA will stay within the small-scale threshold criteria of the Type I. Renewable energy projects.(i.e < 45 MW $_{thermal}$ and/or 15 MW $_{e}$) • Option 1 - The total installed capacity is less than or equal to 45 MW $_{thermal}$. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc. - Retrofit of existing heat generating facility. - Supplying heat to facilities through fuel substitution from fossil fuel (LNG, Diesel etc.) to biogas. - Renewable energy project of CPA comply with national[8]standards. • Option 2 - The total installed capacity is less than or equal to 15 MW $_{e}$ and maximum electricity capacity of cogeneration is 5MW $_{e}$ for Microscale project activities. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc. - Displacing use of national electricity by installing a new biogas cogeneration system. - Emission reduction from electricity will be only claimed. Thermal energy will not be claimed. - Renewable energy project of CPA comply with national standards.
4	The CPA start date is after the date of publication of the PoA-DD for global stakeholder consultation 18/11/2011.
5	The CPA complies with AMS-I.C. (version 19) as described in PoA-DD part II_Option1and/or Option 2 section B.2
6	Additionality check in section D.5 of each CPA-DD is either EB73 Annex 13 (version 5.0.0) “Guidelines for demonstrating additionality of micro scale project activities” or EB 68 Annex 27 (version 09.0.0) “Guidelines on the demonstration of additionality of small scale project activities” as per the project scale.
7	The CPA has the documentary evidence to check project costs and does not result in a diversion of official development assistance from Annex I country.

[8] Waste control act Article [Inspection of waste disposal facilities],
Frame work act on the construction industry, etc.

8	The CPA(s) is a single project which is not a de-bundled component of another large-scale CDM or PoA as per the latest guidance given in CDM EB. De-bundling check in section A.12 of each CPA-DD and the declaration document by CPA implementer.
9	The CPA of the PoA shall meet the small-scale or micro-scale threshold criteria and remains within those thresholds throughout the crediting period of the CPA. It will be checked in D.2 and D.5 of each CPA-DD.
10	The conditions related to sampling requirements for the PoA in accordance with the " Standard for sampling and surveys for CDM project activities and programme of activities"(version 04.1)
11	Produced heat through this project should be provided to the anaerobic digester or the sewage sludge drying facility. Also, produced electricity should be used in the plant area.
12	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis.

B.3. Application of methodologies

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The technology/measures and methodology chosen

This project activity is generating thermal energy and/or electrical energy using biogas to displace fossil fuel use in local sewerage treatment plants. Applied technologies of each CPA are retrofit of heat generating equipment and installation of co-generation system.

Therefore, the following methodology will be used in the CPAs.

Project methodology

"AMS I.C(version 19), Scope 1, EB 61 titled "Thermal energy production with or without electricity"

SECTION C. Management system

CME is in charge of general management and operation of the PoA. CPA implementer assists CME to manage the CPA by operating the renewable heat and/or electricity generation plant, collecting the data and information related to the CPA, and then regularly reporting to the CME

The detailed responsibility/ authority of CME and CPA implementer of the proposed PoA are as described.

<Table 2 - Responsibility/authority of CME and CPA >

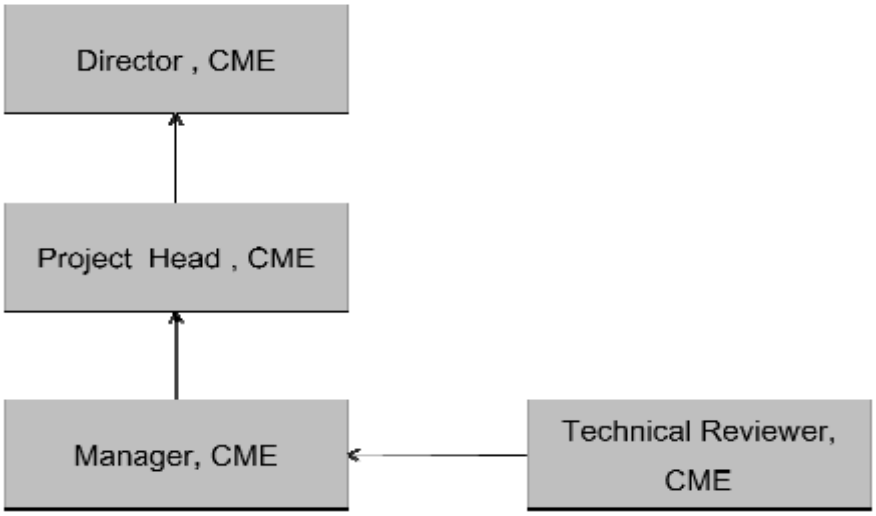
Responsibility/ Authority	
CME(KECO)	CPA implementer
1. CDM registration and verification, communication with DOE, UNFCCC Secretariat and CDM EB 2. Providing CPA implementers with guidance for proper CDM monitoring activity and other CDM related process 3. General management of monitored parameters of all CPAs 4. Technical review of inclusion of CPAs 5. Inclusion of new CPAs 6. Ensure monitoring plan and establish the monitoring system	1. Construction and operation of renewable energy generating plant 2. Direct CDM monitoring activity including data recording 3. Installation and management of the meter including QA/QC activities 4. Report monitoring activity records to CME

7. Verification and recording of monitoring data 8. Make the monitoring report 9. CERs allocation with CPA implementer according to agreements	

Especially, CME will manage and comply with the operational manual based on EB 74 Annex 05 that is described below.

(a) A clear definition of roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies;

The personnel involved in the process of inclusion of CPAs are as follow:



<Figure 2. CME organization chart for PoA Management and development>

The CME's personnel will carry out the following roles and responsibilities.

<Table 3 - CME department roles and responsibilities>

Personnel	Roles/Responsibilities
Director	- Reaches the final decision on CPA inclusion
Project Head	- Identifies the check results of eligibility criteria and forwards it to director
Manager	- Receives and collects documents and data from CPA implementer - Prepares eligibility criteria checklist for CPA inclusion - Checks whether all eligibility criteria are satisfied through desk review and on-site visit - Forwards the check results of eligibility criteria to project head and technical reviewer for CPA inclusion - Develops the CPA-DD - Forwards the CPA inclusion to the DOE for validation
Technical Reviewer	-Cross-check whether the means and evidences for all eligibility criteria are complete and relevant through desk review (If necessary, on-site visit) - Comments on the check results of eligibility criteria

The detailed information related to personnel's roles and responsibilities is based on Section 3. Roles, Responsibility and Competence of "CDM Operational Manual"

(b) Records of arrangements for training and capacity development for personnel;
In order to maintain and upgrade the capability and skill of the CME and CPA implementer's personnel, training will be performed according to Section 6, training of "CDM Operational Manual" which includes the necessary competence for personnel performing PoA operation and management, record-keeping of education, training plan, skills and experience, etc.

Training plan contains training date, place, trainee, trainer, theme and training content includes information in the latest EB guidelines on PoA operation, CPA inclusion, monitoring, verification and issuance. The training would be implemented periodically by CME who manages whole training process and records training results in the training management book. Also, when CME determines that extra training is needed, CME can plan and implement training.

The detailed information is based on Section 6. Training of "CDM Operational Manual"
(c) Procedures for technical review of inclusion of CPAs;
The technical reviewer designated by CME will conduct technical review. The technical reviewer will cross-check the completeness and relevance of means for the eligibility criteria check which had conducted by CME's manager.

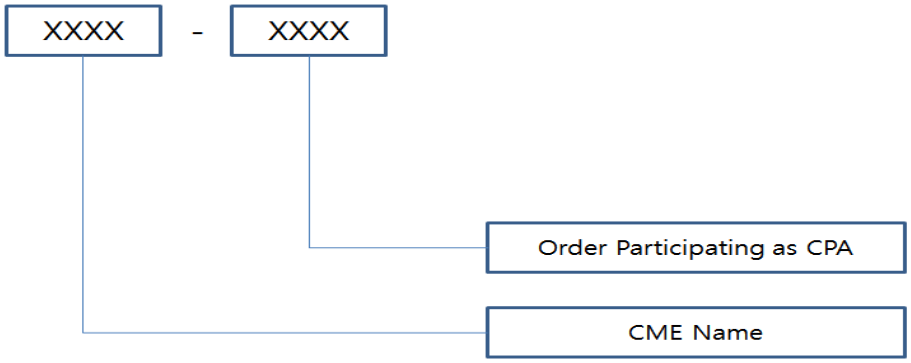
In addition, the technical reviewer will receive the evidence from the manager, check whether the evidence is proper, meets the condition for CPA inclusion, and then make related comments. The technical reviewer will deliver the review results such as the check results and comments to the manager. CME's director will finally confirm CPA inclusion based on technical review results. In case there is any defect on conducting the procedures above, CME could request CPA implementer to supplement the documentary evidence.

The detailed procedures are based on Section 3, CPA inclusion and management of "CDM Operational Manual" including technical review member, subject documents, follow-up action by CPA inclusion team.

(d) A procedure to avoid double counting
Double counting occurs when CPA is registered or under validation as another CDM project activity, a CPA under another PoA or other GHG reduction projects. For preventing this situation, CME should verify that CPA is not a case of double counting project utilizing CPA ID including name, address and capacity, etc and written agreement(between CME and CPA implementer) which includes that it is not registered to any other greenhouse gas reduction mechanism.

The detailed procedures are based on Section 5, CPA inclusion and management of "CDM Operational Manual" and Annex 1of "CDM Operational Manual".

(e) Records and documentation control process for each CPA under the PoA;
CME will provide detailed monitoring procedure to each CPA implementer and CPA implementers will comply with the procedure for their monitoring work. In order to unambiguously identify each CPA in this PoA, CME will grant CPA implementers with ID number according to the following ID numbering system.



<Figure 3.ID forms of CPA implementer>

This ID numbering system will be used to record baseline and monitoring data on a continuous basis with the template of excel database.

Each CPA will follow the monitoring requirements stipulated in AMS.I.C(version 19) and CME will record and document CPA detail information as follows;
- Name, address, details of CPA implementer
- Geographical coordinates of CPA (GPS information)
- The record of technical specification of each renewable energy generation plant participating in the CPA

CME will be responsible for the management of records and data associated with each CPA. The database will be updated using the data supplied by the CPA implementer.

In addition, the CME has established a profound system in order to maintain robustness of record keeping. The flow of data under the PoA will occur at three steps as follows:

STEP Ⅲ	CME
↑	
STEP Ⅱ	Management department(CPA implementer)
↑	
STEP Ⅰ	O & M department(CPA implementer)

As described in the above flow, the data generated at project site (Step I) will first flow to the implementer (Step II) and is then finally archived CME. The flow of data can be simplified.

O&M department (Step I): The record keeping at the project site will be executed by using field instruments, software installed and/or manual data recording in logbook. Since the CPA is the PoA implementers, the quantity of heat and electricity displaced by the project shall be monitored at each site. Appropriate records supplied from each of the project sites will be kept for future verifications. In addition, details and calibration records of meter used for measurement of data will be kept for verification.

Management department (Step II): The captured data at the project sites will be transferred to the database of the each CPA. At this step, the data monitored at the project sites of the CPA will be compiled.

CME (Step III): Further, the data is transferred from each CPA step to CME, which will archive it and make available to DOE for verification. Other records (meter details and implementing records) as relevant will be compiled by CME for the entire PoA at any given time.

In addition, CME will develop an electronic or manual monitoring database which contains all the basic information related to CPA subscribing to the PoA. Each CPA will be uniquely identified within the PoA monitoring database. The CME will be responsible for the management of the PoA monitoring database. All records will be stored at least for a period of two years after the end of the crediting period of each individual CPA. Relevant data capture, verification and storage procedures will be followed in maintaining the data to ensure its accuracy, validity and completeness.

The description above is based on Section 7. Monitoring of "CDM operational manual".

(f) Measures for continuous improvements of the PoA management system;

To achieve the measures for continuous improvements of the PoA management system, some important part have to be set clearly. First of all, it is necessary to set a training plan for CME and CPA implement. Second of all, it is necessary to set a procedure for monitoring plan and verification plan of collected data. Lastly, it is necessary to manage relevant equipments. To set those part clearly, 'Operational Manual' explains those part respectively form Section 6 to 9.
(Section 6. Training, Section 7. Monitoring, Section 8. Testing / Correction, Section 9. Replacement of Monitoring equipments)

SECTION D. Duration of PoA

D.1. Start date of PoA

>>
18th of November, 2011
(The date of publication of the PoA-DD for global stakeholder consultation)

D.2. Length of the PoA

>>
28 years.

SECTION E. Environmental impacts

E.1. Level at which environmental analysis is undertaken

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Environmental Impact Assessment is not a requirement for these project activities.

The project activities covered under the PoA are based on biogas recovery system and/or renewable energy generation system to public sewage treatment facility. This project is voluntary implemented as part of Energy independence of wastewater treatment facilities of Ministry of Environment.

The Korean Ministry of Environment regulates that only eighteen industries are to be subjected to the Environment Impact Assessment (hereafter, EIA). According to Environment Impact Assessment Law, the Republic of Korea does not require an EIA for the project activity as regard modification of existing facility and/or introduction of co-generation system in sewage treatment facilities. Therefore, this project activity will not give any negative impact as well as mankind's health and well-being.

E.2. Analysis of the environmental impacts

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The project activities covered under the PoA are based on biogas recovery system and/or renewable energy generation system to public sewage treatment facility. Hence they do not fall under the purview of the EIA notification of the Ministry of Environment, Government of the Republic of Korea notification. The Ministry's notification, dated 28th March, 2008, on the requirement of EIA studies states that any project developer in the Republic of Korea needs to file an application to the Ministry of Environment (including a public hearing and an EIA) if the proposed industry or project is listed on a predefined list. Eighteen categories of activity with a certain investment criteria are required to undertake an EIA. However, the proposed project activities do not fall under the list of activities requiring EIA. Thus, no EIA study is required for this type of project activities

SECTION F. Local stakeholder comments

F.1. Solicitation of comments from local stakeholders

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Local stakeholder consultation of the PoA is done at PoA level. As described in Section A.6., this project involves retrofit of existing heat generation system and/or installation of co-generation system. There are no significant changes on the process of heat generation system by retrofitting. And there are no regulations of enforcement of public hearing or local consultation on modification or retrofitting project in Korea. Therefore, the project participants considered it appropriate to carry out the local stakeholder consultation at PoA level.

Three aspects of how local stakeholder comments of the PoA were invited, what comments were received and how due account was taken of any comments received are individually indicated as follows.

The KECO organised and participated in several events to inform a wide range of stakeholders and to receive consultation of stakeholders about the programme, such as

- Participation in the workshop for the program to improve energy independence of public sewerage system and presentation on P-CDM related to the program on 25th of Nov 2010
- Presentation of the P-CDM related to the program at the workshop for Environmental infrastructure carbon-neutral program on 17th of Dec 2010
- The event for the program to improve energy independence of public sewerage system about how to relate to P-CDM on 29th of April 2011. This included ceremony of MOU among stakeholders who will implement the programme

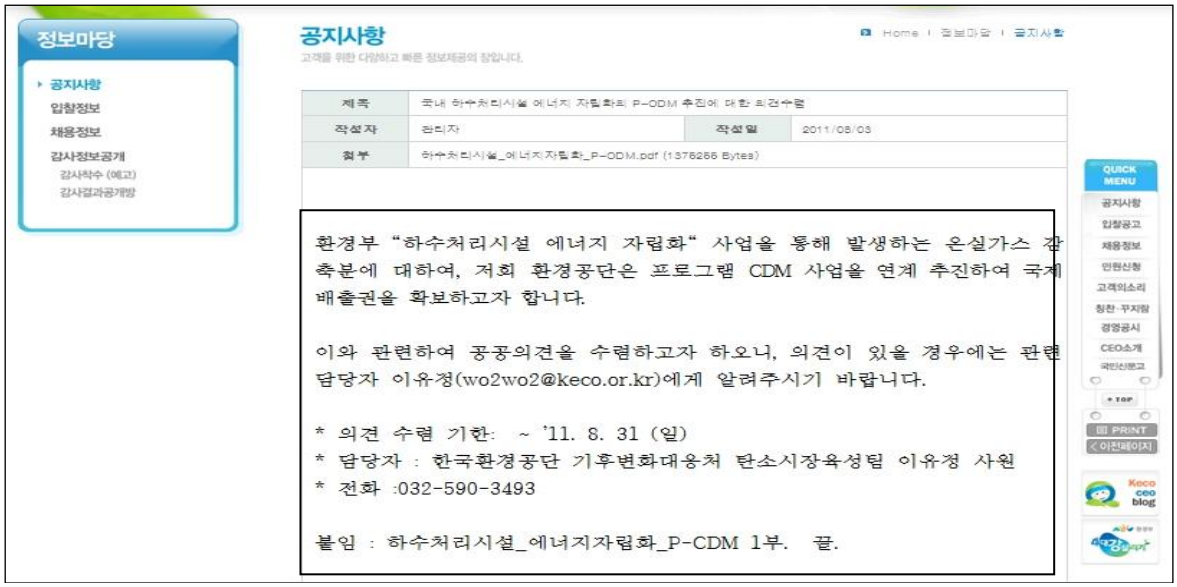
Participated stakeholders are

- CPA implementers
- Related official workers
- Local residents who were interested in P-CDM project
- Business owner/worker/technical experts who work in related field

In addition, the KECO informed the stakeholders about the program on its website. Materials are available and can be downloaded. These include an explanation of the program.

http://www.keco.or.kr/kr/open/communityid/1/view.do?p=56&idx=619&f=1&q=

<Figure 4. Webpage of stakeholder consultation>



Korea Environmental Corporation (KECO) is planning to implement CDM on carbon reduction of project named"Improve Energy Independence of Public Sewerage System" from Department of Environment.

KECO is currently collecting public opinion with regard to this project. If you have any opinion on this project, please contact Ms Lee You Jeong.(wo2wo2@keco.or.kr)

Collecting period:~31th August 2011
Contact : Ms Lee You Jeong, Carbon market Promotion Team, Korea Environment Corporation
Tel : 032-590-3493

Attachment : P-CDM on "Improve Energy Independence of Public Sewerage System"

F.2. Summary of comments received

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No comments have been received by KECO following the call for comments on their website

F.3. Report on consideration of comments received

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N/A

SECTION G. Approval and authorization

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a) Party (ies) involved in the proposed PoA

The following party is involved in the PoA

- Republic of Korea

b) CME letters of authorization of its coordination of the PoA from each Party

Letters of approval from Parties wishing to be involved in the PoA have been obtained. The letter of approval from the DNA of Republic of Korea was issued on 29/10/2012.

<Figure 5. Approval of CDM project>

승인번호 : 2012 - 29

청정개발체제 사업 승인서

한국환경공단 이사장 박승환
404-708 인천광역시 서구 경서동 종합환경연구단지

상기인이 참여하는 "소화가스 활용 및 효율개선 사업을 통한 공공 하수처리시설의 에너지 자립화 프로그램"에 관하여 청정개발체제 심의위원회(CDM Review Committee)의 결정에 따라 대한민국 정부는 각 호의 사항을 확인합니다.

i) 대한민국은 교토의정서를 2002년 11월에 비준하였습니다.

ii) 이 사업은 자발적 참여에 의한 것임을 승인합니다.

iii) 이 사업이 우리나라의 지속가능한 발전에 기여하는 것으로 인정합니다.

2012년 10월 29일

지식경제부 장관 홍 석 우

환경부 장관 유 영 숙

No. 2012 - 29

Approval of CDM Project

Chairman (Mr. Seung Hwan Park)
Korea Environment Corporation
Environmental Research Complex, Kyungseo-dong, Seo-gu, Incheon, Republic of Korea

In respect of "The program to improve energy independence of public sewerage system through biogas increased efficiency in Korea", in which the above-mentioned entities participate, the Government of the Republic of Korea hereby confirms the followings in accordance with the approval decision of the CDM review committee;

i) The Government of Republic of Korea has ratified the Kyoto Protocol in November 2002.

ii) This is approval of voluntary participation in the proposed CDM project activity.

iii) This project contributes to Sustainable Development in Korea.

Oct 29, 2012

Ministry of Knowledge Economy Hong, Suk Woo

Ministry of Environment Yoo, Young Sook

THE REPUBLIC OF KOREA

PART II. Generic component project activity (CPA)

Project Scenario Option 1

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

>>

A typical CPA under the proposed PoA comprises one or more thermal production projects at public sewerage treatment plants in Korea in accordance with methodology AMS I.C(version 19) and its total energy generation capacity do not exceed 45 MW thermal. Produced biogas at anaerobic digestion system of public sewerage treatment plants will be captured and used as fuel to run the heat generation facility. As a result, CPA will displace fossil fuel and lead to reduction of GHG emissions.

In case that the sewerage plant is already been using biogas and generating thermal energy for operation use, the thermal energy from produced biogas shall be considered to calculate emission reductions. To biogas production, measures to create optimal operation condition in sludge treatment system at plants should be taken. Any incremental emissions caused by such measures shall be taken into account either as project or leakage emissions.

The following detailed scenarios are applicable for inclusion under the PoA.

Project Scenario	Description
Option 1	Supplying heat to facilities through fuel substitution from fossil fuel to biogas by retrofit of existing heat generating facility

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

>>

The approved baseline and monitoring methodology applied to a CPA included in this PoA is:

(a) Project methodology

AMS I.C(version 19), Scope 1, EB 61 titled “Thermal energy production with or without electricity”

(b) Any tools and other methodologies

Tool to calculate the emission factor for an electricity system (version 4.0.0)
Project emissions from flaring (version 2.0.0)
Tool to calculate baseline, Project and/or leakage emissions from electricity consumption (version 1)
Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 2)
Project and leakage emissions from anaerobic digesters (version 01.0.0)
Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0)

Further information for the methodology can be found at:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved

B.2. Application of methodology(ies)

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AMS I.C(version 19) is applied in this PoA because the Programme involves renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. Detailed description of the justification of choice of the methodology is given in the following Table.

<Table 4. Applicability conditions of methodology AMS.I.C>

Para.	Applicability Conditions	CPA Status
1	This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	The Project activity uses a renewable biogas in order to produce thermal energy. The Project activity will displace fossil fuel used for generation of thermal energy. Design Report for each CPA should be provided
2	Biomass-based co-generating systems that produce heat and electricity are included in this category. For the purpose of this methodology "Co-generation" shall mean the simultaneous generation of thermal energy and electrical and/or mechanical energy in one process. Project activities that produce heat and power in separate element processes (for example heat from a boiler and electricity from a biogas engine) do not fit under the definition of co-generation project.	A CPA of Option 1 is not applicable.
3	Emission reductions from a biomass co-generation system can accrue from one of the following activities: (a) Electricity to a grid; (b) Electricity and/or thermal energy(steam or heat) for on-site consumption or for consumption by other facilities; (c) Combination of (a) and (b)	A CPA of Option 1 is not applicable.
4	The total installed/rated thermal energy generation capacity of the Project equipment is equal to or less than 45MW thermal.	The total installed/rated thermal energy generation capacity of each CPA will not exceed 45MW thermal.
5	For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel shall not exceed 45MW thermal.	A CPA of Option 1 is not applicable.
6	The following capacity limits apply for biomass co-generation units: (a) If project activity includes emission reductions from both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy; (b) If the emission reductions of the co-generation project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from electricity component), the total installed thermal energy production capacity of the project equipment of the co-generation unit shall not exceed 45MW thermal;	A CPA of Option 1 is not applicable.

	(c) If the emission reductions of the co-generation project activity are solely on account of electrical energy production, the total installed electrical energy generation capacity of the project equipment of the co-generation unit shall not exceed 15MW.	
7	The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6 and should be physically distinct from the existing units.	The total energy generation capacity of a CPA (new and/or retrofit) will be equal to or less than 45 MW thermal. In the case of the installation of new facilities, the total capacity of the units added by the project will be equal to or less than 45 MW thermal. CPA implementer will ensure that the proposed project activity is physically distinct from the existing units.
8	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	CPA of Option 1 will seek to retrofit or modify an existing fossil fuel based heat generating system.
9	New Facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the General Guidelines to SSC CDM methodologies.	A CPA of Option 1 is not applicable.
10	If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	N/A Solid biomass will not be used for the proposed project as fuel.
11	Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	N/A Solid biomass will not be used for the proposed project as fuel.
12	If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	In case of thermal energy delivered to a other facilities, no double-counting section will be addressed at the contract between supplier and consumer and confirmed by CME.
13	If the project activity recovers and utilizes biogas for power/heat production and applies this methodology on a stand-alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity	The proposed project is related to the activity which is recovery and utilization of biogas from a digester. And AMS-I.C(version 19) methodology on a stand-alone is applied to the proposed project Therefore, any incremental emissions

	(e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), .	occurring due to the implementation of the project activity will be taken into account as per the methodological tool. Any incremental emissions will be calculated in CPA-DD
14	Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided; (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology AMS-III.K.(version 5.0)7 Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.	N/A Charcoal based biomass will not be used for the proposed project as fuel.
15	The following conditions apply for use of this methodology in a project activity under a programme of activities: a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues or processed biomass (e.g. briquette) only or biomass from dedicated plantations complying with the applicability conditions of AM0042(version 2.1) b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) or following the procedure included in the leakage section of AM0042(version 2.1); c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity	The proposed project under the PoA shall satisfy the following. The proposed project utilizes biogas which is renewable biomass to generate electricity and thermal energy. Thus, criteria(a), (b) are not applicable c) The proposed project activity does not involve the replacement of equipment. If there is, an independent monitoring of scrapping of replaced equipment shall be implemented.

B.3. Sources and GHGs

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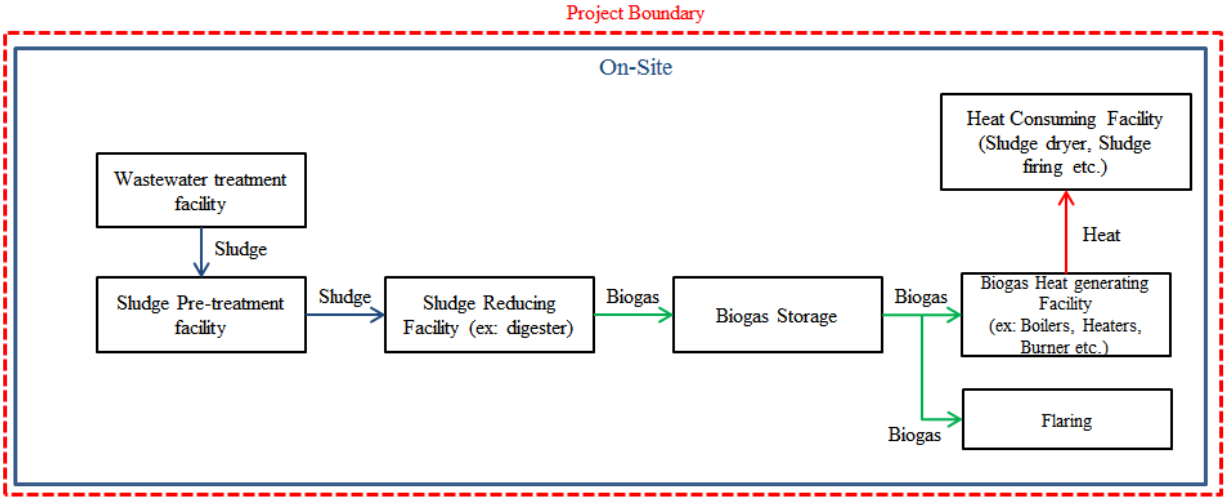
The project diagram for the SSC-CPA is given as below.

Option 1: Biogas generated from the digester will be refined and sent to retrofitted heat generating system (e.g. heater, boiler, burner etc.). And retrofitted heat generating system generates the thermal energy by using biogas and then generated thermal energy will be supplied to the heat consuming facility (Sludge dryer, Sludge firing etc.).

<Figure 6. Project diagram Option 1>



The description of the sources and gases included in the Project boundary is given as below.

<Table 5. Applicability sources and gases included in the SSC-CPA boundary>

	Source	Gas	Included?	Justification / Explanation
Baseline	Fossil fuel combustion in Boiler/heater/burner etc. for heat generation(Applicable to option1)	CH_4	No	Excluded for simplification. This is conservative.
		CO_2	Yes	Main emission source
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Fossil fuel and electricity consumption	CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		CO_2	Yes	On-site fossil fuel and electricity consumption due to the project activity
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Physical leakage	CH_4	Yes	Physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring
		CO_2	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.

B.4. Description of baseline scenario

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In the proposed project activity, baseline is determined by using approved small scale methodology AMS.I.C. Thermal energy production with or without electricity (version 19) of Appendix B of the simplified M&P for small-scale CDM project activities

The baseline scenario would be the following as mentioned in the table below:

<Table 6. Project type and Baseline scenario>

Option	Description	Baseline Scenario
Option 1	Supplying heat to facilities through fuel substitution from fossil fuel to biogas by retrofit of existing fossil fuel heat generating facility	As per methodology, para 16 & para 42 are applicable for determination of baseline of the project activities. Para 16 for baseline calculation is as follows. Para 16 "For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced". Para 42 for baseline calculation is as follows. Para 42 "For project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment, the baseline emissions shall be calculated as per equation (2)."

There are no legal or regulatory requirements which are systematically enforced for the proposed project and no external factors which lead to the project activity such as financial aid. The current baseline scenario therefore will be continued and is the most suitable.

If each CPA needs to be demonstrated that CPA is additional, it will be done at CPA level.

B.5. Demonstration of eligibility for a generic CPA

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The CME has all competencies to check the features of potential CPAs and ensure that each CPA meets all requirements and eligibility criteria (as tabulated below) before inclusion in the registered PoA. The relevant documents for the compliance of paragraph 16 of EB74 Annex 5 have been provided to the DOE for validation.

<Table 7. Demonstration of eligibility for a generic CPA>

No.	ELIGIBILITY CRITERIA	Means of validation	Evidence
1	The CPA is performed within the geographical boundary of Republic of Korea.	Document Review On-site visit	• GPS information • CPA identification No.
2	The CPA is not involved in another project that is registered or under validation as a CDM project activity or as a CPA under another PoA or as	Document Review	• Confirmation by the CME that CPA is not involved in another project or under validation as a CDM project

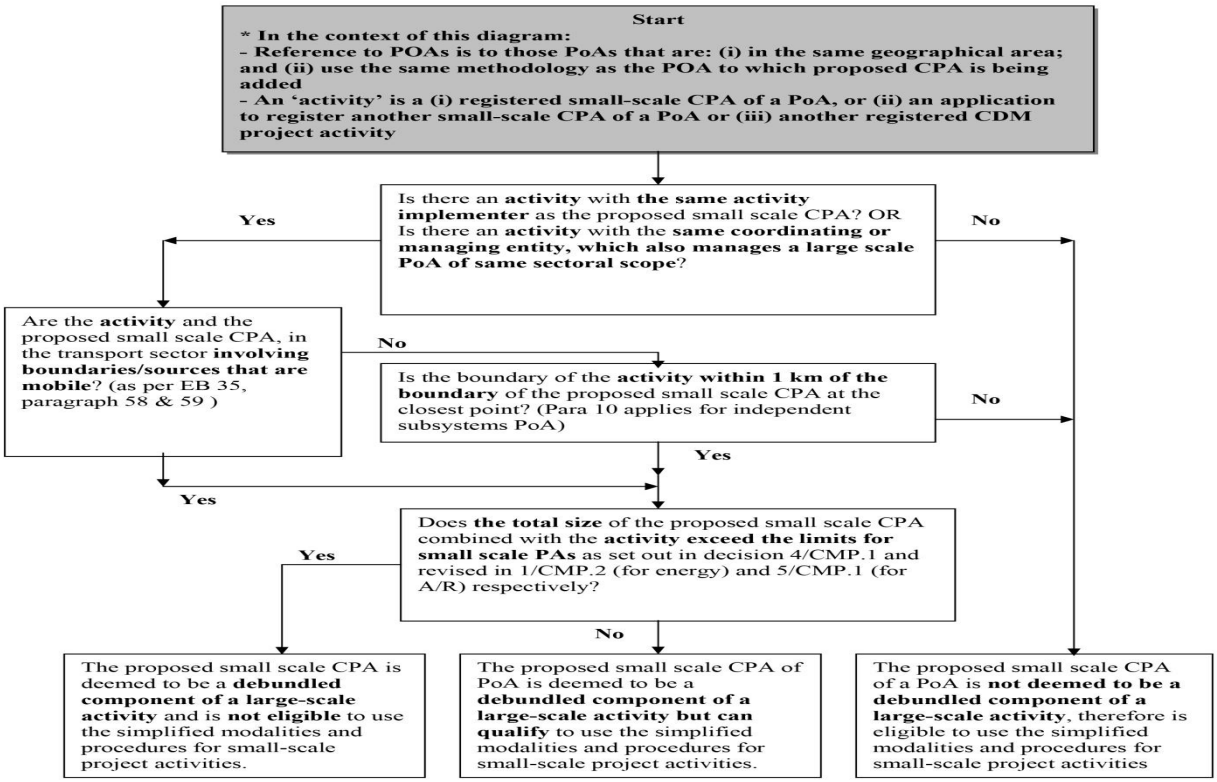
	other GHG reduction projects. Also, to avoid double counting and operate PoA effectively, each CPA shall be issued its own ID by CME.		activity or as a CPA under another PoA or as other GHG reduction projects • CPA identification No.
3	• Each SSC-CPA will stay within the small-scale threshold criteria of the Type I. Renewable energy projects.(i.e < 45 MW $_{thermal}$ and/or 15 MW $_{e}$) • Option 1 - The total installed capacity is less than or equal to 45 MW $_{thermal}$. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc. - Retrofit of existing heat generating. - Supplying heat to facilities through fuel substitution from fossil fuel (LNG, Diesel etc.) to biogas. - Renewable energy project of CPA comply with national standards. • Option 2 - The total installed capacity is less than or equal to 15 MW $_{e}$ and maximum electricity capacity of cogeneration is 5MW $_{e}$ for Microscale project activities. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc - Displacing use of national electricity by installing a new biogas cogeneration system. - Emission reduction from electricity will be only claimed. Thermal energy will not be claimed. - Renewable energy project of CPA comply with national standards.	Document Review	•Confirmation by the CME that CPA meets all national standards. • Construction permit • Electricity facilities permit of Korea Electrical Safety Corporation (KESCO) • The Preliminary and working design report
4	The CPA start date is after the date of publication of the PoA-DD for global stakeholder consultation, 18/11/2011.	Document Review	•Purchase or Construction Contract date for renewable energy unit
5	The CPA complies with AMS-I.C.(version19) as described in PoA-DD part II_Option1 and/or Option2 section B.2	Document Review On-site Visit	• Confirmation by the CME that CPA meets all applicability criteria of AMS-I.C.(version 19) • Explanation in D.2 of CPA-DD

6	Additionality check in D.5 of each CPA-DD is either EB73 Annex 13 (version 5.0.0) "Guidelines for demonstrating additionality of microscale project activities" or EB 68 Annex 27(version 09.0.0) "Guidelines on the demonstration of additionality of small scale project activities" as per the project scale.	Document Review On-site visit	• Detailed assessment document for additionality. • Explanation in D.5 of CPA-DD
7	The CPA has the documentary evidence to check project costs and does not result in a diversion of official development assistance from Annex I country.	Document Review	•Declaration from the CPA implementer regarding the no involvement of public funding or ODA from Annex I parties • Explanation in A.11 of CPA-DD
8	The CPA is a single project which is not a de-bundled component of another large-scale CDM or PoA as per the latest guidance given in CDM EB. De-bundling check in A.12 of each CPA-DD and the declaration document by CPA.	Document Review On-site visit	• Declaration by CPA implementer that the CPA is not a de-bundled component of another CDM program activity (CPA) • CPA identification No • Explanation in A.12 of CPA-DD
9	CPA of the PoA shall meet the small-scale or micro-scale threshold criteria (i.e. combined installed electricity generation capacity less than or equal to 15MW, 45MW thermal) and remains within those thresholds throughout the crediting period of the CPA. Electricity generation capacity check in A.5 of each CPA-DD.	Document Review On-site Visit	• The Preliminary and working design report • CPA identification No. • Explanation in D.2 and D.5 of CPA-DD
10	The conditions related to sampling requirements for the PoA in accordance with the " Standard for sampling and surveys for CDM project activities and programme of activities" (version 04.1)	Document Review	• Confirmed criteria of AMS-I.C.(version 19) • No sampling is done, hence not applicable.
11	Produced heat through this project should be provided to the anaerobic digestion or the sewage sludge drying facility. Also, produced electricity should be used in the plant.	Document Review On-site Visit	• The Preliminary and working design report • Explanation in A.3 of CPA-DD
12	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis.	Document Review	• Explanation in section B and C of CPA-DD

For more detailed assessment, there are used the following method:

Procedure to check de-bundling

KECO will implement de-bundling check for each CPA referring the guidance for determining the occurrence of de-bundling under a PoA (EB 54, Annex13). KECO will perform the de-bundling check using CPA implementer name, location, GPS information, installed capacity, etc.



<Figure 7. Procedure to check de-bundling >

Confirmation of additionality of the generic CPA for its inclusion into the PoA

As per described in B.1 of Part I, the additionality for the SSC-CPA is demonstrated by Approach 1 or Approach 2 applicable for the project activity.

(a) Approach 1

As per "Guidelines for Demonstrating Additionality of Microscale Project Activities (version 5.0)" according to paragraph 8 (d) of EB 73 Annex 13:

8. Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions below is satisfied;

(d) The Project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country.

The DNA of Republic of Korea got the approval of the Board.[9] Therefore, the project activity is additional in cases where the project activities are (i) Option 2, (ii) equal to or smaller than 5 MW; and (iii) no claims of emission reductions from thermal energy production.

Or

(b) Approach 2

[9] http://cdm.unfccc.int/DNA/submissions/files/2012/0105_korea_res.pdf

As per EB 68 Annex 27 "Guidelines for Demonstration of Additionality of Small-Scale Project Activities"(version 09.0), the project activity shall provide an explanation to show that the project activity would not have occurred anyway due to investment barrier. For demonstrating the investment barrier, Step 2 of "Tool for the demonstration and assessment of additionality(version 07.0.0)"is used. As the project generates financial benefits other than CDM-related income and there are no other credible and realistic baseline scenario alternatives other than 'continuation of the current situation', benchmark analysis will be used to demonstrate additionality.

The Benchmark Analysis would be conducted as follows:

A financial indicator (project IRR or equity IRR) would be chosen for the proposed CPA and justification for its selection would be provided. Subsequently, a benchmark would be adopted which is appropriate to the type of financial indicator calculated and could be chosen as either of the following:

<Table 8. Financial indicator>

Indicator chosen	**Benchmark** (any one of the below)
Equity IRR	a. Default value for the expected return on equity for Republic of Korea as per the "Guidelines on the assessment of investment analysis' (increased by applicable tax rate in case of pre-tax IRR[10])" b. Cost of equity determined using best financial practices (such as Capital Asset Pricing Model) using data sources which can be clearly validated while properly justifying all underlying factors in accordance with the "Guidelines on the assessment of investment analysis" c. Government/official approved benchmark where such benchmarks are used for investment decisions
Project IRR	a. Local commercial lending rates applicable in the country (pre-tax rate used in case of pre-tax IRR) b. Weighted Average Costs of Capital (WACC) calculated as: WACC= {D/(D+E)}*{1-T/100}*Cost of Debt + {E/(D+E)}*Cost of Equity (tax-rate not applied in case of pre-tax IRR) Where, Cost of Debt is determined as local commercial lending rate applicable in the country and Cost of Equity is determined from any of the options listed above under Equity IRR. c. Government/official approved benchmark where such benchmarks are used for investment decisions

Determination of Input value

The input values for project IRR calculation will be valid and applicable at the time of investment decision. As for the time of investment decision, the date is based on the source of funds for project implementation. Therefore, the date of the investment decision may vary for the CPA.

Investment cost may involve the facility construction, utility installation and the equipment purchase, etc. Component associated with facility construction cost are preliminary works, sub and super structure works, etc.

O&M costs may involve wages of supervisors and other staffs etc.

Benefits in the project activity result from sludge reduction and save the cost of sludge cake treatment during the facility operation. And the technical lifetime of renewable energy generation unit is determined

[10] Appendix para 8 of the "Guidelines on the assessment of investment analysis" (version 05) states that the default values for the expected return on equity are calculated after taxes.

by technology provider/manufacturer, expert opinion or default factors from the "Tool to determine the remaining lifetime of equipment" (version 01).

This list of data and parameters would include at least the following:

<Table 9. Economic parameter>

PROJECT DATA			
Technical Lifetime	years	Based on information provided by technology provider/manufacturer, expert opinion or default factors from the "Tool to determine the remaining lifetime of equipment" (version 01).	
Investment Decision Date	DD/MM/YYYY	Can be sourced from e.g. board decision, budget document.	
PARAMETERS	**Unit**	**Value**	
Debt : Equity Ratio			
Cost of Debt	%		**Source**
Cost of Equity	%		Budget document
Investment Cost	KRW		Budget document
Tax rate	%		Korea Exchange Bank (http://www.keb.co.kr/)
Depreciation Rate	%		Feasibility study
O&M Cost	KRW/year		National Tax Service (http://www.nts.go.kr)
Annual Amount of Electricity Generated to Grid	kWh/year		Monitoring data
Electricity Tariff	KRW/kWh		Feasibility study
Consumption of Fossil Fuel before project	l/year (㎥/year)		Feasibility study
Consumption of Fossil Fuel after project	l/year (㎥/year)		Feasibility study
Unit Price of Fossil Fuel	KRW/l (KRW/㎥)		"Korea Oil Price" at the Korea National Oil Corporation[11]
Annual Amount of Sludge Cake Treatment	t/year		Feasibility study
Unit Price of Sludge Cake Treatment	KRW/t		Korea Petroleum Information site : Petronet (http://www.petronet.co.kr/v3/index.jsp)

Sensitivity Analysis

The financial indicator should be lower than the benchmark to demonstrate additionality.
The financial indicator would also require to be subjected to a sensitivity analysis (±10%) by varying critical parameters in the financial model to assess the robustness of the result. The following parameters need to be subjected to the sensitivity analysis:

- O&M Cost
- Unit Price of Electricity

[11] http://www.petronet.co.kr/main2.jsp

- Unit Price of Fossil Fuel
- Unit Price of Sludge Cake Treatment
- Construction cost

If the project/equity IRR exceeds the benchmark while altering one of the 5 parameters, the CPA implementer shall provide evidence that this scenario is unlikely to occur. If no sufficient proof is provided, the CPA will be considered as non – additional.

In conclusion, if the SSC-CPA satisfies the above key criteria, the CPA is additional.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices
>>
1. Baseline Emissions

Baseline emission for option 1

Baseline emission for heat production: Baseline calculation is as per Paragraph 22 of methodology AMS.I.C (version 19) of Appendix B of the simplified M&P for small-scale CDM project activities. For steam/heat produced using fossil fuels, the baseline emissions are calculated as follows:

$BE_{thermal,\ CO2,\ y} = (EG_{thermal,y} / \eta_{BL,thermal}) * EF_{FF,CO2}$

$BE_{thermal,\ CO2,\ y}$: The baseline emissions from steam/heat displaced by the project activity during the year *y* (tCO_2)

$EG_{thermal\ y}$: The net quantity of steam/heat supplied by the project activity during the year *y*(TJ)

$EF_{FF,CO2}$: The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (tCO_2/TJ)

$\eta_{BL,thermal}$: The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

Efficiency of the existing plant ($\eta_{BL,thermal}$) shall be determined by Methodology AMS I.C.(version 19) paragraph 30 based on condition of CPA.

2. Total baseline emission

Option 1: $BE_{total,y} = BE_{thermal,\ CO2,\ y}$

3. Project Activity Emissions
In the methodology AMS I.C.(version 19) paragraph 45 stated that Project emissions include 4 emission criteria and 3 criteria are applicable to the proposed project. Detailed calculating tools are addressed below table.

<Table10. Project activity emissions correspondence between AMS I.C and Methodological Tool >

AMS. I.C.	Methodological Tool
i. CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall	Fossil fuel consumption ⇨ "Tool to calculate project or leakage

be calculated using the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02);	CO_2 emissions from fossil fuel combustion" (version 02)
ii. CO_2 emissions from electricity consumption by the project activity using the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"(version 01);	Electricity consumption ⇨ "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 02)
iii. Any other significant emissions associated with project activity within the project boundary.	a) Physical leakage from anaerobic digester due to increased biogas b) Physical leakage from flaring of biogas ⇨ Tool "Project and leakage emission from anaerobic digesters" (version 01)
iv. For geothermal project activities, project participants shall account for the following emission sources, where applicable: fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant	Not applicable

Project emission: Fossil fuel consumption

Fossil fuel consumption in the project site shall be calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (EB41 Annex11 version02). The project emission source *j* referred to in the tool is fossil fuel consumption in the project activity.

$$PE_{FC,j,y} = \Sigma FC_{i,j,y} \times COEF_{i,y}$$

Where:

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

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

$NCV_{i,y}$: Net calorific value of fossil fuel type *i* (GJ/mass or volume unit)
$EF_{CO2,i,y}$: CO_2 emission factor of fuel type *i* in the year y (tCO_2/GJ)

Project emission: Electricity consumption

Electricity consumption shall be calculated using the **"**Tool to calculate baseline, project and/or leakage emissions from electricity consumption"(EB39 Annex7 version 01), where the project emission source j referred to in the tool is the total electricity consumption in the project activity.

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

Where,

$PE_{EC,y}$: Project emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,j,y}$: Quantity of electricity consumed by the project electricity consumption source j in year y(MWh/y)

$EF_{EL,j,y}$: Emission factor for electricity generation for source *j* in year *y*(tCO_2/MWh)

$TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity in year y

Project emission: Physical leakage

Physical leakage shall be calculated using the methodological tool EB66 Annex32 (version 01.0.0) "Project and leakage emissions from anaerobic digesters"

Step 1: Determination of the quantity of methane produced in the digester ($Q_{CH4,y}$)

There are two different procedures to determine the quantity of methane produced in the digester in year *y* ($Q_{CH4,y}$). For large scale projects only Option 1 shall be used. For small scale projects, project participants may choose between Option 1 or Option 2.

- Option 1: Procedure using monitored data
- Option 2: Procedure using a default value

Option 2: Procedure using a default value is chosen.

Under this option, the flow of the biogas is measured and a default value is used for the fraction of methane in the biogas, as follows:

$$Q_{CH4,y} = Q_{biogas,y} \cdot f_{CH4,default} \cdot \rho_{CH4}$$

Where:

$Q_{CH4,y}$: Quantity of methane produced in the digester in year *y* (t CH_4)

$Q_{biogas,y}$: Amount of biogas collected at the digester outlet in year *y* (Nm^3 biogas)

$f_{CH4,default}$: Default value for the fraction of methane in the biogas (Nm^3 CH_4 / Nm^3 biogas)

ρ_{CH4} : Density of methane at normal conditions (t CH_4 / Nm^3 CH_4)

Step 2: Determination of project emissions from electricity consumption ($PE_{EC,y}$)

⇨ Calculated at" Project emission: Electricity consumption" above.

Step 3: Determination of project emissions from fossil fuel consumption ($PE_{FC,y}$)

⇨ Calculated at" Project emission: Fossil fuel consumption" above.

Step 4: Determination of project emissions of methane from the anaerobic digester ($PE_{CH4,y}$)

Project emissions of methane from the anaerobic digester include emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester. These emissions are calculated using a default emission factor ($EF_{CH4,default}$), as follows:

$$PE_{CH4,y} = Q_{CH4,y} \cdot EF_{CH4,default} \cdot GWP_{CH4}$$

Where:

$PE_{CH4,y}$: Project emissions of methane from the anaerobic digester in year *y* (t CO_2e)

$Q_{CH4,y}$: Quantity of methane produced in the anaerobic digester in year *y* (t CH_4)

$EF_{CH4,default}$: Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)

GWP_{CH4} : Global warming potential of CH_4 (t CO_2 / t CH_4)

Step 5: Determination of project emissions from flaring of biogas ($PE_{flare,y}$)

If the project activity includes flaring of biogas, then project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the "Tool to determine project emissions from flaring gases containing methane" (EB28 Annex13). The following applies:

• For small scale projects, project participants may adopt a default value for the fraction of methane in the biogas ($f_{CH4,default}$) in applying the tool; and
• The tool provides default factors for the flare efficiency, which can be used for large or small scale projects as described in the tool.

⇨ Tool updated to EB 68 Annex 15 (version 02.0.0) "Project emissions from flaring".

According to methodological tool "Project emissions from flaring"(version 02.0.0), the calculation procedures provided below determine the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to flare ($F_{CH4,RG,m}$). The project emissions calculation procedure is given in the following steps:

Step.5.1 - Determination of the methane mass flow rate in the residual gas

This step determines the mass flow of methane ($F_{CH4,\ m}$) as kg unit in the residue gaseous stream in the minute "m" as per the guidance given in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).

$F_{CH4,m}$,which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0) provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$F_{i,t}$	kg/h	Mass flow of greenhouse gas *i* (CO_2, CH_4, N_2O, SF_6 or a PFC) in the gaseous stream in time interval *t*

The mass flow of a particular greenhouse gas is calculated based on measurements of: (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gas stream and (c) the gas composition and water content. The flow and volumetric fraction may be measured on a dry basis or wet basis. The tool covers the possible measurement combinations, providing six different calculation options to determine the mass flow of a particular greenhouse gas.

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

Option D is applicable for the proposed project.

Option D:

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to

demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or

- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60℃ (333.15K) at the flow measurement point.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using the following equations:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis(m^3 dry gas/h)
$v_{i,t,db}$ = Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis(m^3 gas i/m^3 dry gas)
$\rho_{i,t}$ = Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3gas *i*)
P_t = Absolute pressure of the gaseous stream in time interval *t*(Pa)
MM_i = Molecular mass of the gaseous gas *i* (kg/kmol)
R_u = Universal ideal gases constant (Pa.m^3/kmol.K)
T_t = Temperature of the gaseous stream in time interval *t*(K)

$$V_{t,db} = M_{t,db}/\rho_{t,db}$$

and

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t}$$

Where:

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$M_{t,db}$ = Mass flow of the gaseous stream in time interval *t* on a dry basis (kg/h)
$\rho_{t,db}$ = Density of the gaseous stream in time interval *t* on a dry basis (kg dry gas/m^3 dry gas)
P_t = Pressure of the gaseous stream in time interval *t*(Pa)
T_t = Temperature of the gaseous stream in time interval *t*(K)
$MM_{t,tb}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated as follows:

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$$

Where:

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis(kg dry gas/kmol

dry gas)

$\nu_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis(m^3 gas *k*/m^3 dry gas)

MM_k = Molecular mass of gas *k* (kg/kmol)

k = All gases, except H2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See available simplification below

The determination of the molecular mass of the gaseous stream ($MMt_{,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.Underlying methodology is AMS I-C.(version 19). Methodology does not specify simplification, hence simplification adopted by the tool has been taken into account.

Step. 5.2 Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares, there is the option to apply a default value or determine the efficiency based on monitored data. For open flares, a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flare, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

Open flare
In case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Enclosed flare
In case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($\eta_{flare,m}$) and shall document in the CPA-DD which option is selected.

Option A: Apply a default value for flare efficiency.
Option B: Measure the flare efficiency.

For enclosed flares that are defined as low height flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Option A or B. For example, the applied should be 80%, rather than 90%, and if for example the measured value was 90%, then the value to be used shall correspond to 89%.

In the case of enclosed flare, Option A is chosen.

The flare efficiency for the minute *m* ($\eta_{flare,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:
(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and

(2) The flame is detected in minute *m* ($Flame_m$). Otherwise $\eta_{flare,m}$ is 0%.

Step 5.3: Calculation of project emissions from flaring
Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based

on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

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

Where;
$PE_{flare,y}$: Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}: Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$: Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$: Flare efficiency in minute m

4. Leakage Calculation

According to Leakage emissions procedure of the Methodological Tool "Project and leakage emissions from anaerobic digesters"(version 01.0.0) leakage is as follow;

$LE_{AD,\,y} = LE_{storage,\,y} + LE_{comp,\,y}$

Where:
$LE_{AD,\,y}$ = Leakage emissions associated with the anaerobic digester in year *y*(tCO_2e)
$LE_{storage,\,y}$ = Leakage emissions associated with storage of digestate in year *y*(tCO_2e)
$LE_{comp,\,y}$ = Leakage emissions associated with composting digestate in year *y*(tCO_2e)

Step 1: Determination of leakage emissions associated with storage of digestate($LE_{storage,\,y}$)

This step applies in the case that the digestate is stored under the following anaerobic conditions:
- In an un-aerated lagoon that has a depth of more than one meter; or
- In a SWDS, including stockpiles that are considered a SWDS as per the definitions section.

Storage of digestate under anaerobic conditions can cause CH_4 emissions due to further anaerobic digestion of the residual biodegradable organic matter. The procedure for determining $LE_{storage,y}$ is distinguished for liquid digestate and solid digestate.

Step 2: Determination of leakage emissions associated with composting digestate($LE_{COMP,\,y}$)

$LE_{COMP,\,y}$ shall be calculated using the methodological tool "Project and leakage emission from composting" (version 01.0.0):. The term $PE_{COMP,\,y} + LE_{COMP,\,y}$ in the methodological tool "Project and leakage emissions from composting" (version 01.0.0) provides the value for $LE_{COMP,\,y}$ of this tool.

As per paragraph 47, methodology AMS I-C.(version 19) "If the energy generating equipment currently being utilized is transferred from outside the boundary to the project activity, leakage is to be considered".It will be proved at CPA level.

As per paragraph 48, methodology AMS I-C.(version 19) "In cases where the collection/ processing/ transportation of biomass residues is outside the project boundary CO2 emissions from the collection processing/transportation of biomass residues to the project site shall be taken into account as leakage".
It will be proved at CPA level.

5. Emission Reductions

$\boldsymbol{ER_y = BE_{total,y} - PE_{total,y} - LE_y}$
Where,
$\boldsymbol{ER_y}$ Emission reductions in year *y* (tCO_2e)

$BE_{total,y}$ Baseline emissions in year *y* (tCO_2e)
$PE_{total,y}$ Project emissions in year *y* (tCO_2 e)
LE_y Leakage emissions in year *y* (tCO_2e)

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	$\eta_{BL,thermal}$
Unit	%
Description	The efficiency of the existing plant using fossil fuel that would have been used in the absence of the project activity
Source of data	Determined according to paragraph 30 in the methodology AMS I.C.(version 19), based on data from CPA implementer provided
Value(s) applied	To be determined with respect to each CPA.
Choice of data or Measurement methods and procedures	According to paragraph 30, methodology AMS I.C.(version 19) this parameter shall be determined adopting one of the following three options (a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards; (b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel; (c) Default efficiency of 100%.
Purpose of data	Applicable to thermal energy baseline in option 1
Additional comment	N/A

Data / Parameter	$EF_{grid,OM, y}$
Unit	tCO_2/ MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6922
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system(version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea (2008, 2009, 2010) (KEPCO)'.
Purpose of data	Applicable to electricity project emission
Additional comment	This data has been calculated at the time of PDD submission and will not be changed during the first crediting period.

Data / Parameter	$EF_{grid,BM, y}$
Unit	tCO_2/ MWh
Description	Build margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6412
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system (version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea 2010 (KEPCO)'.
Purpose of data	Applicable to electricity project emission
Additional comment	This data has been calculated at the time of PDD submission and will not be changed during the first crediting period.

Data / Parameter	$EF_{grid, CM, y}$
Unit	tCO_2/ MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6667
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system(version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea (KEPCO)'.
Purpose of data	Applicable to electricity project emission
Additional comment	- w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period

Data / Parameter	$f_{CH4,default}$
Unit	Nm^3 CH_4 / Nm^3 biogas
Description	Default value for the fraction of methane in the biogas
Source of data	The default value was derived based on reported values from registered projects and research papers (Davidsson, 2007)
Value(s) applied	0.6
Choice of data or Measurement methods and procedures	Methodological Tool "Project and leakage emissions from anaerobic digesters" (version 01.0.0)
Purpose of data	Applicable to project emission
Additional comment	N/A

Data / Parameter	ρ_{CH4}
Unit	t CH_4 / Nm^3 CH_4
Description	Density of methane at normal conditions
Source of data	Technical literature
Value(s) applied	0.00067
Choice of data or Measurement methods and procedures	Methodological Tool "Project and leakage emissions from anaerobic digesters" (version 01.0.0)
Purpose of data	Applicable to project emission
Additional comment	Normal conditions are defined as 20℃ and 1 atm pressure

Data / Parameter	$EF_{CH4,default}$
Unit	t CH_4 leaked / t CH_4 produced
Description	Default emission factor for the fraction of CH4 produced that leaks from the anaerobic digester
Source of data	IPCC (2006), Flesch et al. (2011) and Kurup (2003)
Value(s) applied	To be determined with respect to each CPA type of digester
Choice of data or Measurement methods and procedures	Use the default value corresponding to the type of digester used in the project activity. The digester type shall be identified by manufacturer information. If this is not possible, then the factor 0.1 shall be applied (upper range of the IPCC values). • 0.028: Digesters with steel or lined concrete or fiberglass digesters and a gas holding system (egg shaped digesters) and monolithic construction; • 0.05: UASB type digesters, floating gas holders with no external water seal; • 0.10: Digesters with unlined concrete/ferrocement/brick masonry arched type gas holding section; monolithic fixed dome digesters, covered anaerobic lagoon.
Purpose of data	Applicable to project emission
Additional comment	N/A

Data / Parameter	GWP_{CH4}
Unit	tCO_2e / tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC
Value(s) applied	25 for the second commitment period.
Choice of data or Measurement methods and procedures	IPCC
Purpose of data	Applicable to Project emission
Additional comment	N/A

Data / Parameter	$SPEC_{flare}$
Unit	Temperature - ℃ Flow rate or heat flux - kg/h or m^3/h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	To be determined with respect to each CPA
Choice of data or Measurement methods and procedures	Document in the CPA the flare specifications set by the manufacturer for the correct operation of the flare for the following parameters: (a) Minimum and maximum inlet flow rate, if necessary converted to flow rate at reference conditions or heat flux; (b) Minimum and maximum operating temperature; and (c) Maximum duration in days between maintenance events
Purpose of data	Applicable to Project emission
Additional comment	Only applicable in case of enclosed flares. The maintenance schedule is not required if Option A is selected to determine flare efficiency of an enclosed flare.

Data / Parameter	R_u
Unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	Methodological tool "Project emissions from flaring"(version 02.0.0)
Value(s) applied	0.008314472
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the Formula which density of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	N/A

Data / Parameter	MM_i
Unit	kg/kmol
Description	Molecular mass of greenhouse gas CH_4
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0)
Value(s) applied	
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the Formula which density of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	NA

Compound	Structure	Molecular mass (kg / kmol)
Carbon dioxide	CO_2	44.01
Methane	CH_4	16.04
Nitrous oxide	N_2O	44.02
Sulfur hexafluoride	SF_6	146.06
Perfluoromethane	CF_4	88.00
Perfluoroethane	C_2F_6	138.01
Perfluoropropane	C_3F_8	188.02
Perfluorobutane	C_4F_{10}	238.03
Perfluorocyclobutane	c-C_4F_8	200.03
Perfluoropentane	C_5F_{12}	288.03
Perfluorohexane	C_6F_{14}	338.04

Data / Parameter	MM_k
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0)
Value(s) applied	For gases *k* that are greenhouse gases appy values for MM_i.
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the formula which molecular mass of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	NA

Compound	Structure	Molecular mass (kg / kmol)
Nitrogen	N_2	28.01
Oxygen	O_2	32.00
Carbon monoxide	CO	28.01
Hydrogen	H_2	2.02
Nitric oxide	NO	30.01
Nitrogen dioxide	NO_2	46.01
Sulfur dioxide	SO_2	64.06

B.6.3. Ex-ante calculations of emission reductions

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1. Determination of Grid Emissions Factor:

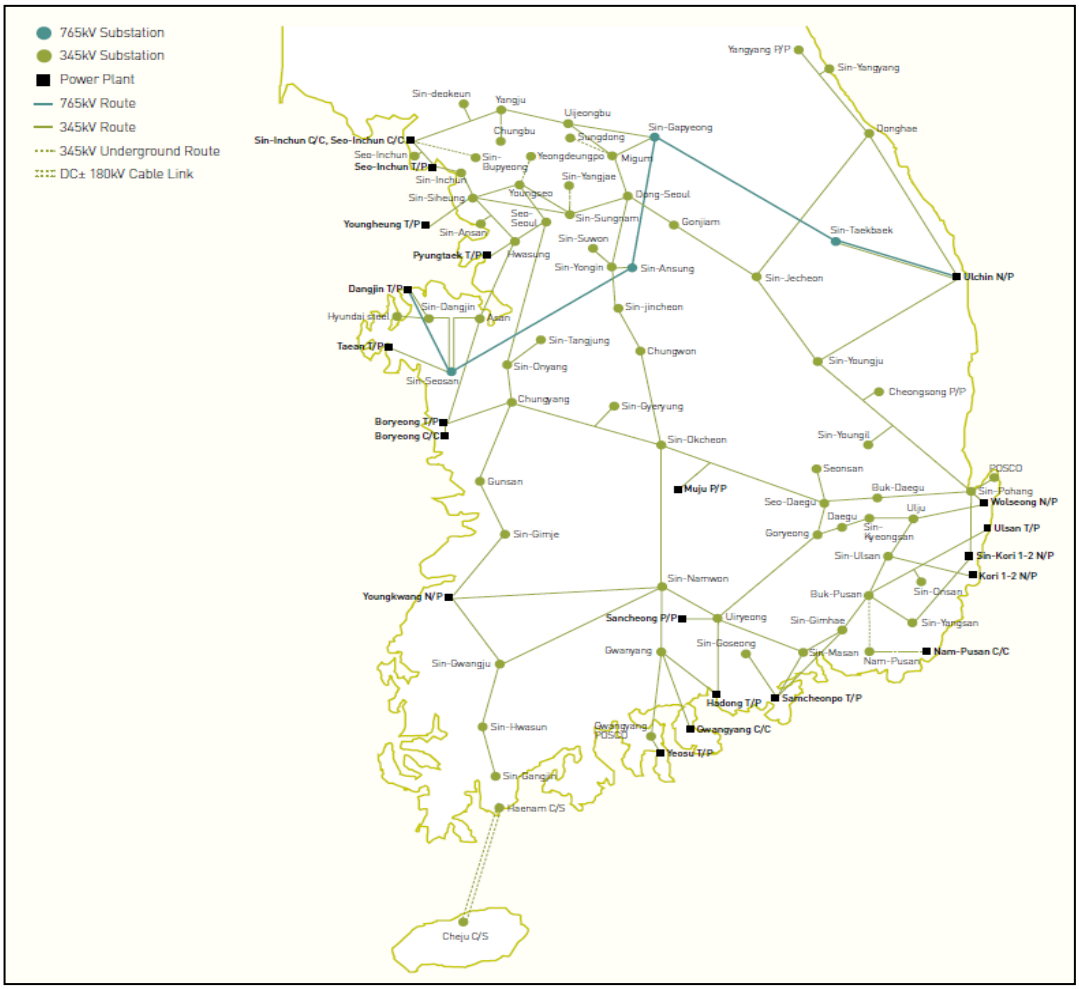
Emissions Factor is calculated according to "Tool to calculate the emission factor for an electricity system" (version 04.0.0).

This tool provides procedures to determine the following parameters:

Parameter	SI Unit	Description
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for the project electricity system in year *y*

Step 1. Identify the relevant electricity systems

The electricity of proposed project is connected to KEPCO grid which covers all area of Korea. The grid is relevant electric power system for electricity emission factor.



<Figure 8. Electric Power Grid Nationwide in Republic of Korea>

(Source: 2010 Annual Report (KEPCO))

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)
Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

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

In this project, Option I is chosen. Only grid power plants are included in the calculation.

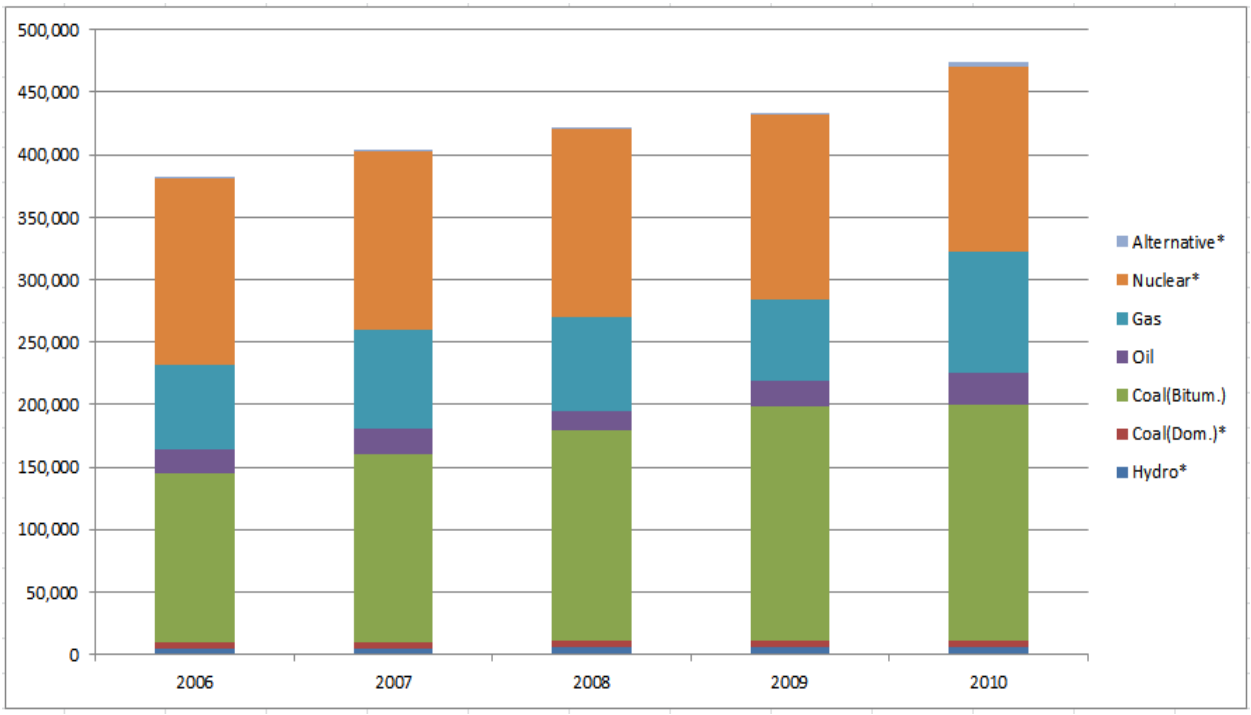
Step 3. Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

If low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years, (a)simple OM can be chosen. Referring to the gross electricity generation rate by energy sources of the host country (Republic of Korea), the rate of low cost/must run power generation will not exceed 50% of the total grid. In fact, the average data of most recent 5 years (2006-2010) shows that the rate of low cost/must run is 37.78% (Source: KEPCO).

<Figure 9. Yearly gross generation graph by energy sources>
(Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation)



<Table 11. Yearly proportion of the Generation of Electricity based on the Source of Energy[12]>

	2006	2007	2008	2009	2010	Total	%
Hydro*	5,219	5,042	5,563	5,641	6,472	27,937	1.32
Coal(Dom.)*	4,312	4,470	5,010	5,559	4,613	23,964	1.13
Coal(Bitum.)	134,894	150,204	168,498	187,657	189,156	830,409	39.26
Oil	19,195	21,215	15,425	19,912	25,356	101,103	4.78
Gas	68,302	78,427	75,809	65,273	96,483	384,294	18.17
Nuclear*	148,749	142,937	150,958	147,771	148,596	739,011	34.94
Alternative*	511	829	1,092	1,791	3,984	8,207	0.39
Total	381,182	403,124	422,355	433,604	474,660	2,114,925	100.00
The rate of low cost/ must run power generation (%)	37.78%						

(*: low-operating cost and must-run power plant)

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the following data vintages:
• Ex ante option: if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation; OR
• Ex post option: if the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year *y-2* may be used. The same data vintage (*y*, *y-1* or *y-2*) should be used throughout all crediting periods.

Ex ante option is applied. The average data of 5 years (2006-2010) is available from KEPCO[13]'s Statistics of Electric Power.

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

(a) Simple OM

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Option A :Based on the net electricity generation and a CO_2 emission factor of each power unit;
- Option B :Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system

[12]Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation, 2011
[13] KEPCO : Korea Electric Power Corporation

As the data on Fuel consumption and net electricity generation of each power plant is available in Korea. Therefore Option A was chosen. Where Option A is used, the simple OM emission factor is calculated as follows;

Option A-based on average efficiency and electricity generation of each plant

$$EF_{grid,OM,simple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

$EF_{grid,OMsimple,y}$: Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$: CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m : All power units serving the grid in year *y* except low-cost/must-run power units
y : The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

•Option A1. If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

$EF_{EL,m,y}$: CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,y}$: Amount of fossil fuel type *I* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$: Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$: CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m : All power units serving the grid in year *y* except low-cost/must-run power units
i : All fossil fuel types combusted in power unit *m* in year *y*
y : The relevant year as per the data vintage chosen in Step 3

For the proposed project, $NCV_{i,y}$ provided by official data source of Korea is used. According to "Tool to calculate the emission factor for an electricity system (version 04.0.0)", the emission factor is calculated using a 3-year generation-weighted average, based on the most recent statistics available at the time of PDD submission. As a result, the OM emission factor ($EF_{grid,OM,y}$) is 0.6922 (tCO_2/MWh).

<Table 12. Generation weighted average OM>

Year	2008	2009	2010	Total	OM Margin (tCO_2/MWh).
Simple operating margin(tCO_2)	165,088,792	177,090,681	191,490,645	533,670,118	0.6922

Net generation by OM plants(MWh)	237,888,671	247,025,690	286,089,511	771,003,872	
EF(tCO_2/MWh).	0.6940	0.7169	0.6693		

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

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

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

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.
And here, the option 1 was chosen in this project.

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

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-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≥20%) and determine their annual electricity generation (AEGSET-≥20%, in MWh);

(c) From SET5-units and SET≥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.

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 electricity generation data is available, calculated as follows

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	:	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	:	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	:	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

<Table 13. Sample Plant group for determining Build margin Emission factor>

sample group	Electricity generation (MWh)	% of total electricity supplied to the grid
The five power units that have been built most recently	4,309,824	0.94810%
The power plant capacity additions in the electricity system that comprise 20% of the system generation and that have been built most recently	**91,735,155**	**20.181%**

Therefore the "The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently." is chosen as a sample group. In result, Build Margin is 0.6412(tCO_2/MWh).

Step 6. Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:
(a) Weighted average CM; or
(b) Simplified CM.
The weighted average CM method (option A) should be used as the preferred option.
The simplified CM method (option B) can only be used if:
•The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered CDM projects at the starting date of validation; and
•The data requirements for the application of step 5 above cannot be met.

Option (a) Weighted average CM was chosen in this PoA.

(a) Weighted average
The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y,} = EF_{grid,OM\,y} \cdot w_{OM} + EF_{grid,BM,\,y} \cdot w_{BM}$$

Where:
$EF_{grid,BM,y}$: Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$: Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM} : Weighting of operating margin emissions factor (%)
w_{BM} : Weighting of build margin emissions factor (%)

According to "Tool to calculate the emission factor for an electricity system" (version 04.0.0), this project

activity is w_{OM}=0.5 and w_{BM}= 0.5 for the first crediting period and and w_{OM}= 0.25 and w_{BM}= 0.75 for the second and third crediting period unless otherwise specified in the approved methodology which refers to this tool. And $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

Therefore baseline emission factor ($EF_{grid,CM,y)}$ for this project is 0.6667(tCO_2/MWh) as follows:

$$EF_{grid,CM,y,} = w_{OM} \cdot EF_{grid,OM\,y} + w_{BM} \cdot EF_{grid,BM,y}$$

$$= 0.5 \times 0.6922(tCO_2/MWh) + 0.5 \times 0.6412(tCO_2/MWh)$$

$$= \mathbf{0.6667}(tCO_2/MWh)$$

Thus, the combined margin emissions factor of 0.6667tCO_2/MWh (for other system) will be used for this PoA *ex-ante.*

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	$EG_{thermal,y}$
Unit	TJ
Description	The net quantity of steam/heat supplied by the project activity during the year *y*(TJ)
Source of data	Measured by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Heat generation is determined as the difference of the enthalpy of the steam or hot fluid and/or gases generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and/or gases blow-down and if applicable any condensate returns. The respective enthalpies should be determined based on the mass(or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. In case of equipment that produces hot water/oil this is expressed as the difference in the enthalpy between the hot water/oil supplied to and returned by the plant. In case of equipment that produces hot gases or combustion gases, this is expressed as the difference in the enthalpy between the hot gas produced and all streams supplied to the plant. The enthalpy of all relevant streams shall be determined based on the monitored mass flow, temperature, pressure, density and specific heat of the gas.
Monitoring frequency	Continuous monitoring, aggregated monthly and annually
QA/QC procedures	CPA implementers shall ensure that the equipment is calibrated either in accordance with the local/national standards or as per the manufaxture's specification. If each of these is not available, international standard may be used.
Purpose of data	Applicable to thermal energy baseline in option 1
Additional comments	NA

Data / Parameter	$Q_{hot\ air}$
Unit	Nm^3/yr
Description	Quantity of hot air
Source of data	Measured flow meters by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measurement method: Flow meter Where it is not feasible, spot measurements can be used through sampling with a 90% confidence level and a 10% precision.
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment is calibrated either in accordance with the local/national standards or as per the manufacture's specification. If each of these is not available, international standard may be used.
Purpose of data	Applicable to thermal energy baseline in option 1
Additional comments	NA

Data / Parameter	Q_{steam}
Unit	Nm^3/yr
Description	Quantity of steam
Source of data	Measured flow meters by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measurement method: Flow meter
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment is calibrated either in accordance with the local/national standards or as per the manufacture's specification. If each of these is not available, international standard may be used.
Purpose of data	Applicable to thermal energy baseline in option 1
Additional comments	NA

Data / Parameter	T
Unit	℃
Description	Temperature
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measures using calibrated meters.
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	At least once in three years.
Purpose of data	Hot water/fluid or steam which will be used for calculating enthalpy (heat content) of steam or hot fluid
Additional comment	N/A

Data / Parameter	P
Unit	kg/cm^2
Description	Pressure
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measures using calibrated meters.
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	At least once in three years.
Purpose of data	Hot water/fluid or steam which will be used for calculating enthalpy (heat content) of steam or hot fluid
Additional comment	N/A

Data / Parameter	$Q_{biogas,y}$
Unit	Nm^3 biogas
Description	Amount of biogas collected at the digester outlet in year *y*
Source of data	Gas analyser data recorded by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Test result Data archiving : - Amount of biogas will be measured automatically, respectively with the installed measuring instruments(flow meter). - The measured data will be filed in writing monthly by CPAs implementer. CPAs implementer will keep the data documents during 12 years (10 years are credit period and 2 years are additional). Accuracy : ± 5% or better
Monitoring frequency	Continuously measurement by the flow meter. Data to be aggregated monthly and yearly
QA/QC procedures	Calibration frequency: Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years.
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$EC_{PJ,j,y}$
Unit	MWh
Description	Quantity of electricity consumed by project activity in a process j during the year y
Source of data	Data from CPA implementer provided
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Digital measurement or calculated data Data archiving: - Quantity of electricity will be measured automatically, with the installed measuring instruments (Electronic power gauge) or will be calculated using the following data (Operating time will be applied conservatively as 24 hours. Power consumption data for each facility will be applied from the list of facilities spec data in A.5 "Technical description" of the CPA-DD). - The measured data will be filed in writing monthly by CPAs implementer. CPAs implementer will keep the data documents during 12 years (10 years are credit period and 2 years are additional). Accuracy : ± 1% or better
Monitoring frequency	Continuously measurement. Data to be aggregated monthly and yearly or data to be calculated yearly (reference: Retrofitted/new installed equipment electricity consumption of Emission reduction Excel sheet)
QA/QC procedures	Calibration frequency: Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years.
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type *i* in year *y*
Source of data	IPCC default values at the upper limit of uncertainly at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2(Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	To be determined with respect to fossil fuel that each CPA used
Choice of data or Measurement methods and procedures	Any future revision of the IPCC Guidelines should be taken into account
Purpose of data	Applicable to baseline emission in option 1
Additional comment	N/A

Data / Parameter	$TDL_{j,y}$
Unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	National database KEPCO in brief
Value(s) applied	To be determined every year
Measurement methods and procedures	National database KEPCO in brief "(2009) 1.Transmission & Distribution Loss in Ⅵ. Electricity sales, No.111" and link address is http://cyber.kepco.co.kr/kepco/KO/ntcob/list.do?boardCd=BRD_000098&menuCd=FN05030102
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	NA
Purpose of data	Applicable to baseline and project emission
Additional comments	The data will be updated annually to reflect

Data / Parameter	$FC_{i,j,y}$
Unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr)
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Digital measurement Recording : monthly Monitoring Frequency : continuous Data archiving: Data will be archived by Electronic/Paper mode. Accuracy : ± 5% or better
Monitoring frequency	Continuously
QA/QC procedures	Calibration frequency : Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should be cross-checked with available purchase invoices from the financial records
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$Flame_m$
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	CPA Implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measure using a fixed installation optical flame detector
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations. Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$T_{flare,m}$
Unit	℃
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	CPA Implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment. Measurements outside the operational temperature specified by the manufacture may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare. Where more than one temperature port is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturers specifications for temperature.
Monitoring frequency	Once per minute.
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule
Purpose of data	Applicable to project emission(enclosed flare)
Additional comments	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacture's flare specifications for operating temperature are met.

Data / Parameter	$v_{i,t,db}$
Unit	m^3 gas *i*/m^3 dry gas
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a dry basis
Source of data	Characteristics analysis of the gaseous stream
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Continuous gas analyser operating in dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data	Applicable to project emission
Additional comments	This parameter will be monitored in Options D

Data / Parameter	$M_{t,db}$
Unit	kg/h
Description	Mass flow of the gaseous stream in time interval *t* on a dry basis
Source of data	Onsite measurements by CPA implementer (Gas flow meter data recorded)
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Calculated based on the wet basis flow measurement plus water concentration measurement
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Applicable to project emission
Additional comments	This parameter will be monitored in Options D

Data / Parameter	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval *t*
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Applicable to project emission
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being 60℃ is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval *t*
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly.
Purpose of data	Applicable to project emission
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency).

Data / Parameter	$v_{k,t,db}$
Unit	m^3 gas *k*/m^3 dry gas
Description	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Continuous gas analyzer operating in dry basis
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Applicable to project emission
Additional comments	As a simplified approach, project participants may only measure the content CH_4 and CO_2 of the residual gas and consider the remaining part as N_2.

Data / Parameter	$NCV_{i, y}$
Unit	GJ/mass or volume
Description	Net calorific value of the fuel i in the year y
Source of data	IPCC default values at the upper limit of uncertainly at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2(Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	To be determined with respect to fuel i that each CPA used
Measurement methods and procedures	NA
Monitoring frequency	Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	NA
Purpose of data	Applicable to project emission on-site consumption of fossil fuel
Additional comment	N/A

Data / Parameter	NCV_k
Unit	GJ/mass or volume
Description	Net calorific value of biomass type *k*
Source of data	Measurement in laboratories according to relevant national/international standard
Value(s) applied	To be determined with respect to biomass *k* that each CPA used
Measurement methods and procedures	Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period. Measure the NCV based on dry biomass. Check the consistency of the measurements by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC.(If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements)
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	NA
Purpose of data	Applicable of baseline emission for project activities
Additional comment	N/A

B.7.2. Description of the monitoring plan for a generic CPA

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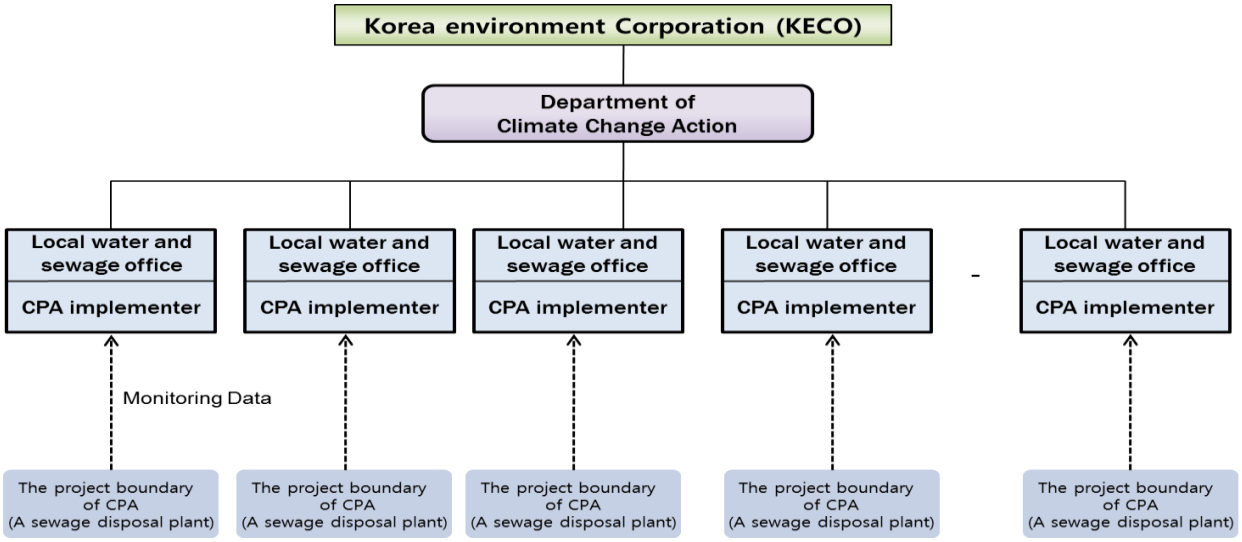
In order to ensure all CPAs are monitored and verified as per the applied monitoring methodology, the CME has prepared a comprehensive monitoring plan for all the CPAs to be included in the PoA. Furthermore, the CME will conduct periodical inspection of CPAs randomly at any given time in a year.

For monitoring activity, CDM Operational Manual will be provided to each CPA. The Manual has information on general procedure and responsibilities of each party to personnel training and templates for data recording.

Monitoring Structure

Each CPA is responsible for operation and maintenance of the plants, the KECO as CME is responsible for operation of this PoA, data collection and management and handling of irregularity. Data monitored and recorded in accordance with CDM Operational Manual and any guideline CME provided shall be reported to CME periodically. CME shall keep and manage the data with each CPA's identification.



<Figure 10. Managing structure of the CDM monitoring>

The key considerations for developing monitoring plans in individual CPAs are discussed below.

1. Introduction

The monitoring plan would present a plan to meet the requirements for the collection, processing and reporting of data. It will describe the management systems and procedures to be implemented by CME upon implementation of each CPA in order to ensure consistency between the project operation as well as monitoring, processing and reporting of data required for the calculation of emission reductions(ERs).

2. Obligations of CPA implementer

It will be the responsibility of the CPA implementer to comply with the monitoring plan provided by CME of the PoA.

3. Recommendations for improvisation in the monitoring plan

During the course of monitoring and verification; if the CPA implementer is of the opinion that there exist potential to improve the monitoring process which would eventually result in improving the quality of monitoring and reporting of emission reductions, then such quality enhancement measures may be implemented in the monitoring process.

4. Detailed description on monitoring of each of the data parameters

This section will contain a detailed description of the data collection and reporting measures to be implemented for each of the data parameter which is monitored under the CPA. Templates are made to record the data to be monitored. The monitoring personnel of the CME would be provided with such templates. In-house training shall be imparted to plant personnel(at the CPA site) for the efficient monitoring/recording of the data and to translate the same into the computation of emission reductions. This section will address the following criteria for each of the monitoring data parameter;

1. Description of the primary source of data from where the information pertaining to the data parameter will be collected.
2. Description of the data collection process
3. Description of the data recording process
4. Description of the measurement instruments
6. Description of the data storage process
7. Other information, if required

The other relevant data will be recorded by the CPA owners and would be provided on quarterly basis to the CME. The data received will be archived electronically for computations of emission reductions on annual basis. Such archived data will be kept until two years after the end of the crediting period or the issuance of CERs whichever is later. Each small scale CPA shall follow all the provision of the PoA including that related to monitoring.

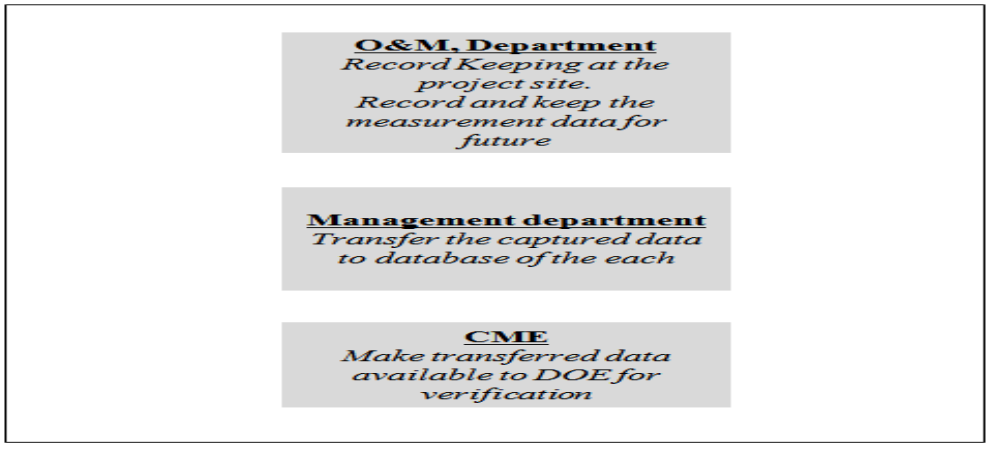
5. Procedures for emergency preparedness for cases where emergencies cause unintended emissions:
During operation of the CPA under the PoA, no emergencies are expected to cause unintended emissions.

6. Procedures for review of the reported results/data:
To minimize the possible errors in the process of data collection, the entry of data gathered during onsite visits by the monitoring personnel of the CME will be compared with the data submitted by CPA implementers throughout the year. The data will be reviewed by the CME and a comparison between the data sent by the CPA implementers and the data obtained during the onsite visit by the monitoring personnel shall be performed to ensure that the data are consistent and correct.

Monitoring plan
The CPA shall be required to monitor the quantity of thermal energy. Measurements are undertaken using mass flow meters. Calibration should be undertaken as prescribed in the General Guidelines to SSC CDM Methodologies and relevant national standards.

OPERATIONAL AND MANAGEMENT STRUCTURE FOR MONITORING
The monitoring of the emission reductions will be carried out according to the scheme shown in Figure 11. The project entity CME will engage its CDM advisor to assure that all monitoring requirements are met. Within the CPA Implementer, a monitoring officer is appointed to carry the day-to-day supervision responsibility. The first step is the measurement of the thermal energy supplied to reporting of daily operations, which will be carried out by the plant operation staff.

The monitoring officer will be responsible for verification of the measurement. The monitoring officer will prepare operational reports of the project activity, Finally, the monitoring reports will be reviewed by CME.



<Figure 11. Management structure in order to monitor emission reduction

PART II. Generic component project activity (CPA)

Project Scenario Option 2

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

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A typical CPA under the proposed PoA comprises one or more thermal and/orelectrical production projects at public sewerage treatment plants in Korea in accordance with methodology AMS I.C.(version 19) and its total energy generation capacity do not exceed 45 MW thermal. Produced biogas at anaerobic digestion system of public sewerage treatment plants will be captured and used as fuel to run the heat and/or electricity generation facility. As a result, CPA will displace fossil fuel and lead to reduction of GHG emissions.

In case that the sewerage plant is already been using biogas and generating thermal energy for operation use, the electrical energy from produced biogas shall be considered to calculate emission reductions. To biogas production, measures to create optimal operation condition in sludge treatment system at plants should be taken. Any incremental emissions caused by such measures shall be taken into account either as project or leakage emissions.

The following detailed scenarios are applicable for inclusion under the PoA.

Project Scenario	Description
Option 2	Displacing electricity by installing a new biomass co-generation system

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

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The approved baseline and monitoring methodology applied to a CPA included in this PoA is:

(a) Project methodology

AMS I.C.(version 19), Scope 1, EB 61 titled "Thermal energy production with or without electricity"

(b) Any tools and other methodologies

AMS I.D. "Grid connected renewable electricity generation" (version 17)
Tool to calculate the emission factor for an electricity system (version 4.0.0)
Project emissions from flaring (version 2.0.0)
Tool to calculate baseline, Project and/or leakage emissions from electricity consumption (version 1)
Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 2)
Project and leakage emissions from anaerobic digesters (version 01.0.0)
Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0)

Further information for the methodology can be found at:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved

B.2. Application of methodology(ies)

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AMS I.C.(version 19) is applied in this PoA because the Programme involves renewable energy technologies that supply users with thermal energy and/or electricity that displaces fossil fuel use. Detailed description of the justification of choice of the methodology is given in the following Table.

<Table 14. Applicability conditions of methodology AMS.I.C.>

Para.	Applicability Conditions	CPA Status
1	This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	The Project activity uses a renewable biogas in order to produce electricity and thermal energy. The Project activity will displace fossil fuel used for generation of electricity. Design Report for each CPA should be provided
2	Biomass-based co-generating systems that produce heat and electricity are included in this category. For the purpose of this methodology "Co-generation" shall mean the simultaneous generation of thermal energy and electrical and/or mechanical energy in one process. Project activities that produce heat and power in separate element processes (for example heat from a boiler and electricity from a biogas engine) do not fit under the definition of co-generation project.	A CPA of Option 2 will generate thermal energy and electrical energy in one process.
3	Emission reductions from a biomass co-generation system can accrue from one of the following activities: (a) Electricity to a grid; (b) Electricity and/or thermal energy(steam or heat) for on-site consumption or for consumption by other facilities; (c) Combination of (a) and (b)	A CPA of option 2 is applicable. Detailed description will be described in CPA-DD.
4	The total installed/rated thermal energy generation capacity of the Project equipment is equal to or less than 45MW thermal.	The total installed/rated thermal energy generation capacity of each CPA will not exceed 45MW thermal.
5	For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel shall not exceed 45MW thermal.	A CPA of Option 2 is not applicable.
6	The following capacity limits apply for biomass co-generation units: (a) If project activity includes emission reductions from both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy; (b) If the emission reductions of the co-generation project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from electricity component), the total installed thermal energy production capacity of the	A CPA of option 2 is applicable. (c) If the emission reductions are solely on account of electrical energy production, the total electrical energy generation capacity will not exceed 15MW.

	project equipment of the co-generation unit shall not exceed 45MW thermal; (c) If the emission reductions of the co-generation project activity are solely on account of electrical energy production, the total installed electrical energy generation capacity of the project equipment of the co-generation unit shall not exceed 15MW.	
7	The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6 and should be physically distinct from the existing units.	The total energy generation capacity of a CPA (new and/or retrofit) will be equal to or less than 45 MW thermal. In the case of the installation of new facilities, the total capacity of the units added by the project will be equal to or less than 45 MW thermal. CPA implementer will ensure that the proposed project activity is physically distinct from the existing units
8	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	A CPA of Option 2 is not applicable.
9	New Facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the General Guidelines to SSC CDM methodologies.	A CPA of Option 2 is a new facility. It will comply with the related and relevant requirements in the *"General Guidelines to SSC CDM methodologies"*
10	If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	N/A Solid biomass will not be used for the proposed project as fuel.
11	Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	N/A Solid biomass will not be used for the proposed project as fuel.
12	If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	In case of electricity delivered to a grid/other facilities, no double-counting section will be addressed at the contract between supplier and consumer and confirmed by CME.
13	If the project activity recovers and utilizes biogas for power/heat production and applies	The proposed project is related to the activity which is recovery and utilization

	this methodology on a stand-alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), .	of biogas from a digester. And AMS-I.C.(version 19) methodology on a stand-alone is applied to the proposed project. Therefore, any incremental emissions occurring due to the implementation of the project activity will be taken into account as per the methodological tool. Any incremental emissions will be calculated in CPA-DD
14	Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided; (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology AMS-III.K.(version 5)7 Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.	N/A Charcoal based biomass will not be used for the proposed project as fuel.
15	The following conditions apply for use of this methodology in a project activity under a programme of activities: a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues or processed biomass(e.g. briquette) only or biomass from dedicated plantations complying with the applicability conditions of AM0042(version 2.1). b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities(attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) or following the procedure included in the leakage section of AM0042(version 2.1); c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced	The proposed project under the PoA shall satisfy the following The proposed project utilizes biogas which is renewable biomass to generate electricity and thermal energy. Thus, criteria(a),(b) are not applicable c) The proposed project activity does not involve the replacement of equipment. If there is, an independent monitoring of scrapping of replaced equipment shall be implemented.

	equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity	

B.3. Sources and GHGs

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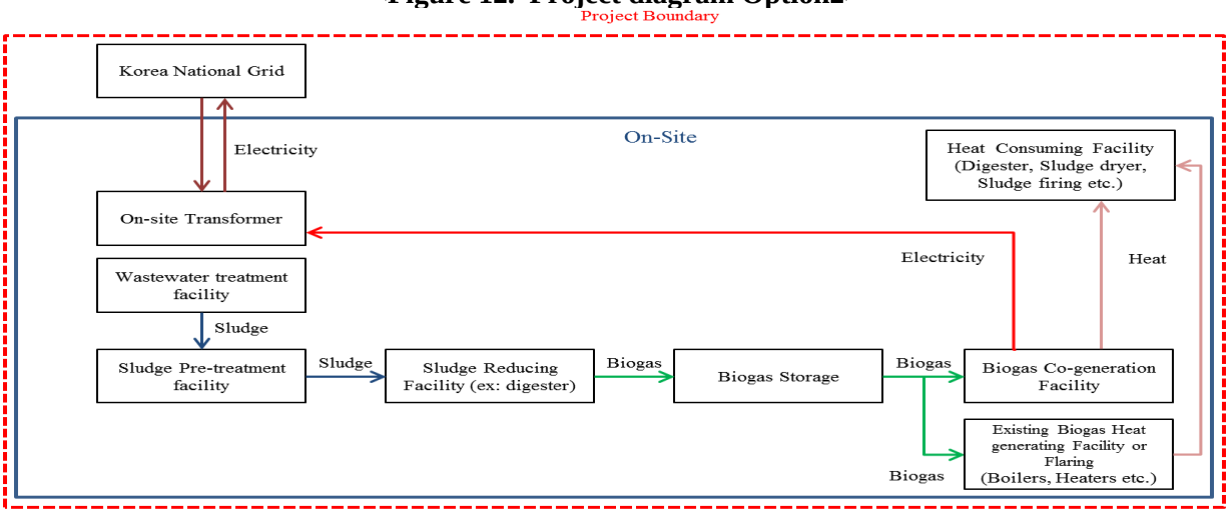
The project diagram for the SSC-CPA is given as below.

Option 2: Biogas generated from the digester will be refined and sent to the new biomass micro gas turbine (hereafter MGT). And biogas in MGT will be combusted and convert to thermal and electricity energy. (In this case, option 2 applies only the electricity energy.) Generated electricity from the co-generation will be exported to the national grid or used on-site consumption.

<Figure 12. Project diagram Option2>



The description of the sources and gases included in the Project boundary is given as below.

<Table 15. Applicability sources and gases included in the SSC-CPA boundary>

	Source	Gas	Included?	Justification / Explanation
Baseline	Fossil fuel combustion in Boiler/heater for heat generation(Applicable to option 2)	CH_4	No	Excluded for simplification. This is conservative.
		CO_2	Yes	Main emission source
		N_2O	No	Excluded for simplification. This is conservative.
	Electricity generation (Applicable to option2)	CH_4	No	Excluded for simplification. This is conservative.
		CO_2	Yes	Main emission source
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Fossil fuel and electricity consumption	CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		CO_2	Yes	On-site fossil fuel and electricity consumption due to the project activity
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

	Physical leakage	CH_4	Yes	Physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring
		CO_2	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.

B.4. Description of baseline scenario

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In the proposed project activity, baseline is determined by using approved small scale methodology AMS.I.C. Thermal energy production with or without electricity (version 19) of Appendix B of the simplified M&P for small-scale CDM project activities

The baseline scenario would be one of the following as mentioned in the table below:

<Table 16. Project type and Baseline scenario>

Option	Description	Baseline Scenario
Option 2	Displacing electricity by installing a new biomass co-generation system	The baseline emission shall be calculated as per Baseline scenario for power and heat production paragraph 19 (i) "Electricity is imported from a grid and/or produced in a biomass fired co-generation unit (without a possibility of export of electricity either to the grid or to other facilities); steam/heat is produced in a biomass fired co-generation unit and/or a biomass fired boiler (without a possibility of export of thermal energy to other facilities). This scenario applies to a project activity that installs a new biomass co-generation system that displaces electricity which otherwise would have been imported from a grid." of methodology AMS.I.C.(version 19)

There are no legal or regulatory requirements which are systematically enforced for the proposed project and no external factors which lead to the project activity such as financial aid. The current baseline scenario therefore will be continued and is the most suitable.

If each CPA needs to be demonstrated that CPA is additional, it will be done at CPA level.

B.5. Demonstration of eligibility for a generic CPA

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The CME has all competencies to check the features of potential CPAs and ensure that each CPA meets all requirements and eligibility criteria (as tabulated below) before inclusion in the registered PoA. The relevant documents for the compliance of paragraph 16 of EB74 Annex 5 has been provided to the DOE for validation.

<Table 17. Demonstration of eligibility for a generic CPA>

No.	ELIGIBILITY CRITERIA	Means of validation	Evidence
1	The CPA is performed within the geographical boundary of Republic of Korea.	Document Review On-site visit	• GPS information • CPA identification No.
2	The CPA is not involved in another project that is registered or under	Document Review	• Confirmation by the CME that CPA is not involved in

	validation as a CDM project activity or as a CPA under another PoA or as other GHG reduction projects. Also, to avoid double counting and operate PoA effectively, each CPA shall be issued its own ID by CME.		another project or under validation as a CDM project activity or as a CPA under another PoA or as other GHG reduction projects • CPA identification No.
3	• Each SSC-CPA will stay within the small-scale threshold criteria of the Type I. Renewable energy projects.(i.e < 45 MW $_{thermal}$ and/or 15 MW $_{e}$) • Option 1 - The total installed capacity is less than or equal to 45 MW $_{thermal}$. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc. - Retrofit of existing heat generating facility. - Supplying heat to facilities through fuel substitution from fossil fuel (LNG, Diesel etc.) to biogas. - Renewable energy project of CPA comply with national standards. • Option 2 - The total installed capacity is less than or equal to 15 MW $_{e}$ and maximum electricity capacity of cogeneration is 5MW $_{e}$ for Microscale project activities. - Improved anaerobic digestion through sludge thickener improvement and digester dredging etc - Displacing use of national electricity by installing a new biogas cogeneration system. - Emission reduction from electricity will be only claimed. Thermal energy will not be claimed. - Renewable energy project of CPA comply with national standards.	Document Review	•Confirmation by the CME that CPA meets all national standards. • Construction permit • Electricity facilities permit of Korea Electrical Safety Corporation (KESCO) • The Preliminary and working design report
4	The CPA start date is after the date of publication of the PoA-DD for global stakeholder consultation, 18/11/2011.	Document Review	•Purchase or Construction Contract date for renewable energy unit
5	The CPA complies with AMS-I.C.(version19) as described in PoA-DD part II_Option1 and/or Option2 section B.2	Document Review On-site Visit	• Confirmation by the CME that CPA meets all applicability criteria of AMS-I.C.(version 19) • Explanation in D.2 of

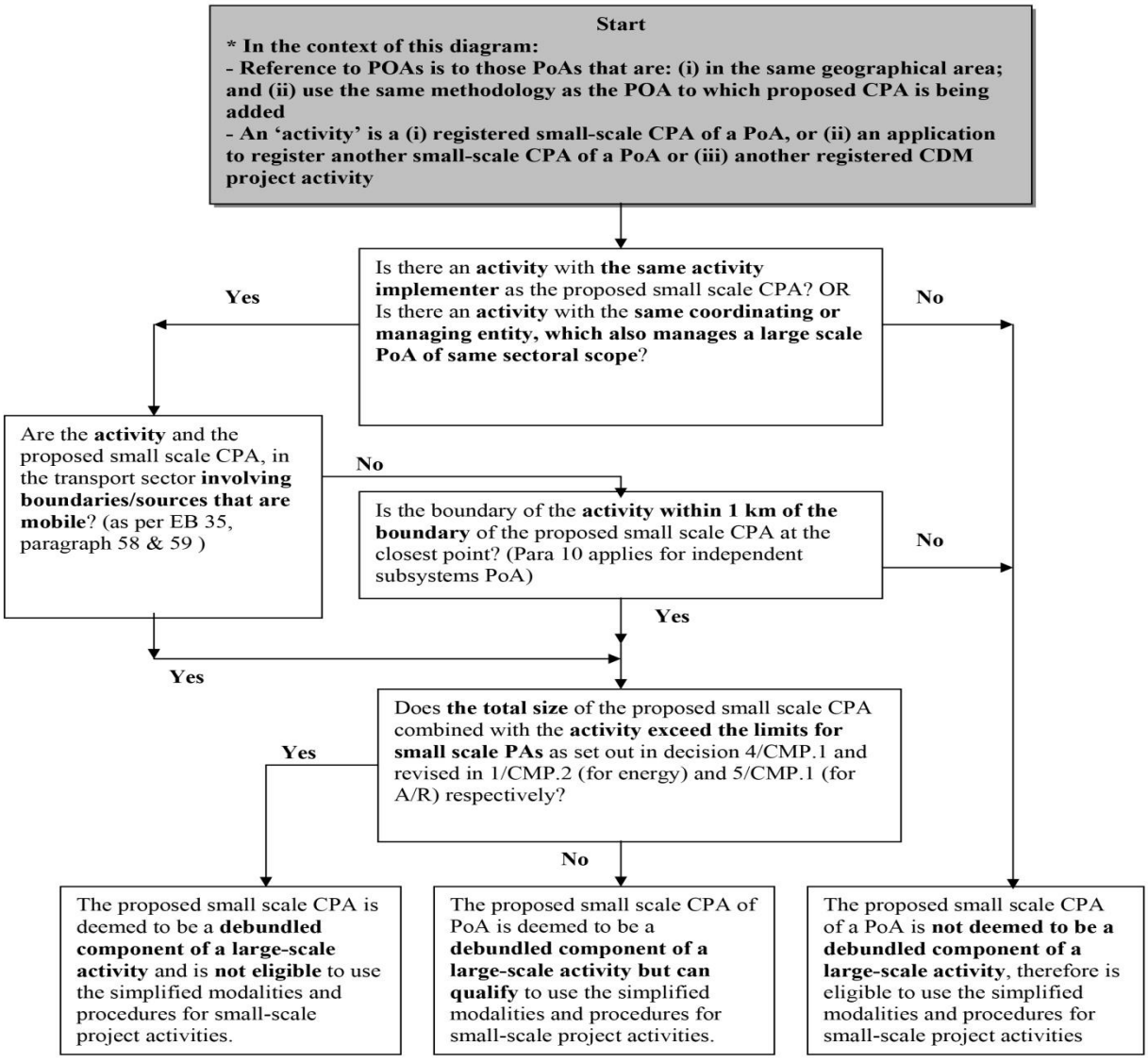
			CPA-DD
6	Additionality check in D.5 of each CPA-DD is either EB73 Annex 13 (version 5.0.0) "Guidelines for demonstrating additionality of microscale project activities" or EB 68 Annex 27(version 09.0.0) "Guidelines on the demonstration of additionality of small scale project activities" as per the project scale.	Document Review On-site visit	• Detailed assessment document for additionality. • Explanation in D.5 of CPA-DD
7	The CPA has the documentary evidence to check project costs and does not result in a diversion of official development assistance from Annex I country.	Document Review	•Declaration from the CPA implementer regarding the no involvement of public funding or ODA from Annex I parties • Explanation in A.11 of CPA-DD
8	The CPA is a single project which is not a de-bundled component of another large-scale CDM or PoA as per the latest guidance given in CDM EB. De-bundling check in A.12 of each CPA-DD and the declaration document by CPA.	Document Review On-site visit	• Declaration by CPA implementer that the CPA is not a de-bundled component of another CDM program activity (CPA) • CPA identification No • Explanation in A.12 of CPA-DD
9	CPA of the PoA shall meet the small-scale or micro-scale threshold criteria (i.e. combined installed electricity generation capacity less than or equal to 15MW, 45MW thermal) and remains within those thresholds throughout the crediting period of the CPA. Electricity generation capacity check in A.5 of each CPA-DD.	Document Review On-site Visit	• The Preliminary and working design report • CPA identification No. • Explanation in D.2 and D.5 of CPA-DD
10	The conditions related to sampling requirements for the PoA in accordance with the " Standard for sampling and surveys for CDM project activities and programme of activities" (version 04.1)	Document Review	• Confirmed criteria of AMS-I.C.(version 19) • No sampling is done, hence not applicable.
11	Produced heat through this project should be provided to the anaerobic digestion or the sewage sludge drying facility. Also, produced electricity should be used in the plant.	Document Review On-site Visit	• The Preliminary and working design report • Explanation in A.3 of CPA-DD
12	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and	Document Review	• Explanation in section B and C of CPA-DD

	environmental impact analysis.		

For more detailed assessment, there are used the following method:

Procedure to check de-bundling

KECO will implement de-bundling check for each CPA referring the guidance for determining the occurrence of de-bundling under a PoA (EB 54, Annex13). KECO will perform the de-bundling check using CPA implementer name, location, GPS information, installed capacity, etc.



<Figure 13. Procedure to check de-bundling >

Confirmation of additionality of the generic CPA for its inclusion into the PoA

As per described in B.1 of Part I, the additionality for the SSC-CPA is demonstrated by Approach 1 or Approach 2 applicable for the project activity.

(a) Approach 1
As per "Guidelines for Demonstrating Additionality of Microscale Project Activities(version 5.0)" according to paragraph 8(d) of EB 73 Annex 13:

8. Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions below is satisfied;

(d) The Project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country.

The DNA of Republic of Korea got the approval of the Board.[14] Therefore, the project activity is additional in cases where the project activities are (i) Option 2, (ii) equal to or smaller than 5 MW; and (iii) no claims of emission reductions from thermal energy production.

Or

(b) Approach 2
As per EB 68 Annex 27 "Guidelines for Demonstration of Additionality of Small-Scale Project Activities"(version 09.0), the project activity shall provide an explanation to show that the project activity would not have occurred anyway due to investment barrier. For demonstrating the investment barrier, Step 2 of "Tool for the demonstration and assessment of additionality(version 07.0.0)"is used. As the project generates financial benefits other than CDM-related income and there are no other credible and realistic baseline scenario alternatives other than 'continuation of the current situation', benchmark analysis will be used to demonstrate additionality.

The Benchmark Analysis would be conducted as follows:

A financial indicator (project IRR or equity IRR) would be chosen for the proposed CPA and justification for its selection would be provided. Subsequently, a benchmark would be adopted which is appropriate to the type of financial indicator calculated and could be chosen as either of the following:

<Table 18. Financial indicator>

Indicator chosen	Benchmark (any one of the below)
Equity IRR	a. Default value for the expected return on equity for Republic of Korea as per the "Guidelines on the assessment of investment analysis' (increased by applicable tax rate in case of pre-tax IRR[15])" b. Cost of equity determined using best financial practices (such as Capital Asset Pricing Model) using data sources which can be clearly validated while properly justifying all underlying factors in accordance with the "Guidelines on the assessment of investment analysis" c. Government/official approved benchmark where such benchmarks are used for investment decisions
Project IRR	a. Local commercial lending rates applicable in the country (pre-tax rate used in case of pre-tax IRR) b. Weighted Average Costs of Capital (WACC) calculated as: WACC= {D/(D+E)}*{1-T/100}*Cost of Debt + {E/(D+E)}*Cost of Equity (tax-rate not applied in case of pre-tax IRR)

[14] http://cdm.unfccc.int/DNA/submissions/files/2012/0105_korea_res.pdf
[15] Appendix para 8 of the "Guidelines on the assessment of investment analysis" (version 05) states that the default values for the expected return on equity are calculated after taxes.

	Where, Cost of Debt is determined as local commercial lending rate applicable in the country and Cost of Equity is determined from any of the options listed above under Equity IRR. c. Government/official approved benchmark where such benchmarks are used for investment decisions

Determination of Input value

The input values for project IRR calculation will be valid and applicable at the time of investment decision. As for the time of investment decision, the date is based on the source of funds for project implementation. Therefore, the date of the investment decision may vary for the CPA.

Investment cost may involve the facility construction, utility installation and the equipment purchase, etc. Component associated with facility construction cost are preliminary works, sub and super structure works, etc.
O&M costs may involve wages of supervisors and other staffs etc.

Benefits in the project activity result from sludge reduction and save the cost of sludge cake treatment during the facility operation. And the technical lifetime of renewable energy generation unit is determined by technology provider/manufacturer, expert opinion or default factors from the "Tool to determine the remaining lifetime of equipment"(version 01).

This list of data and parameters would include at least the following:

<Table 19. Economic parameter>

PROJECT DATA			
Technical Lifetime	years	Based on information provided by technology provider/manufacturer, expert opinion or default factors from the "Tool to determine the remaining lifetime of equipment"(version 01).	
Investment Decision Date	DD/MM/YYYY	Can be sourced from e.g. board decision, budget document.	
PARAMETERS	**Unit**	**Value**	
Debt : Equity Ratio			
Cost of Debt	%		**Source**
Cost of Equity	%		Budget document
Investment Cost	KRW		Budget document
Tax rate	%		Korea Exchange Bank (http://www.keb.co.kr/)
Depreciation Rate	%		Feasibility study
O&M Cost	KRW/year		National Tax Service (http://www.nts.go.kr)
Annual Amount of Electricity Generated to Grid	kWh/year		Monitoring data
Electricity Tariff	KRW/kWh		Feasibility study
Consumption of Fossil Fuel before project	l/year (㎥/year)		Feasibility study
Consumption of Fossil Fuel after project	l/year		Feasibility study

	(㎥/year)		
Unit Price of Fossil Fuel	KRW/l (KRW/㎥)		"Korea Oil Price" at the Korea National Oil Corporation[16]
Annual Amount of Sludge Cake Treatment	t/year		Feasibility study
Unit Price of Sludge Cake Treatment	KRW/t		Korea Petroleum Information site : Petronet (http://www.petronet.co.kr/v3/index.jsp)

Sensitivity Analysis

The financial indicator should be lower than the benchmark to demonstrate additionality.
The financial indicator would also require to be subjected to a sensitivity analysis (±10%) by varying critical parameters in the financial model to assess the robustness of the result. The following parameters need to be subjected to the sensitivity analysis:

- O&M Cost
- Unit Price of Electricity
- Unit Price of Fossil Fuel
- Unit Price of Sludge Cake Treatment
- Construction cost

If the project/equity IRR exceeds the benchmark while altering one of the 5 parameters, the CPA implementer shall provide evidence that this scenario is unlikely to occur. If no sufficient proof is provided, the CPA will be considered as non – additional.

In conclusion, if the SSC-CPA satisfies the above key criteria, the CPA is additional.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices
>>
1. Baseline Emissions

Baseline emission for option 2

Baseline emission for co-generation system: Baseline scenario Methodology AMS I.C.(version 19) Paragraph 19(i), baseline emissions of electricity and thermal are calculated as below:

i) Baseline for electricity production
As per paragraph 21, methodology AMS I.C.(version 19), "Baseline emissions for supply of electricity to and/or displacement of electricity from a grid shall be calculated as per the procedures detailed in AMS-I.D.(version 17) or AMS-I.F.(version 2) as applicable". To the proposed project, both AMS-I.D.(version 17) and AMS-I.F.(version 2) are applicable depending on CPA's condition.

AMS I.D.(version 17) paragraph 11, equation (1)

$$BE_{electricity,\ CO2,y} = EG\ BL_{,electricity}\ y^{*}\ EF_{\ CO2,\ grid\ y,}$$

[16] http://www.petronet.co.kr/main2.jsp

$BE_{electricity, CO2,y}$: Baseline emissions of electricity generation from the project activity in year *y* (t CO_2)
$EG\ BL_{, electricity, y}$: Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{grid,CM,y}$: The CO_2 emission factor of the national grid electricity for other system (tCO_2/MWh)

AMS I.F.(version 02) paragraph 14, equation (1)

$$BE_{electricity, CO2,y} = EG\ BL_{, electricity\ y} * EF_{CO2, y}$$

$BE_{electricity, CO2y}$: Baseline emissions of electricity generation from the project activity in year *y* (t CO_2)
$EG\ BL_{,electricity\ y}$: Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2, y}$: CO_2 emission factor (tCO_2/MWh)
According to AMS I.D.(version 17) table 2 : Applicability of AMS-I.D.(version 17), AMS-I.F.(version 02) and AMS-I.A.(version 16) based on project types, each CPA will be calculated appropriate methodology.

<Table 20: Applicability of AMS-I.D., AMS-I.F. and AMS-I.A. based on project types>

		AMS-I.A.	AMS-I.D.	AMS-I.F.
1	Project supplies electricity to a national/regional grid		√	
2	Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)			√
3	Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)		√	
4	Project supplies electricity to a mini grid17 system where in the baseline all generators use exclusively fuel oil and/or diesel fuel			√
5	Project supplies electricity to household users (included in the project boundary) located in off grid areas	√		

And emission factor of a grid shall be calculated as per the "Tool to calculate the emission factor for an electricity system"(version 04.0.0). Detailed calculation addressed section B.6.3

2. Total baseline emission

Option 2: $BE_{total,y} = BE_y$

3. Project Activity Emissions
In the methodology AMS I.C.(version 19) paragraph 45 stated that Project emissions include 4 emission criteria and 3 criteria are applicable to the proposed project. Detailed calculating tools are addressed below table.

<Table21. Project activity emissions correspondence between AMS I.C and Methodological Tool >

AMS. I.C.	Methodological Tool
j. CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02);	Fossil fuel consumption ⇨ "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02)

v. CO_2 emissions from electricity consumption by the project activity using the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01);	Electricity consumption ⇨ "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 02)
vi. Any other significant emissions associated with project activity within the project boundary.	c) Physical leakage from anaerobic digester due to increased biogas d) Physical leakage from flaring of biogas ⇨ Tool "Project and leakage emission from anaerobic digesters" (version 01)
vii. For geothermal project activities, project participants shall account for the following emission sources, where applicable: fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant	Not applicable

Project emission: Fossil fuel consumption

Fossil fuel consumption in the project site shall be calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (EB41 Annex11 version 02). The project emission source j referred to in the tool is fossil fuel consumption in the project activity.

$$PE_{FC,j,y} = \Sigma FC_{i,j,y} \times COEF_{i,y}$$

Where:

$PE_{FC,j,y}$: CO_2 emissions from fossil fuel combustion in process *j* during the year *y*
$FC_{i,j,y}$: Quantity of fossil fuel type *i* combusted in the process *j* during the year *y* (mass or volume unit/yr);
$COEF_{i,y}$: CO_2emission coefficient of fossil fuel type *i* in the year *y* (CO_2/mass or volume unit)
K : Fuel types combusted in process *j* during the year *y*

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

$NCV_{i,y}$: Net calorific value of fossil fuel type *i*(GJ/mass or volume unit)
$EF_{CO2,i,y}$: CO_2 emission factor of fuel type *i* in the year y (tCO_2/GJ)

Project emission : Electricity consumption

Electricity consumption shall be calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"(EB39 Annex7 version01), where the project emission source j referred to in the tool is the total electricity consumption in the project activity.

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

Where,

$PE_{EC,y}$: Project emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ,j,y}$: Quantity of electricity consumed by the project electricity consumption source j in year y(MWh/y)
$EF_{EL,j,y}$: Emission factor for electricity generation for source *j* in year *y*(tCO_2/MWh)
$TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity in year y

Project emission: Physical leakage

Physical leakage shall be calculated using the methodological tool EB66 Annex32 (version 01.0.0) "Project and leakage emissions from anaerobic digesters"

Step 1: Determination of the quantity of methane produced in the digester ($Q_{CH4,y}$)
There are two different procedures to determine the quantity of methane produced in the digester in year *y* ($Q_{CH4,y}$). For large scale projects, only Option 1 shall be used. For small scale projects, project participants may choose between Option 1 or Option 2.

- Option 1: Procedure using monitored data
- Option 2: Procedure using a default value

Option 2: Procedure using a default value is chosen.
Under this option, the flow of the biogas is measured and a default value is used for the fraction of methane in the biogas, as follows:

$$Q_{CH4,y} = Q_{biogas,y} \cdot f_{CH4,default} \cdot \rho_{CH4}$$

Where:
$Q_{CH4,y}$: Quantity of methane produced in the digester in year *y* (t CH_4)
$Q_{biogas,y}$: Amount of biogas collected at the digester outlet in year *y* (Nm^3 biogas)
$f_{CH4,default}$: Default value for the fraction of methane in the biogas (Nm^3 CH_4 / Nm^3 biogas)
ρ_{CH4} : Density of methane at normal conditions (t CH_4 / Nm^3 CH_4)

Step 2: Determination of project emissions from electricity consumption ($PE_{EC,y}$)
⇨ Calculated at" Project emission : Electricity consumption" above.

Step 3: Determination of project emissions from fossil fuel consumption ($PE_{FC,y}$)
⇨ Calculated at" Project emission : Fossil fuel consumption" above.

Step 4: Determination of project emissions of methane from the anaerobic digester ($PE_{CH4,y}$)
Project emissions of methane from the anaerobic digester include emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester. These emissions are calculated using a default emission factor ($EF_{CH4,default}$), as follows:

$$PE_{CH4,y} = Q_{CH4,y} \cdot EF_{CH4,default} \cdot GWP_{CH4}$$

Where:
$PE_{CH4,y}$: Project emissions of methane from the anaerobic digester in year *y* (t CO_2e)
$Q_{CH4,y}$: Quantity of methane produced in the anaerobic digester in year *y* (t CH_4)
$EF_{CH4,default}$: Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)
GWP_{CH4} : Global warming potential of CH_4 (t CO_2 / t CH_4)

Step 5: Determination of project emissions from flaring of biogas ($PE_{flare,y}$)
If the project activity includes flaring of biogas, then project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the "Tool to determine project emissions from flaring gases containing methane"(EB28 Annex13). The following applies:

• For small scale projects, project participants may adopt a default value for the fraction of methane in the biogas ($f_{CH4,default}$) in applying the tool; and
• The tool provides default factors for the flare efficiency, which can be used for large or small scale projects as described in the tool.

⇨ Tool updated to EB 68 Annex 15 (version 02.0.0) "Project emissions from flaring".

According to methodological tool "Project emissions from flaring"(version 02.0.0), the calculation procedures provided below determine the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to flare ($F_{CH4,RG,m}$). The project emissions calculation procedure is given in the following steps:

Step.5.1 - Determination of the methane mass flow rate in the residual gas
This step determines the mass flow of methane ($F_{CH4,\ m}$) as kg unit in the residue gaseous stream in the minute "m" as per the guidance given in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0).

$F_{CH4,m}$,which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0) provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$F_{i,t}$	kg/h	Mass flow of greenhouse gas *i* (CO_2, CH_4, N_2O, SF_6 or a PFC) in the gaseous stream in time interval *t*

The mass flow of a particular greenhouse gas is calculated based on measurements of: (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gas stream and (c) the gas composition and water content. The flow and volumetric fraction may be measured on a dry basis or wet basis. The tool covers the possible measurement combinations, providing six different calculation options to determine the mass flow of a particular greenhouse gas.

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

Option D is applicable for the proposed project.

Option D:

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or
- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60℃ (333.15K) at the flow measurement point.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using the following equations:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

and

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis(m^3 dry gas/h)
$v_{i,t,db}$ = Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis(m^3 gas i/m^3 dry gas)
$\rho_{i,t}$ = Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3gas *i*)
P_t = Absolute pressure of the gaseous stream in time interval *t*(Pa)
MM_i = Molecular mass of the gaseous gas *i* (kg/kmol)
R_u = Universal ideal gases constant (Pa.m^3/kmol.K)
T_t = Temperature of the gaseous stream in time interval *t*(K)

$$V_{t,db} = M_{t,db}/\rho_{t,db}$$

and

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t}$$

Where:

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$M_{t,db}$ = Mass flow of the gaseous stream in time interval *t* on a dry basis (kg/h)
$\rho_{t,db}$ = Density of the gaseous stream in time interval *t* on a dry basis (kg dry gas/m^3 dry gas)
P_t = Pressure of the gaseous stream in time interval *t*(Pa)
T_t = Temperature of the gaseous stream in time interval *t*(K)
$MM_{t,tb}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated as follows:

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$$

Where:

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis(kg dry gas/kmol dry gas)
$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis(m^3 gas *k*/m^3 dry gas)
MM_k = Molecular mass of gas *k* (kg/kmol)
k = All gases, except H2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See available simplification

The determination of the molecular mass of the gaseous stream ($MMt_{, db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.Underlying methodology is AMS I-C.(version 19). Methodology does not specify simplification, hence simplification adopted by the tool has been taken into account.

Step. 5.2 Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares, there is the option to apply a default value or determine the efficiency based on monitored data. For open flares, a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

Open flare
In case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Enclosed flare
In case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($\eta_{flare,m}$) and shall document in the CPA-DD which option is selected.

Option A: Apply a default value for flare efficiency.
Option B: Measure the flare efficiency.

For enclosed flares that are defined as low height flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Option A or B. For example, the applied should be 80%, rather than 90%, and if for example the measured value was 90%, then the value to be used shall correspond to 89%.

In the case of enclosed flare, Option A is chosen.

The flare efficiency for the minute *m* ($\eta_{flare,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:
(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and

(2) The flame is detected in minute *m* ($Flame_m$). Otherwise $\eta_{flare,m}$ is 0%.

Step 5.3: Calculation of project emissions from flaring
Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

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

Where:
$PE_{flare,y}$: Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}: Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)

$F_{CH4,RG,m}$: Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$: : Flare efficiency in minute m

4. Leakage Calculation

According to Leakage emissions procedure of the Methodological Tool "Project and leakage emissions from anaerobic digesters" (version 01.0.0) leakage is as follow;

$LE_{AD, y} = LE_{storage, y} + LE_{comp, y}$

Where:
$LE_{AD, y}$ = Leakage emissions associated with the anaerobic digester in year *y*(tCO_2e)
$LE_{storage, y}$ = Leakage emissions associated with storage of digestate in year *y*(tCO_2e)
$LE_{comp, y}$ = Leakage emissions associated with composting digestate in year *y*(tCO_2e)

Step 1: Determination of leakage emissions associated with storage of digestate($LE_{storage, y}$)

This step applies in the case that the digestate is stored under the following anaerobic conditions:
- In an un-aerated lagoon that has a depth of more than one meter; or
- In a SWDS, including stockpiles that are considered a SWDS as per the definitions section.

Storage of digestate under anaerobic conditions can cause CH_4 emissions due to further anaerobic digestion of the residual biodegradable organic matter. The procedure for determining $LE_{storage,y}$ is distinguished for liquid digestate and solid digestate.

Step 2: Determination of leakage emissions associated with composting digestate($LE_{COMP, y}$)

$LE_{COMP, y}$ shall be calculated using the methodological tool "Project and leakage emission from composting" (version 01.0.0). The term $PE_{COMP, y} + LE_{COMP, y}$ in the methodological tool "Project and leakage emissions from composting" (version 01.0.0) provides the value for $LE_{COMP, y}$ of this tool.

As per paragraph 47, methodology AMS I-C.(version 19) "If the energy generating equipment currently being utilized is transferred from outside the boundary to the project activity, leakage is to be considered". It will be proved at CPA level.

As per paragraph 48, methodology AMS I-C.(version 19) "In cases where the collection/ processing/ transportation of biomass residues is outside the project boundary CO2 emissions from the collection processing/transportation of biomass residues to the project site shall be taken into account as leakage". It will be proved at CPA level.

5. Emission Reductions

$$\boldsymbol{ER_y = BE_{total,y} – PE_{total,y} - LE_y}$$

Where,
$\boldsymbol{ER_y}$ Emission reductions in year *y* (tCO_2e)
$\boldsymbol{BE_{total,y}}$ Baseline emissions in year *y* (tCO_2e)
$\boldsymbol{PE_{total,y}}$ Project emissions in year *y* (tCO_2 e)
$\boldsymbol{LE_y}$ Leakage emissions in year *y* (tCO_2e)

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	$EF_{grid,OM, y}$
Unit	tCO_2/ MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6922
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system(version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea (2008, 2009, 2010) (KEPCO)'.
Purpose of data	Applicable to electricity baseline and project emission
Additional comment	This data has been calculated at the time of PDD submission and will not be changed during the first crediting period.

Data / Parameter	$EF_{grid,BM, y}$
Unit	tCO_2/ MWh
Description	Build margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6412
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system (version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea 2010 (KEPCO)'.
Purpose of data	Applicable to electricity baseline and project emission
Additional comment	This data has been calculated at the time of PDD submission and will not be changed during the first crediting period.

Data / Parameter	$EF_{grid, CM, y}$
Unit	tCO_2/ MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.6667
Choice of data or Measurement methods and procedures	This value is calculated according to "Tool to calculate the emission factor for an electricity system(version 04.0.0)". Applied value was calculated based on 'Statistics of Electric Power in Korea (KEPCO)'.
Purpose of data	Applicable to electricity baseline and project emission
Additional comment	- w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period

Data / Parameter	$f_{CH4,default}$
Unit	Nm^3 CH_4 / Nm^3 biogas
Description	Default value for the fraction of methane in the biogas
Source of data	The default value was derived based on reported values from registered projects and research papers (Davidsson, 2007)
Value(s) applied	0.6
Choice of data or Measurement methods and procedures	Methodological Tool "Project and leakage emissions from anaerobic digesters" (version 01.0.0)
Purpose of data	Applicable to project emission
Additional comment	N/A

Data / Parameter	ρ_{CH4}
Unit	t CH_4 / Nm^3 CH_4
Description	Density of methane at normal conditions
Source of data	Technical literature
Value(s) applied	0.00067
Choice of data or Measurement methods and procedures	Methodological Tool "Project and leakage emissions from anaerobic digesters" (version 01.0.0)
Purpose of data	Applicable to project emission
Additional comment	Normal conditions are defined as 20℃ and 1 atm pressure

Data / Parameter	$EF_{CH4,default}$
Unit	t CH_4 leaked / t CH_4 produced
Description	Default emission factor for the fraction of CH4 produced that leaks from the anaerobic digester
Source of data	IPCC (2006), Flesch et al. (2011) and Kurup (2003)
Value(s) applied	To be determined with respect to each CPA type of digester
Choice of data or Measurement methods and procedures	Use the default value corresponding to the type of digester used in the project activity. The digester type shall be identified by manufacturer information. If this is not possible, then the factor 0.1 shall be applied (upper range of the IPCC values). • 0.028: Digesters with steel or lined concrete or fiberglass digesters and a gas holding system (egg shaped digesters) and monolithic construction; • 0.05: UASB type digesters, floating gas holders with no external water seal; • 0.10: Digesters with unlined concrete/ferrocement/brick masonry arched type gas holding section; monolithic fixed dome digesters, covered anaerobic lagoon.
Purpose of data	Applicable to project emission
Additional comment	N/A

Data / Parameter	GWP_{CH4}
Unit	tCO_2e / tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC
Value(s) applied	25 for the second commitment period.
Choice of data or Measurement methods and procedures	IPCC
Purpose of data	Applicable to Project emission
Additional comment	N/A

Data / Parameter	$SPEC_{flare}$
Unit	Temperature - ℃ Flow rate or heat flux - kg/h or m^3/h Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	To be determined with respect to each CPA
Choice of data or Measurement methods and procedures	Document in the CPA the flare specifications set by the manufacturer for the correct operation of the flare for the following parameters: (a) Minimum and maximum inlet flow rate, if necessary converted to flow rate at reference conditions or heat flux; (b) Minimum and maximum operating temperature; and (c) Maximum duration in days between maintenance events
Purpose of data	Applicable to Project emission
Additional comment	Only applicable in case of enclosed flares. The maintenance schedule is not required if Option A is selected to determine flare efficiency of an enclosed flare.

Data / Parameter	R_u
Unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	Methodological tool "Project emissions from flaring"(version 02.0.0)
Value(s) applied	0.008314472
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the Formula which density of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	N/A

Data / Parameter	MM_i
Unit	kg/kmol
Description	Molecular mass of greenhouse gas CH_4
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0)
Value(s) applied	
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the Formula which density of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	NA

Compound	Structure	Molecular mass (kg / kmol)
Carbon dioxide	CO_2	44.01
Methane	CH_4	16.04
Nitrous oxide	N_2O	44.02
Sulfur hexafluoride	SF_6	146.06
Perfluoromethane	CF_4	88.00
Perfluoroethane	C_2F_6	138.01
Perfluoropropane	C_3F_8	188.02
Perfluorobutane	C_4F_{10}	238.03
Perfluorocyclobutane	c-C_4F_8	200.03
Perfluoropentane	C_5F_{12}	288.03
Perfluorohexane	C_6F_{14}	338.04

Data / Parameter	MM_k
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"(version 02.0.0)
Value(s) applied	For gases *k* that are greenhouse gases appy values for MM_i.
Choice of data or Measurement methods and procedures	Default value
Purpose of data	To apply the formula which molecular mass of the gaseous stream in time interval *t* on a dry basis. Applicable to project emission.
Additional comment	NA

Compound	Structure	Molecular mass (kg / kmol)
Nitrogen	N_2	28.01
Oxygen	O_2	32.00
Carbon monoxide	CO	28.01
Hydrogen	H_2	2.02
Nitric oxide	NO	30.01
Nitrogen dioxide	NO_2	46.01
Sulfur dioxide	SO_2	64.06

B.6.3. Ex-ante calculations of emission reductions

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Reference to B.6.3. Ex-ante calculations of emission reductions of PART Ⅱ Generic component project activity (CPA)_Option 1.

B.7. Application of the monitoring methodology and description of the monitoring plan

B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	$EG_{BL,electricity\ y}$
Unit	MWh
Description	Quantity of net electricity supplied to the grid and/or to the on-site as a result of the implementation of the CPA project activity in year y
Source of data	Electricity meter
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	-Amount of electricity transmitted to the on-site will be measured automatically, respectively with the installed measuring instruments. -Amount of electricity transmitted to the grid will be measured automatically, respectively with the installed measuring instruments.
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	-The measuring instrument will be in compliance with the national standard or as per manufacturer's specifications. -If local/national standards and manufacturer's specification is not available, it will be calibrated as per international standard, but at least once in 3years. Accuracy : + 1% or better
Purpose of data	Applicable to baseline emission of electricity in option 2
Additional comments	NA

Data / Parameter	$Q_{biogas,y}$
Unit	Nm^3 biogas
Description	Amount of biogas collected at the digester outlet in year *y*
Source of data	Gas analyser data recorded by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Test result Data archiving : - Amount of biogas will be measured automatically, respectively with the installed measuring instruments(flow meter). - The measured data will be filed in writing monthly by CPAs implementer. CPAs implementer will keep the data documents during 12 years (10 years are credit period and 2 years are additional). Accuracy : ± 5% or better
Monitoring frequency	Continuously measurement by the flow meter. Data to be aggregated monthly and yearly
QA/QC procedures	Calibration frequency: Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years.
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$EC_{PJ,j,y}$
Unit	MWh
Description	Quantity of electricity consumed by project activity in a process j during the year y
Source of data	Data from CPA implementer provided
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Digital measurement or calculated data Data archiving : - Quantity of electricity will be measured automatically, with the installed measuring instruments (Electronic power gauge).or will be calculated using the following data (Operating time will be applied conservatively as 24 hours. Power consumption data for each facility will be applied from list of facilities spec data in A.5 "Technical description" of the CPA-DD) - The measured data will be filed in writing monthly by CPAs implementer. CPAs implementer will keep the data documents during 12 years (10 years are credit period and 2 years are additional). Accuracy : ± 1% or better
Monitoring frequency	Continuously measurement. Data to be aggregated monthly and yearly or Data to be calculated yearly(reference: Retrofitted/new installed equipment electricity consumption of Emission reduction Excel sheet)
QA/QC procedures	Calibration frequency: Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years.
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$TDL_{j,y}$
Unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	National database KEPCO in brief
Value(s) applied	To be determined every year
Measurement methods and procedures	National database KEPCO in brief "(2009) 1.Transmission & Distribution Loss in Ⅵ. Electricity sales, No.111" and link address is http://cyber.kepco.co.kr/kepco/KO/ntcob/list.do?boardCd=BRD_000098&menuCd=FN05030102
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	NA
Purpose of data	Applicable to baseline and project emission
Additional comments	The data will be updated annually to reflect

Data / Parameter	$FC_{i,j,y}$
Unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr)
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Data type : Digital measurement Recording : monthly Monitoring Frequency : continuous Data archiving : Data will be archived by Electronic/Paper mode. Accuracy : ± 5% or better
Monitoring frequency	Continuously
QA/QC procedures	Calibration frequency : Measuring instrument will be calibrated as per local/national standard or as per manufacturer's specifications. If local/national standards and manufacturer's specification is not available, it will be as per international standard, but at least once in 3 years. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should be cross-checked with available purchase invoices from the financial records
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$Flame_m$
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	CPA Implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Measure using a fixed installation optical flame detector
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations. Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Applicable to project emission
Additional comments	NA

Data / Parameter	$T_{flare,m}$
Unit	℃
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	CPA Implementer
Value(s) applied	To be determined with respect to each CPA

Measurement methods and procedures	Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment. Measurements outside the operational temperature specified by the manufacture may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare. Where more than one temperature port is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturers specifications for temperature.
Monitoring frequency	Once per minute.
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule
Purpose of data	Applicable to project emission(enclosed flare)
Additional comments	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacture's flare specifications for operating temperature are met.

Data / Parameter	$v_{i,t,db}$
Unit	m^3 gas *i*/m^3 dry gas
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a dry basis
Source of data	Characteristics analysis of the gaseous stream
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Continuous gas analyser operating in dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Applicable to project emission
Additional comments	This parameter will be monitored in Options D

Data / Parameter	$M_{t,db}$
Unit	kg/h
Description	Mass flow of the gaseous stream in time interval *t* on a dry basis
Source of data	Onsite measurements by CPA implementer (Gas flow meter data recorded)
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Calculated based on the wet basis flow measurement plus water concentration measurement
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Applicable to project emission
Additional comments	This parameter will be monitored in Options D

Data / Parameter	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval *t*
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Applicable to project emission
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being 60℃ is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval *t*
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly.
Purpose of data	Applicable to project emission
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency).

Data / Parameter	$v_{k,t,db}$
Unit	m^3 gas *k*/m^3 dry gas
Description	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis
Source of data	Onsite measurements by CPA implementer
Value(s) applied	To be determined with respect to each CPA
Measurement methods and procedures	Continuous gas analyzer operating in dry basis
Monitoring frequency	Continuous if not specified in the underlying methodology
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Applicable to project emission
Additional comments	As a simplified approach, project participants may only measure the content CH_4 and CO_2 of the residual gas and consider the remaining part as N_2.

Data / Parameter	$NCV_{i, y}$
Unit	GJ/mass or volume
Description	Net calorific value of the fuel i in the year y
Source of data	IPCC default values at the upper limit of uncertainly at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2(Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	To be determined with respect to fuel i that each CPA used
Measurement methods and procedures	NA
Monitoring frequency	Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	NA
Purpose of data	Applicable to project emission on-site consumption of fossil fuel
Additional comment	N/A

Data / Parameter	NCV_k
Unit	GJ/mass or volume
Description	Net calorific value of biomass type *k*
Source of data	Measurement in laboratories according to relevant national/international standard
Value(s) applied	To be determined with respect to biomass *k* that each CPA used
Measurement methods and procedures	Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period. Measure the NCV based on dry biomass. Check the consistency of the measurements by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC.(If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements)
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	NA
Purpose of data	Applicable of baseline emission for project activities
Additional comment	N/A

B.7.2. Description of the monitoring plan for a generic CPA

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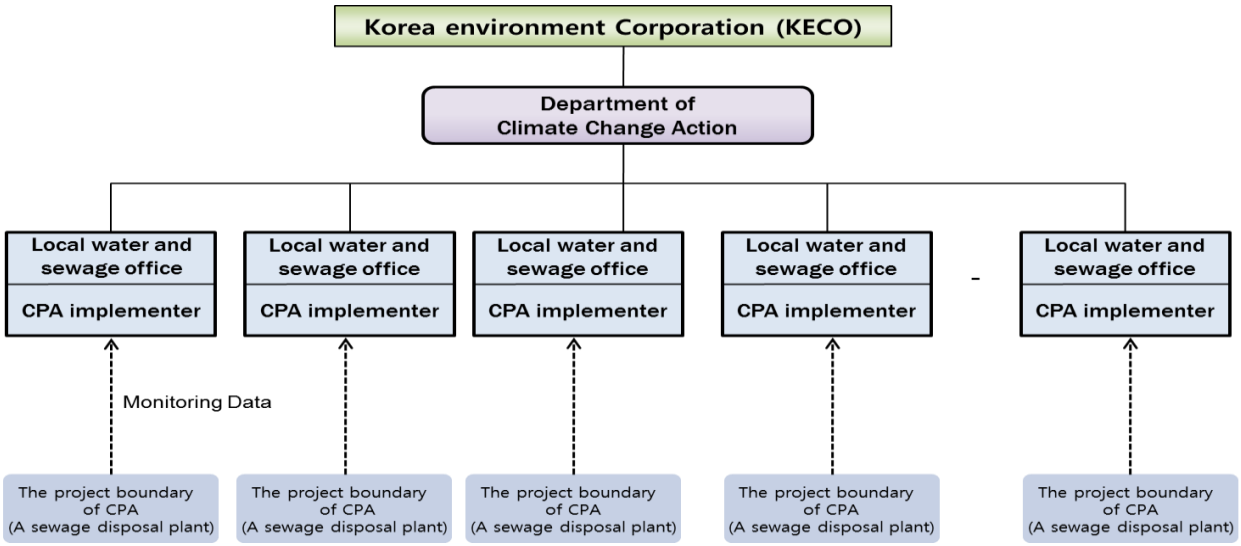
In order to ensure all CPAs are monitored and verified as per the applied monitoring methodology, the CME has prepared a comprehensive monitoring plan for all the CPAs to be included in the PoA. Furthermore, the CME will conduct periodical inspection of CPAs randomly at any given time in a year.

For monitoring activity, CDM Operational Manual will be provided to each CPA. The Manual has information on general procedure and responsibilities of each party to personnel training and templates for data recording.

Monitoring Structure

Each CPA is responsible for operation and maintenance of the plants, the KECO as CME is responsible

for operation of this PoA, data collection and management and handling of irregularity. Data monitored and recorded in accordance with CDM Operational Manual and any guideline CME provided shall be reported to CME periodically. CME shall keep and manage the data with each CPA's identification.



<Figure 14. Managing structure of the CDM monitoring>

The key considerations for developing monitoring plans in individual CPAs are discussed below.

1. Introduction

The monitoring plan would present a plan to meet the requirements for the collection, processing and reporting of data. It will describe the management systems and procedures to be implemented by CME upon implementation of each CPA in order to ensure consistency between the project operation as well as monitoring, processing and reporting of data required for the calculation of emission reductions(ERs).

2. Obligations of CPA implementer

It will be the responsibility of the CPA implementer to comply with the monitoring plan provided by CME of the PoA.

3. Recommendations for improvisation in the monitoring plan

During the course of monitoring and verification; if the CPA implementer is of the opinion that there exist potential to improve the monitoring process which would eventually result in improving the quality of monitoring and reporting of emission reductions, then such quality enhancement measures may be implemented in the monitoring process.

4. Detailed description on monitoring of each of the data parameters

This section will contain a detailed description of the data collection and reporting measures to be implemented for each of the data parameter which is monitored under the CPA. Templates are made to record the data to be monitored. The monitoring personnel of the CME would be provided with such templates. In-house training shall be imparted to plant personnel(at the CPA site) for the efficient monitoring/recording of the data and to translate the same into the computation of emission reductions. This section will address the following criteria for each of the monitoring data parameter;

1. Description of the primary source of data from where the information pertaining to the data parameter will be collected.
2. Description of the data collection process
3. Description of the data recording process
4. Description of the measurement instruments

6. Description of the data storage process
7. Other information, if required

The other relevant data will be recorded by the CPA owners and would be provided on quarterly basis to the CME. The data received will be archived electronically for computations of emission reductions on annual basis. Such archived data will be kept until two years after the end of the crediting period or the issuance of CERs whichever is later. Each small scale CPA shall follow all the provision of the PoA including that related to monitoring.

5. Procedures for emergency preparedness for cases where emergencies cause unintended emissions:
During operation of the CPA under the PoA, no emergencies are expected to cause unintended emissions.

6. Procedures for review of the reported results/data:
To minimize the possible errors in the process of data collection, the entry of data gathered during onsite visits by the monitoring personnel of the CME will be compared with the data submitted by CPA implementers throughout the year. The data will be reviewed by the CME and a comparison between the data sent by the CPA implementers and the data obtained during the onsite visit by the monitoring personnel shall be performed to ensure that the data are consistent and correct.

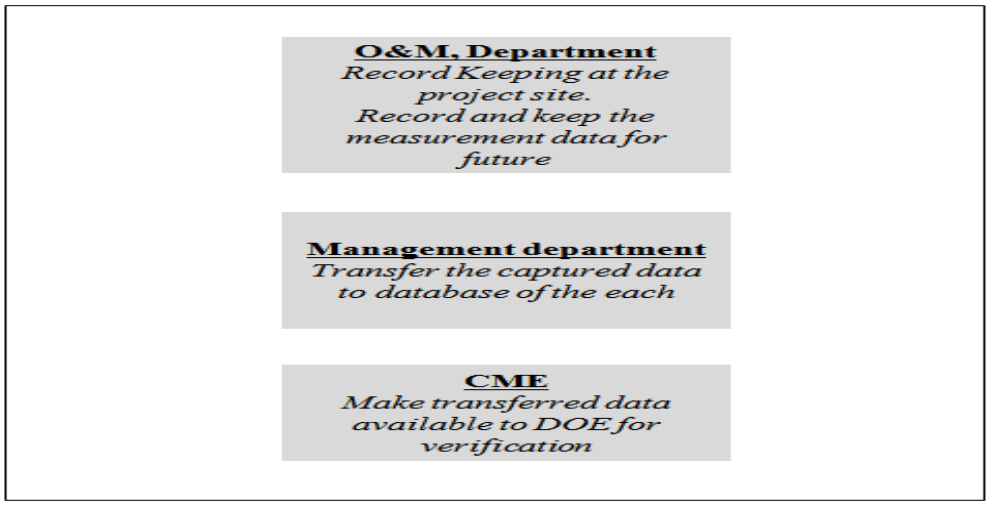
Monitoring plan

In case of selling electricity to the national grid, the CPA shall be required to monitor the quantity of net electricity supplied to the national grid. Measurements are undertaken using energy meters. Calibration should be undertaken as prescribed in the General Guidelines to SSC CDM Methodologies and relevant national standards. Measurement results shall be cross checked with records for sold electricity (e.g. invoices/receipts). The net electricity export/supplied to a national grid is the difference between the measured quantities of the national grid electricity export and the import

In case of consuming electricity at on-site, the CPA shall be required to monitor the quantity of net electricity supplied to on-site. Measurements are undertaken using energy meters. Calibration should be undertaken as prescribed in the General Guidelines to SSC CDM Methodologies and relevant national standards. If electricity consumption for on-site can not be measured by using any measurements it will be calculated using the following data (Operating time will be applied conservatively as 24 hours. Power consumption data for each facility will be applied from the list of facilities spec data).

OPERATIONAL AND MANAGEMENT STRUCTURE FOR MONITORING
The monitoring of the emission reductions will be carried out according to the scheme shown in Figure 11. The project entity CME will engage its CDM advisor to assure that all monitoring requirements are met. Within the CPA Implementer, a monitoring officer is appointed to carry the day-to-day supervision responsibility. The first step is the measurement of the electrical and thermal energy supplied to the grid and reporting of daily operations, which will be carried out by the plant operation staff.

The monitoring officer will be responsible for verification of the measurement. The monitoring officer will prepare operational reports of the project activity. Finally, the monitoring reports will be reviewed by CME.



<Figure 15. Management structure in order to monitor emission reductions>

Appendix 1: Contact information on entity/individual responsible for the PoA

Organization	Korea Environment Corporation
Street/P.O. Box	Environmental Research Complex, Kyungseo-dong, Seo-gu, Incheon, 404-708, Republic of Korea
Building	
City	Incheon
State/Region	Incheon
Postcode	404-708
Country	Republic of Korea
Telephone	
Fax	
E-mail	
Website	http://www.keco.or.kr
Contact person	
Title	Assistant Manager
Salutation	Ms.
Last name	Kim
Middle name	
First name	Eun-Young
Department	Department of Climate Change Action / Carbon Market Promotion Team)
Mobile	
Direct fax	+82-32-590-3429
Direct tel.	+82-32-590-3498
Personal e-mail	ecomania@keco.or.kr

Appendix 2: Affirmation regarding public funding

The PoA does not receive any public funding from Parties included in Annex I of the UNFCCC.

Appendix 3: Application of methodology(ies)

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

Fuel consumption, net caloric value and electricity generation for plants in the Operating Margin

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2008	Honam	#1	793,048	808	177		5,089	9,310	8,484		1,614,014
2008	Honam	#2	887,772	1,225	167		5,105	9,309	8,492		1,816,464
2008	Samchonpo	#1	1,759,936		137		5,524		4,577		4,230,470
2008	Samchonpo	#2	1,628,693		1,065		5,506		8,373		3,931,527
2008	Samchonpo	#3	1,635,809		614		5,506		8,349		4,024,666
2008	Samchonpo	#4	1,662,981		726		5,524		8,349		4,118,892
2008	Samchonpo	#5	1,718,759		874		4,839		8,550		3,779,114
2008	Samchonpo	#6	1,844,647		448		4,836		8,550		4,071,070
2008	Yonghung	#1	1,894,596		5,594		5,871		8,246		5,137,490
2008	Yonghung	#2	1,881,013		3,033		5,870		8,446		5,112,704
2008	Yonghung	#3	1,694,625		2,173		5,767		9,564		4,535,951
2008	Yonghung	#4	1,217,547		769		5,771		8,416		3,193,481
2008	Boryeong	#1	1,697,622		566		5,402		8,496		4,017,302
2008	Boryeong	#2	1,328,646		196		5,442		8,496		3,247,137
2008	Boryeong	#3	1,528,112		233		5,377		10,876		3,733,602
2008	Boryeong	#4	1,694,212		339		5,387		8,558		4,162,971
2008	Boryeong	#5	1,503,611		642		5,380		9,208		3,677,963
2008	Boryeong	#6	1,704,157		301		5,386		8,655		4,170,094
2008	Boryeong	#7	1,102,498		2,696		5,451		8,139		2,878,738
2008	Boryeong	#8	227,312		1,060		5,401		4,824		748,005
2008	Taean	#1	1,493,418		589		5,636		8,366		3,894,659
2008	Taean	#2	1,570,393		146		5,639		8,398		4,093,884
2008	Taean	#3	1,442,632		551		5,632		8,396		3,763,910
2008	Taean	#4	1,582,461		122		5,638		8,224		4,119,808
2008	Taean	#5	1,566,721		363		5,660		8,226		4,089,287
2008	Taean	#6	1,419,495		626		5,662		8,341		3,711,227

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2008	Taean	#7	1,285,747		1,224		5,700		8,355		3,482,731
2008	Taean	#8	1,553,992		635		5,666		8,393		4,186,293
2008	Hadong	#1	1,478,000		355		5,579		8,377		3,827,102
2008	Hadong	#2	1,551,832		311		5,569		8,344		4,012,667
2008	Hadong	#3	1,573,892		474		5,575		8,475		4,074,310
2008	Hadong	#4	1,469,828		495		5,572		8,466		3,804,790
2008	Hadong	#5	1,592,246		256		5,573		8,487		4,114,218
2008	Hadong	#6	1,525,471		521		5,572		8,419		3,953,083
2008	Hadong	#7	310,138		2,900		5,798		7,546		870,781
2008	Dangjin	#1	1,559,086		60		5,520		8,555		3,991,074
2008	Dangjin	#2	1,621,753		136		5,501		8,537		4,162,369
2008	Dangjin	#3	1,474,550		751		5,513		8,554		3,800,792
2008	Dangjin	#4	1,457,994		771		5,503		8,464		3,737,406
2008	Dangjin	#5	1,490,658		250		5,570		8,596		3,908,658
2008	Dangjin	#6	1,509,171		132		5,562		8,537		4,006,307
2008	Dangjin	#7	1,264,913		645		5,581		7,678		3,336,619
2008	Dangjin	#8	1,494,311		314		5,566		8,543		3,992,732
2008	Ulsan	#1		30,689	565			9,440	8,635		114,753
2008	Ulsan	#2		29,228	562			9,444	8,664		108,931
2008	Ulsan	#3		32,541	480			9,440	8,664		123,706
2008	Ulsan	#4		228,138	4,016			9,516	8,662		945,479
2008	Ulsan	#5		163,748	2,965			9,530	8,662		678,426
2008	Ulsan	#6		225,645	3,757			9,513	8,662		937,531
2008	Yeongnam	#1		59,763	1,476			9,674	8,446		229,316
2008	Yeongnam	#2		40,030	802			9,676	8,454		149,357
2008	Yeosu	#1		32,576	202			9,449	8,371		130,854
2008	Yeosu	#2		111,854	341			9,447	8,352		454,052
2008	Pyeongtaek	#1		91,937	77	2,562		9,423	8,525	12,235	386,361
2008	Pyeongtaek	#2		125,789	90	4,744		9,430	8,529	12,312	534,121
2008	Pyeongtaek	#3		135,720	145	4,232		9,426	8,426	12,260	576,432
2008	Pyeongtaek	#4		86,454	100	3,020		9,418	8,493	12,309	365,269

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2008	Namjeju	#3		132,984	146			9,415	8,543		559,817
2008	Namjeju	#4		119,301	127			9,356	8,587		517,866
2008	Jeju	#2		84,258	81			9,423	8,491		336,676
2008	Jeju	#3		89,652	101			9,421	8,456		357,666
2008	Seoul	#4			1	55,095			6,650	12,391	258,052
2008	Seoul	#5			0	138,068				12,386	596,641
2008	Incheon	#1				28,582				12,388	141,085
2008	Incheon	#2				30,186				12,389	152,576
2008	Incheon	#3			292	32,472			8,478	12,391	162,092
2008	Incheon	#4			238	27,637			8,458	12,386	139,637
2008	Pyongtaek	C/C				150,276				12,397	903,201
2008	Ilsan	C/C				636,633				12,383	3,491,175
2008	Bundang	C/C				651,005				12,389	3,748,232
2008	Ulsan	C/C				655,938				12,295	4,454,326
2008	Seoincheon	C/C			721	1,436,788				12,392	10,308,626
2008	Shinincheon	C/C				1,607,180				12,391	11,531,252
2008	Boryeong	C/C				894,790				12,384	6,126,641
2008	Incheon	C/C				459,923				12,347	3,420,631
2008	Busan	C/C				1,456,370				12,382	10,848,484
2008	Hallim	C/C			6,883				8,535		23,547
2008	Anyang	C/C				292,931				12,472	1,638,638
2008	Bucheon	C/C				302,746				11,813	1,657,898
2008	POSCO POWER	C/C				587,956				12,392	3,328,129
2008	GS Bugog	C/C				709,116				12,756	5,509,092
2008	Yulchon	C/C				347,123				12,389	2,488,267
2008	Namjeju	D/P		19,875	482			9,392	8,548		93,201
2008	Jeju	G/T			503				8,457		643
2008	Jeju	D/P		46,728				9,407			223,630
2009	Honam	#1	923,895	471	167	0	5,012	9,323	8,510		1,843,823
2009	Honam	#2	853,508	818	201	0	4,982	9,314	8,507		1,696,597

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2009	Samchonpo	#1	1,611,736	0	299	0	5,582		8,496		3,881,067
2009	Samchonpo	#2	1,596,153	0	447	0	5,543		8,446		3,869,863
2009	Samchonpo	#3	1,818,061	0	110	0	5,545		8,490		4,494,850
2009	Samchonpo	#4	1,552,530	0	486	0	5,557		8,384		3,873,780
2009	Samchonpo	#5	1,909,143	0	151	0	4,850		8,537		4,225,306
2009	Samchonpo	#6	1,765,537	0	576	0	4,854		8,557		3,902,690
2009	Yonghung	#1	2,316,758	0	1,996	0	5,681		8,446		6,121,660
2009	Yonghung	#2	2,437,083	0	1,632	0	5,654		8,218		6,309,794
2009	Yonghung	#3	2,533,024	0	966	0	5,642		8,469		6,711,338
2009	Yonghung	#4	2,740,096	0	117	0	5,647		6,764		7,183,514
2009	Boryeong	#1	896,958	0	1,982	0	5,259		8,496		2,076,329
2009	Boryeong	#2	1,361,908	0	5,689	0	5,292		8,385		3,148,655
2009	Boryeong	#3	1,686,579	0	180	0	5,363		8,476		4,153,516
2009	Boryeong	#4	1,554,579	0	672	0	5,337		8,551		3,823,603
2009	Boryeong	#5	1,681,591	0	516	0	5,354		8,425		4,136,937
2009	Boryeong	#6	1,538,187	0	935	0	5,378		8,363		3,802,516
2009	Boryeong	#7	1,438,768	0	568	0	5,390		8,319		3,720,811
2009	Boryeong	#8	1,701,650	0	341	0	5,384		8,661		4,417,673
2009	Taean	#1	1,561,372	0	348	0	5,646		8,400		4,087,057
2009	Taean	#2	1,483,233	0	22	0	5,651		8,248		3,858,541
2009	Taean	#3	1,550,278	0	209	0	5,650		8,327		4,041,441
2009	Taean	#4	1,471,251	0	410	0	5,641		8,351		3,843,816
2009	Taean	#5	1,409,802	0	978	0	5,672		8,369		3,689,068
2009	Taean	#6	1,548,690	0	285	0	5,688		8,393		4,064,658
2009	Taean	#7	1,576,347	0	394	0	5,674		8,437		4,232,409
2009	Taean	#8	1,382,469	0	1,397	0	5,676		8,385		3,730,433
2009	Hadong	#1	1,647,434	0	341	0	5,469		8,416		4,064,233
2009	Hadong	#2	1,551,648	0	648	0	5,428		8,456		3,799,030
2009	Hadong	#3	1,554,931	0	473	0	5,462		8,442		3,862,769
2009	Hadong	#4	1,634,941	0	226	0	5,465		8,441		4,049,790
2009	Hadong	#5	1,543,027	0	547	0	5,467		8,434		3,848,711

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2009	Hadong	#6	1,637,877	0	286	0	5,465		8,407		4,085,588
2009	Hadong	#7	1,500,309	0	72	0	5,614		8,497		4,068,510
2009	Hadong	#8	1,169,132	0	692	0	5,625		7,654		3,153,402
2009	Dangjin	#1	1,601,422	0	677	0	5,425		8,602		4,025,605
2009	Dangjin	#2	1,572,097	0	291	0	5,423		8,547		3,964,389
2009	Dangjin	#3	1,669,969	0	155	0	5,431		8,575		4,232,358
2009	Dangjin	#4	1,658,923	0	110	0	5,432		8,585		4,195,301
2009	Dangjin	#5	1,324,949	0	582	0	5,445		8,553		3,400,082
2009	Dangjin	#6	1,330,803	0	517	0	5,468		8,530		3,471,850
2009	Dangjin	#7	1,609,342	0	133	0	5,478		8,564		4,172,321
2009	Dangjin	#8	1,334,679	0	625	0	5,513		8,550		3,531,321
2009	Ulsan	#1	0	30,963	35	0		9,415	8,767		116,425
2009	Ulsan	#2	0	27,250	41	0		9,416	8,689		104,292
2009	Ulsan	#3	0	7,139	35	0		9,399	8,631		26,061
2009	Ulsan	#4	0	253,330	2,938	0		9,486	8,517		1,058,708
2009	Ulsan	#5	0	313,474	2,805	0		9,488	8,619		1,318,789
2009	Ulsan	#6	0	288,842	2,460	0		9,491	8,601		1,215,616
2009	Yeongnam	#1	0	108,767	764	0		9,681	8,657		437,034
2009	Yeongnam	#2	0	104,675	647	0		9,684	8,709		415,404
2009	Yeosu	#1	0	113,633	187	0		9,419	8,357		466,519
2009	Yeosu	#2	0	193,394	203	0		9,427	7,792		805,262
2009	Pyeongtaek	#1	0	56,671	354	2,922		9,456	11,684	12,082	251,576
2009	Pyeongtaek	#2	0	280,992	696	4,203		9,388	11,900	12,118	1,211,425
2009	Pyeongtaek	#3	0	282,894	581	4,046		9,378	11,595	12,242	1,225,561
2009	Pyeongtaek	#4	0	192,380	545	3,838		9,399	10,619	12,263	834,285
2009	Namjeju	#3	0	140,564	143	0		9,387	8,510		550,851
2009	Namjeju	#4	0	153,841	89	0		9,385	8,529		603,417
2009	jeju	#2	0	82,010	103	0		9,360	8,495		324,784
2009	jeju	#3	0	91,221	72	0		9,348	8,537		356,297
2009	Seoul	#4	0	0	0	36,893				12,397	157,606
2009	Seoul	#5	0	0	0	91,258				12,393	412,265

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2009	Incheon	#1	0	0	0	15,168				12,390	72,854
2009	Incheon	#2	0	0	0	15,317				12,391	76,672
2009	Incheon	#3	0	0	47	2,411			8,550	12,406	11,865
2009	Pyongtaek	C/C	0	0	0	80,050				12,392	483,959
2009	Ilsan	C/C	0	0	0	595,190				12,389	3,270,241
2009	Bundang	C/C	0	0	13,142	541,739			0	12,181	3,108,338
2009	Ulsan	C/C	0	0	0	489,946				12,200	3,299,104
2009	Seoincheon	C/C	0	0	0	1,061,332				12,392	7,503,395
2009	Shinincheon	C/C	0	0	0	1,394,939				12,391	9,901,080
2009	Boryeong	C/C	0	0	86	543,342			0	12,377	3,655,848
2009	Incheon	C/C	0	0	0	806,154				12,439	6,075,599
2009	Busan	C/C	0	0	0	1,247,488				12,400	9,268,113
2009	Anyang	C/C	0	0	0	202,108				14,866	1,301,286
2009	Bucheon	C/C	0	0	0	230,085				15,023	1,556,502
2009	POSCO POWER	C/C	0	0	0	342,724				12,391	1,859,273
2009	GS Bugog	C/C	0	0	0	603,232				13,228	4,344,271
2009	Yulchon	C/C	0	0	0	282,344				12,397	1,995,914
2009	Namjeju	D/P	0	29,527	275	0		9,407	8,498		136,189
2009	Jeju	G/T	0	0	626	0			8,503		842
2009	Jeju	D/P	0	72,724	0	0		6,082			345,163
2010	Honam	#1	661,468	1855	301	0	5,014	9,321	8,458		1,321,140
2010	Honam	#2	722,994	897	350	0	5,057	9,322	8,482		1,462,407
2010	Samchonpo	#1	1,899,819	0	518	0	5,385		8,466		4,433,574
2010	Samchonpo	#2	1,891,944	0	421	0	5,388		8,457		4,418,264
2010	Samchonpo	#3	1,581,512	0	1,261	0	5,373		8,478		3,766,380
2010	Samchonpo	#4	1,909,672	0	369	0	5,358		8,473		4,544,757
2010	Samchonpo	#5	1,949,826	0	293	0	4,714		8,563		4,174,333
2010	Samchonpo	#6	1,758,651	0	573	0	4,718		8,557		3,767,928
2010	Yonghung	#1	2,201,446	0	2,189	0	5,432		8,387		5,558,681
2010	Yonghung	#2	2,264,564	0	1,531	0	5,433		8,381		5,627,774

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2010	Yonghung	#3	2,778,041	0	739	0	5,386		8,391		6,887,344
2010	Yonghung	#4	2,821,533	0	663	0	5,379		8,381		6,943,045
2010	Boryeong	#1	1,771,953	0	732	0	5,176		8,402		4,012,817
2010	Boryeong	#2	1,635,347	0	1,068	0	5,175		8,353		3,706,927
2010	Boryeong	#3	1,618,460	0	464	0	5,206		8,321		3,855,846
2010	Boryeong	#4	1,775,851	0	289	0	5,206		8,349		4,232,288
2010	Boryeong	#5	1,604,934	0	911	0	5,201		8,313		3,817,181
2010	Boryeong	#6	1,778,254	0	359	0	5,202		8,317		4,226,837
2010	Boryeong	#7	1,670,727	0	662	0	5,244		8,322		4,189,558
2010	Boryeong	#8	1,493,422	0	439	0	5,255		8,316		3,787,312
2010	Taean	#1	1,512,930	0	865	0	5,458		8,428		3,817,336
2010	Taean	#2	1,626,596	0	518	0	5,427		8,429		4,058,392
2010	Taean	#3	1,506,479	0	476	0	5,433		8,436		3,776,949
2010	Taean	#4	1,656,710	0	296	0	5,456		8,422		4,165,579
2010	Taean	#5	1,450,465	0	680	0	5,491		8,437		3,657,234
2010	Taean	#6	1,319,263	0	1,094	0	5,486		8,428		3,339,271
2010	Taean	#7	1,521,262	0	879	0	5,469		8,430		3,940,580
2010	Taean	#8	1,674,579	0	240	0	5,456		8,431		4,335,230
2010	Hadong	#1	1,651,998	0	386	0	5,263		7,561		3,948,643
2010	Hadong	#2	1,758,216	0	133	0	5,262		8,421		4,181,012
2010	Hadong	#3	1,760,793	0	94	0	5,264		8,671		4,229,016
2010	Hadong	#4	1,623,350	0	610	0	5,260		8,416		3,877,595
2010	Hadong	#5	1,762,407	0	369	0	5,259		8,643		4,210,179
2010	Hadong	#6	1,642,064	0	367	0	5,263		8,423		3,972,047
2010	Hadong	#7	1,314,119	0	674	0	5,528		8,474		3,497,189
2010	Hadong	#8	1,586,695	0	34	0	5,525		8,578		4,221,464
2010	Dangjin	#1	1,802,866	0	89	0	5,140		8,294		4,240,235
2010	Dangjin	#2	1,812,592	0	168	0	5,133		8,522		4,271,208
2010	Dangjin	#3	1,660,911	0	430	0	5,140		8,532		3,924,887

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2010	Dangjin	#4	1,593,667	0	974	0	5,134		8,469		3,757,184
2010	Dangjin	#5	1,676,374	0	332	0	5,198		8,533		4,133,329
2010	Dangjin	#6	1,722,658	0	157	0	5,195		8,520		4,242,960
2010	Dangjin	#7	1,572,939	0	347	0	5,207		8,534		3,870,155
2010	Dangjin	#8	1,729,056	0	90	0	5,191		8,497		4,272,886
2010	Ulsan	#1	0	59,593	278	0		9,420	8,369		220,710
2010	Ulsan	#2	0	50,627	249	0		9,423	8,382		185,534
2010	Ulsan	#3	0	70,519	286	0		9,352	8,361		261,312
2010	Ulsan	#4	0	229,069	4,116	0		9,511	8,350		927,792
2010	Ulsan	#5	0	204,124	4,395	0		9,526	8,350		823,717
2010	Ulsan	#6	0	217,795	3,058	0		9,506	8,350		887,331
2010	Yeongnam	#1	0	91,050	1,170	0		9,705	8,785		354,224
2010	Yeongnam	#2	0	80,387	786	0		9,702	8,696		304,146
2010	Yeosu	#1	0	118,289	370	0		9,539	8,350		481,530
2010	Yeosu	#2	0	236,662	278	0		9,543	8,345		956,556
2010	Pyeongtaek	#1	0	188,289	121	3,409		9,462	8,542	12,343	794,103
2010	Pyeongtaek	#2	0	172,352	102	6,484		9,430	8,485	12,340	742,439
2010	Pyeongtaek	#3	0	194,662	115	4,814		9,443	8,517	12,352	830,437
2010	Pyeongtaek	#4	0	158,042	91	3,646		9,443	8,540	12,298	669,443
2010	Namjeju	#3	0	151,950	105	0		9,410	8,505		594,537
2010	Namjeju	#4	0	146,544	134	0		9,410	8,472		580,342
2010	Jeju	#2	0	76,706	78	0		9,379	8,440		298,469
2010	Jeju	#3	0	89,373	82	0		9,379	8,492		344,920
2010	Seoul	#4	0	0	0	77,219				12,399	356,493
2010	Seoul	#5	0	0	1	169,145			0	12,399	815,062
2010	Incheon	#1	0	0	0	95,108				12,399	477,252
2010	Incheon	#2	0	0	0	105,649				12,401	544,351
2010	Seoincheon	C/C	0	0	76	1,633,316			8,750	12,398	11,756,041
2010	Shinincheon	C/C	0	0	0	1,349,902				12,399	9,595,856

Year	Plant		Fuel Consumption				Net caloric value				Electricity generation (MWh)
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L.N.G. (t)	Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L.N.G. (kcal/kg)	
2010	Bundang	C/C	0	0	0	725,097				12,400	4,311,466
2010	Ilsan	C/C	0	0	0	755,305				12,398	4,306,850
2010	Pyongtaek	C/C	0	0	0	237,805				12,340	1,472,808
2010	Boryeong	C/C	0	0	0	1,016,783				12,400	7,053,566
2010	Ulsan	C/C	0	0	0	846,672				12,219	5,709,782
2010	Hallim	C/C	0	0	12,737	0			8,536		45,450
2010	Busan	C/C	0	0	12	1,666,675			4,275	12,401	12,489,596
2010	Incheon	C/C	0	0	0	1,035,486				12,398	7,789,931
2010	Gunsan	C/C	0	0	0	398151				13,051	2,996,413
2010	Yeongwol	C/C	0	0	263	182365				13,055	1,313,074
2010	POSCO POWER	C/C	0	0	0	809,100				12,679	4,297,788
2010	GS Anyang	C/C	0	0	0	308,918				13,830	1,824,654
2010	GS Bucheon	C/C	0	0	0	303,789				13,838	1,806,919
2010	GS Bugog	C/C	0	0	0	428,568				12,679	6,172,259
2010	Yulchon	C/C	0	0	0	378,514				13,054	2,680,710
2010	Kwangyang	C/C	0	0	0	0					6,842,597
2010	Namjeju	D/P	0	20,334	369	0		0	8,493		91,340
2010	Jeju	G/T	0	0	697	0			8,550		1,115
2010	Jeju	D/P	0	85,093	0	0		9,371			405,643

Sample group plants used in the Build Margin calculation and CO_2 Emission Factor of the Build Margin

Registered CDM power plant | data do not exist

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
2010	1	Kunsan		CC	LNG	2010.5	2,996,413	0.3943	0.0129
	2	Yeongwol		CC	LNG	2010.1	1,313,074	0.4122	0.0059
	3	Hangwon		small hydro power		2010.11	1		
	4	Gunwi		small hydro power		2010.1	228		
	5	Seolibo		small hydro power		2010.1	108		
	6	Kyeongcheon 2		small hydro power		2010.1			
	7	Rural community corp.		small hydro power		2010.1			
	8	Yeoicheon solar park		solar		2010.1	5,057		
	9	Dangjin solar park		solar		2010.1	265		
	10	haengwon solar park		solar		2010.11			
2009	1	Gosan		small hydro power		2009.12	-		
	2	Incheon	#2		LNG	2009.06	544,351	0.5472	0.0032
	3	Ilsan fuel cell		fuel cell		2009.09	19,028		
	4	Gosado solar		solar		2009.07			
	5	Pyeongsado solar		solar		2009.07			
	6	Yukdo solar		solar		2009.07			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	7	Yuldo solar		solar		2009.07			
	8	Hadong	# 8	steam power	Bituminous coal	2009.06	4,221,464	0.7782	0.0358
	9	Daehanboryeong		small hydro power		2009.05			
	10	Hankukhaeyang		small hydro power		2009.05			
	11	Dangsado solar		solar		2009.04			
	12	Hahwado solar		solar		2009.04			
	13	Hwangjedo solar		solar		2009.04			
	14	Seongsan-wind		wind		2009.04	34,603		
	15	Yeongwol solar		solar		2009.01			
	16	Boseong		small hydro power		2009	3,973		
	17	Seongju		small hydro power		2009			
	18	New solar energy and others				2009			
2008	1	Boryeong	#8	steam power	Bituminous coal	2008.12	3,787,312	0.7767	0.0321
	2	Hadong	#7	steam power	Bituminous coal	2008.12	3,497,189	0.7789	0.0297
	3	Yeongheung	#4	steam power	Bituminous coal	2008.12	6,943,045	0.8193	0.0620
	4	Kyeongcheon		small hydro power		2008.11	2,845		
	5	Seongnam 2		small hydro power		2008.1			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	6	Nulokdo solar		solar		2008.09			
	7	Jeju solar		solar		2008.09	57		
	8	Boryeong fuel cell		fuel cell		2008.09	1,999		
	9	Naebyeong solar		solar		2008.08			
	10	Yulhyeon		small hydro power		2008.07	1,248		
	11	Busan C/C solar		solar		2008.07	395		
	12	Hadong solar		solar		2008.07	1,556		
	13	Hongikdongjin		small hydro power		2008.06			
	14	Daecheongdaem		small hydro power		2008.06			
	15	Boryeong	#7	steam power	Bituminous coal	2008.06	4,189,558	0.7840	0.0358
	16	Kori-wind power		wind		2008.05			
	17	Samlangjin solar		solar		2008.04			
	18	Boryeong solar		solar		2008.04	668		
	19	Boryeong		small hydro power		2008.03			
	20	Yeongheung		small hydro power		2008.03			
	21	Yeonggwang solar park		solar		2008.03			
	22	Boryeong 2		small hydro power		2008.03	1,338		
	23	POSCO fuel cell		fuel cell		2008.03			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	24	Gunjang heat & power		combined		2008.01			
	25	Seocheon solar		solar		2008.01	1,551		
	26	New solar energy and others		solar		2008			
2007	1	Yeongheung	#3	steam power	Bituminous coal	2007	6,887,344	0.8144	0.0611
	2	Taean		small hydro power		2007	4,324		
	3	Hanbit Sungsan the second solar		solar		2007.12			
	4	Taein gangjin solar		solar		2007.12			
	5	Suni gangjin solar		solar		2007.12			
	6	Korea yeongcheon solar		solar		2007.12			
	7	Solar yungam solar		solar		2007.12			
	8	Changwhan yeongduk solar		solar		2007.12			
	9	Samsung jindo		solar		2007.12			
	10	Hwaseong heat & power		combined		2007.12			
	11	Dangjin	#8	steam power	Bituminous coal	2007.12	4,272,886	0.7872	0.0367
	12	SP solar yonggwang		solar		2007.11			
	13	Dongyang energy sinan		solar		2007.11			
	14	Ef yungam solar		solar		2007.11			
	15	Dongwon gangjin solar		solar		2007.11			
	16	Solec yonggwang solar		solar		2007.11			
	17	Solar jungeub solar		solar		2007.11			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	18	Sinbuk yungam solar		solar		2007.11			
	19	Hyein haenam solar		solar		2007.11			
	20	Samlangjin solar		solar		2007.11			
	21	Hyosung daegi-wind power		wind		2007.11			
	22	Nonhyun heat & power		combined		2007.1			
	23	Wuriyungam solar		solar		2007.08			
	24	Hwasung solar		solar		2007.08			
	25	Yeongju the first solar		solar		2007.08			
	26	Muan solar		solar		2007.08			
	27	Jangheung solar		solar		2007.08			
	28	Gomun		small hydro power		2007.08			
	29	Taean	#8	steam power	Bituminous coal	2007.08	4,335,230	0.7899	0.0373
	30	Dangjin	#7	steam power	Bituminous coal	2007.06	3,870,155	0.7932	0.0335
	31	Munkyung solar		solar		2007.06			
	32	Younggwang solar park		solar		2007.06			
	33	Yungam Solar		solar		2007.06			
	34	Wonjungsu		small hydro power		2007.05			
	35	Baekgok		small hydro power		2007.05	1,144		
	36	damyangho		small hydro		2007.05	1,727		

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
				power					
	37	Juam		small hydro power		2007.05			
	38	Namjeju	#4	thermal	heavy oil	2007.03	580,342	0.7517	0.0048
	39	Eco energy		solar		2007.03			
	40	hapcheon		small hydro power		2007.02	7,472		
	41	Jeonju-resource recovery facility				2007.02			
	42	Seoul Marin(suncheon)		solar		2007.02			
	43	Mirae energy		solar		2007.02			
	44	Seomjingang		small hydro power		2007.02	128,895		
	45	samcheonpo		small hydro power		2007.02			
	46	dalbang		small hydro power		2007.02			
	47	Taean	#7	steam power	Bituminous coal	2007.02	3,940,580	0.7918	0.0340
	48	Yeongju the second solar		solar		2007.01			
	49	Hyundaedaesan		combined		2007.01			
2006	1	Cheongsong pumping	#2	pumping		2006.12	305,821		
	2	S&P Solar		solar		2006.1			
	3	Bundang fuel cell		fuel cell	LNG	2006.1	1,897		
	4	Namhae Solar		solar		2006.1			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	5	HanlaJeunggong Solar		solar		2006.1			
	6	Yungam Solar		solar		2006.09			
	7	Enepark		solar		2006.09			
	8	Yeongheung solar		solar		2006.09	1,160		
	9	Cheongsong pumping	#1	pumping		2006.09	301,551		
	10	Namjeju	#3	thermal	heavy oil	2006.09	594,537	0.7607	0.0049
	11	yangyang(pumping)	#4	pumping		2006.08	204,280		
	12	Donghae Solar		solar		2006.08			
	13	Kangwon-wind power		wind		2006.07			
	14	Woljeong-wind power		wind		2006.07			
	15	yangyang pump windpower		wind		2006.06			
	16	Hadongho		small hydro power		2006.06	2,923		
	17	yangyang (pumping)	#3	pumping		2006.06	194,083		
	18	Goheung Solar		solar		2006.06			
	19	Jangseong		small hydro power		2006.05	2,056		
	20	yangyang (pumping)	#2	pumping		2006.04	194,653		
	21	Dangjin	#6	thermal	Bituminous coal	2006.04	3,471,850	0.7904	0.0299
	22	Sinchang-wind power		wind		2006.03			
	23	yangyang (pumping)	#1	pumping		2006.02	122,320		
2	1	Janghengdam		small hydro		2005.12			

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
2005				power					
	2	Suncheon Solar		solar		2005.12			
	3	Samcheonpo solar energy		solar		2005.12	1,129		
	4	Dangjin	#5	steam power	Bituminous coal	2005.1	4,133,329	0.7902	0.0356
	5	yangyang pump small hydro		small hydro power		2005.1			
	6	Taean solar energy		solar		2005.1	116		
	7	Jeju DP		internal combustion	heavy oil	2005.07	405,643	0.6214	0.0027
	8	WunjeongLFG		internal combustion	LFG	2005.07			
	9	Yulchon		combined	LNG	2005.07	2,680,710	0.4190	0.0122
	10	Incheon		combined	LNG	2005.07	7,789,931	0.3747	0.0318
	11	Daegok		small hydro power		2005.07	1,038		
	12	Donghwa		small hydro power		2005.07	3,289		
	13	Ulchin	#6	nuclear		2005.04	8,425,588		
	14	Hanrye		LFG	LFG	2005.04			
	15	Busan Bio-gas		internal combustion	LFG	2005.03			
2004	1	Sungnam		small hydro power		2004.12			
	2	Yungduk-wind power		wind		2004.12			
	3	Yongdam		small hydro power		2004.12	113,371		

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2010	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	4	Maebongsan-wind power		wind		2004.12			
	5	Daegwanryeong-wind power		wind		2004.12			
	6	Yeongheung	#2	steam power	Bituminous coal	2004.11	5,558,681	0.8071	0.0489
	7	Yeongheung	#1	steam power	Bituminous coal	2004.07	5,627,774	0.8199	0.0503
Total							**91,735,155**		0.6412

Appendix 5: Further background information on the monitoring plan

NA

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History of the document

Version	Date	Nature of revision(s)
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the programme design document form for small-scale CDM programmes of activities" (EB 66, Annex 13).
01	EB33, Annex43 27 July 2007	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		