THE HYUNDAI STEEL WASTE ENERGY COGENERATION PROJECT

Document Prepared By CERPD Inc.

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Prepared By	*CERPD Inc.*
Contact	1420 156th AVE NE Ste H, Bellevue, WA, USA 98007

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Hyundai Steel Waste Energy Recovery Co-generation Project (hereafter referred in this document as the 'proposed project') is a 400MW cogeneration plant at Hyundai Steel (Dangjin works), which is developed by Hyundai Green power CO., Ltd(hereafter referred in this document as the 'project owner').

The project utilizes surplus waste gases including BFG(Blast Furnace Gas), COG(Coke Oven Gas) and LDG(Converter Gas) produced by Steel (Dangjin works) to generate electricity. The waste gases created by Steel are reused by the steel mill and the rest are consumed by the proposed project. Through this project, approximately 2,741,035MWh electricity will be sent to power grid, and 1,285,000 ton steam will be produced and sent to Steel (Dangjin works). Without the proposed project the rest of waste gases are emitted to atmosphere after incineration, the electricity generated by the proposed project will be supplied by grid.

The Project has significant benefits:

- Energy saving (recycling) by using waste energy,
- Using local energy as opposed to importing energy from foreign countries,
- Reducing environmental pollution, and meeting the current environmental policies of South Korea.

Additionally, the project is innovative in that it differs from the traditional thermal electricity generation process, as it uses a high efficiency compound generation system decreasing the amount of imported fuel and reducing emissions by approximately 1,774,699 tCO_2e/year.

1.2 Sectoral Scope and Project Type

The project activity pertains to sectoral scope 1 (Energy industries (renewable / non-renewable) & 4 (Manufacturing industries)

1.3 Project Proponent

Project Owner, Hyundai Green power CO., Ltd:
Donggug Kim, energy management team
zugglae@hotmail.com

Co-project proponent, Hyundai Steel Mill CO., Ltd
Dongkuk.kim@hyundai-steel.com

1.4 Other Entities Involved in the Project

Project Developer: CERPD Inc.
Jongbum Kim, Ph.D. CEO, 1420 156th AVE NE Ste H, Bellevue, WA, USA 98007
jbk@cerpd.com

1.5 Project Start Date

- Project start date[1] : March 24, 2010

1.6 Project Crediting Period

- Project crediting period: 10 years (March. 24, 2010 ~ March. 23, 2020),

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project	
Mega-project	√

Years	Estimated GHG emission reductions or removals (tCO2e)
Year 1 (2010)	1,478,916 (part year)
Year 2 (2011)	1,774,699
Year 3 (2012)	1,774,699
Year 4 (2013)	1,774,699
Year 5 (2014)	1,774,699
Year 6 (2015)	1,774,699
Year 7 (2016)	1,774,699
Year 8 (2017)	1,774,699
Year 9 (2018)	1,774,699
Year 10 (2019)	1,774,699
Year 11 (2020)	295,783 (part year)
Total estimated ERs	17,746,990
Total number of crediting years	10
Average annual ERs	1,774,699

1.8 Description of the Project Activity

Steel mills create waste gas in the production processes, including Blast Furnace Gas (BFG) which is created from melting iron ore, Coke Oven Gas (COG) which comes from the dry distillation of flaming coal, and Linz Donawitz Gas) (LDG) from the decarburization process which gets rid of impurities from the melted iron from the blast furnaces. Figure 1 illustrates the project activity.

[1] The construction period of the Project was from April 23,2008 to December 10,2010 and the date on which the Project began reducing GHG emissions by commercial operation was March 24,2010.

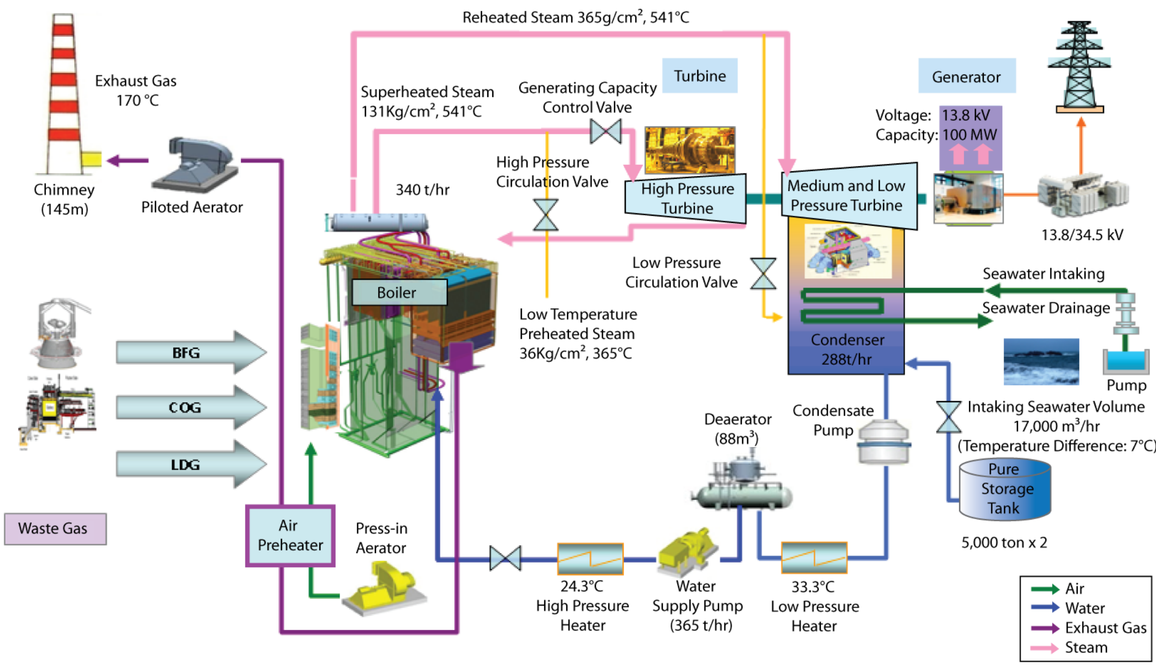


Figure 1. Project Activity Flow Chart

Table 2. Summary of the Project activity

Category	Contents
Type	• Steam power generation
Volume	• 400 MW (100 MW × 4)
Types of generation equipment	• Steam Generator : balanced draft type, drum type, subcritical pressure type. • Steam Turbine : series arrangement, single current high steam pressure turbine , one of the double current turbine (plural method) .
Main equipments	①Plan for main equipments: • Steam Turbine/Generator, boiler. • Electric power system equipments, measuring and control equipments in the power plant.
	②Equipment Installation plan: •Coolant supply system Installation •industrial water supply and reservation installation.
	③Main Pollution preservation system installation: • Air quality standard: Selective Catalytic Reduction (SCR). • Water quality: waste water advanced treatment system (activated carbon absorption). • Noise / vibration: protection against dust , soundproof equipments.

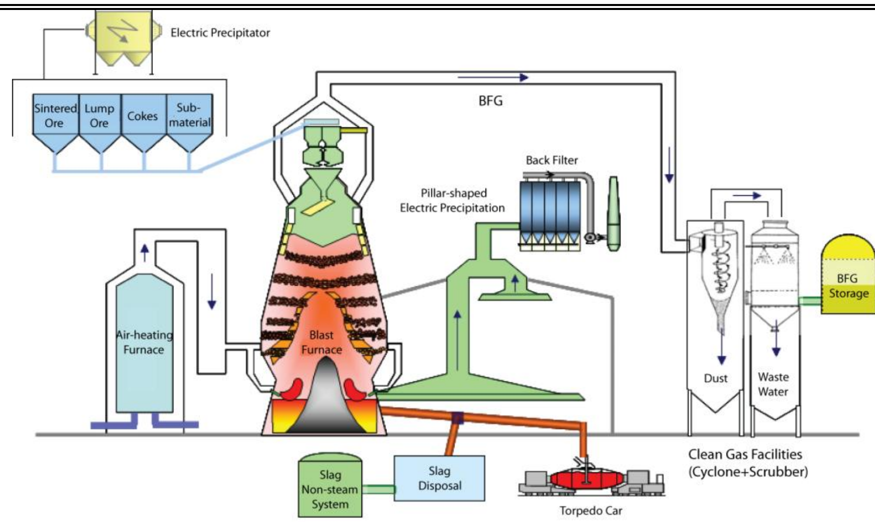
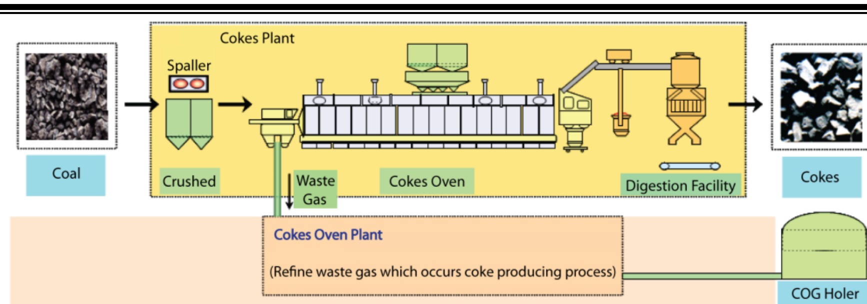
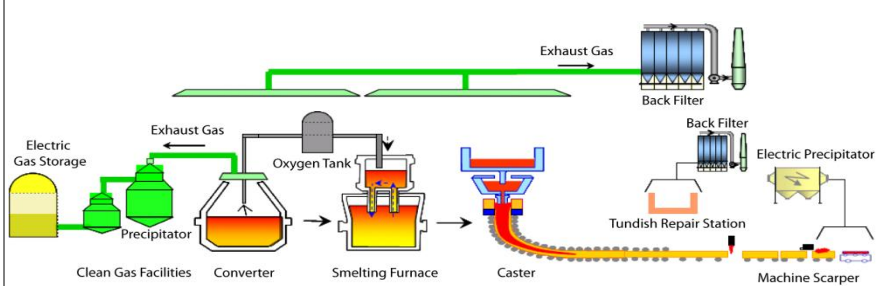
Generation fuel	• Refined waste gas (BFG, COG, LDG) ※ see properties of waste gas for further information.
Main installation placement conditions	①Coolant supply method: Once-through System, discharging in depth.
	②Industrial water supply: Since the project facility is constructed within the Hyundai Steel property in Naedo, the needed industrial water would be supplied through the already existing pipe rack.
	③Fuel supply: Waste gas created at Song San tech industrial for general facilities would be delivered to the project facility through the sealed pipe and the pipe rack.
	④ Power transmission and mutation equipments: •When generating power, within the Nae-do Hyundai Steel district, the generated electricity is transmitted using pre-installed cable. when the power is to be transmitted to outside of the district, it uses the national grid.

Table 3a. Properties of waste gases

Type	Properties
BFG	By-product gas created from a blast furnace. The ignition point is around 650℃, and its flame is dark blue which is difficult to see in the daylight. Its gravity is 1.05 which is a little heavier than the air.
COG	By product gas created from coke production. The ignition point is around 600℃, and its flame is red. Its gravity is 0.36 which is lighter than the air.
LDG	By product gas created while adding O_2 to the metal, and it contains a small amount of dust. Its flame is either light blue or light brown, and its gravity is similar to the one of BFG.

Table 2b. Properties of waste gas

Type	Contents

BFG (Blast Furnace Gas)	 * Furnace is an equipment which melts iron ore. BFG is generated during the reduction reaction of iron ore, and such BFG can be used as fuel for power plants after preprocessing through the dry and wet processes. * Properties : caloric value (720 ~ 750kcal/N ㎥), CO (22.0%), CO_2 (20.7%), H_2 (3.2%), N_2 (54.1%)
COG (CokeOven Gas)	 * Cokes, the fuel to fire up the furnace, is created while carbonizing bituminous coal. The gas generated during this process is COG. After the electric precipitation process and refining through the pre-process including desulfurization, it can be used as fuel for power plants. *Properties: caloric value (4,285 ~ 4,400kcal/N ㎥), CO (5.0%), CO_2 (1.8%), H_2 (57.0%), O_2(0.1%), CH_4 (25.0%), CmHn (2.5%), N_2 (8.6%)
LDG (Linz Donawitz Gas)	 * LDG is gas created during the decarbonization process in which impurities are filtered out from the melted iron. LDG is used as fuel for power plants

	after dry-and-wet cleansing process. * Properties: caloric value (1,960 ~ 2,000 kcal/N ㎥), CO (64.2%), CO_2 (17.8%), H_2 (2.0%), O_2 (0.1%), N_2 (15.9%)

Through the project activity, the waste gas, which would have been emitted to the atmosphere without the project, will be recovered to generate power and supply to the grid that based on fossil fuel power generation. So the power generated by the proposed project will substitute part of power on the grid generated by fossil fuel power plants, which will reduce the consumption of fossil fuels and GHG emission.

1.9 Project Location

The project is located in Donggok-ri Songsan-myeon Dangjin-gun Chungchongnam-do, Republic of Korea. The geographical coordinates are126°42'11.60" E, 36°58'58.27" N. The maps show below the location of the project activity.

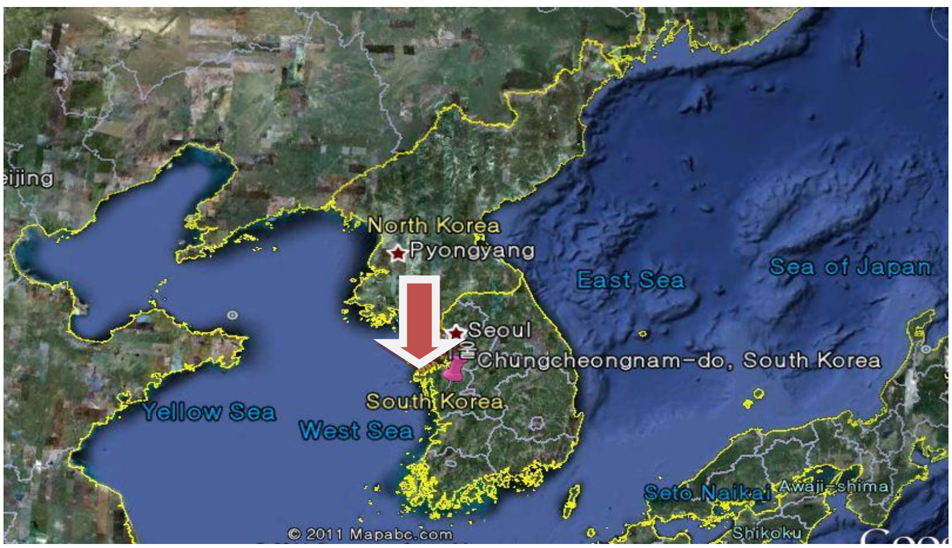


Figure 2. The location of the Chungchongnam province in Republic of Korea

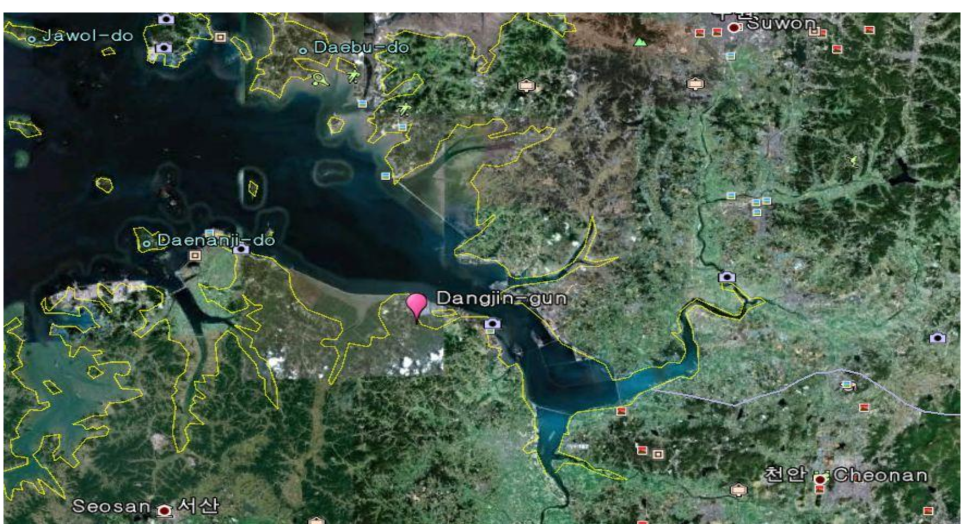


Figure 3. The location of Dangjin county in Chungchongnam Do

Figure 4. The proposed Project in Dangjin county

1.10 Conditions Prior to Project Initiation

The proposed project is a Greenfield power plant using waste gases(BFG, COG, LDG) coming from two blast furnaces of Hyundai steel (Dangjin works) which are also new facilities. The baseline scenario will be based on the two blast furnaces being built and the proposed project no being built. The scenarios existed prior to the start of the implementation of the project activity (the same with the baseline scenarios) are as follows:

In the absence of the proposed project, the blast furnace will be built, and a portion of the waste gas produced from blast furnace will be recovered for inner use, while the rest of the waste energy which used in the proposed project will be emitted to atmosphere after incineration. So in the absence of the proposed project, the waste energy used in the proposed project will be all emitted to atmosphere after incineration.

In the absence of the project, the steam which produced by the proposed project will be produced using LNG by Hyundai steel (Dangjin works).

In the absence of the project, the electricity generated by the proposed project will be supplied by the grid.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

For the emission of the waste gas or other air pollutant to atmosphere, the proposed project must comply with CLEAN AIR CONSERVATION ACT and its related regulations published by Korea Legislation Research Institute. In which the allowed emission standard is established such as the emission of SOx and NOx and the project must comply with it. The related law and regulations will be submitted to DOE.

For discharge of the waste water, the project must comply with THE WATER QUALITY AND ECOSYSTEM CONSERVATION ACT and its related regulations published by Korea Legislation Research Institute. In which the allowed discharge standard is established such as the discharge of COD and BOD and the project must comply with it. The related law and regulations will be submitted to DOE.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

The proof of title is the generation permit of Hyundai Green Power and the letter of assurance provided by Hyundai Green Power, which can prove that Hyundai Green Power has the right to operate the power plant and has the ownership of the carbon credits generated by the proposed project. The related documents will be submitted to DOE.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable

1.12.3 Participation under Other GHG Programs

The project is not under any other greenhouse gas markets (such as KCER or CDM).

1.12.4 Other Forms of Environmental Credit

The project does not pursue any environmental credits related to greenhouse gas other than credits created through VCS.

1.12.5 Projects Rejected by Other GHG Programs

The proposed project was not rejected under any GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

This project is not a grouped project.

Leakage Management

N/A

Commercially Sensitive Information

The information about the dividends rate and gas flow rate has been excluded from the public version of the project description due to commercially sensitive information.

Further Information

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

(a) The proposed project applies the following approved methodology for PD preparation:

Version 4.0.0 of ACM 0012: "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" which was approved on the EB's 60th meeting and detailed information refers to
http://cdm.unfccc.int/methodologies/DB/L731WMCXLT0WE6ALG5AYAGLTJP7KW7

(b) The tools drawn upon from Version 4.0.0 of ACM0012 are:

Version 02.2.1 of the tool to calculate the emission factor for an electricity system; detailed information refers to: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf

Version 5.2.1 of the tool for the demonstration and assessment of additionality; detailed information refers to: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.1.pdf

Version 01 of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" detailed information refers to:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf

Version 02 of "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", detailed information refers to: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

2.2 Applicability of Methodology

The consolidated methodology (ACM0012, Version 04.0) is for the following type of project activities:

The consolidated methodology is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried out in identified Waste Energy Carrying Medium (here after WECM) stream(s) into useful energy. The WECM stream may be an energy source for:

- Generation of electricity;
- Cogeneration;
- Direct use as process heat source;
- Generation of heat in element process;
- Generation of mechanical energy; or
- Supply of heat of reaction with or without process heating.

This project is a cogeneration project using waste gas from Hyundai steel mill, so the proposed project complies with the Methodology.

In the absence of the project activity, the WECM stream:

(a) Would not be recovered and therefore would be flared, released to atmosphere, or remain unutilized in the absence of the project activity at the existing or Greenfield project facility; or

(b) Would be partially recovered, and the unrecovered portion of WECM stream would be flared, vented, or remained unutilized at the existing or Greenfield project facility.

For the proposed project, in the absence of the project activity, the WECM stream used in the proposed project would not be recovered and will be vented after incineration.

Further the comparative analysis between the project activity and methodology ACM0012 is used to justify the choice of methodology;

Table 4. Reason for the applicability to project activity

No.	Applicability Conditions as per ACM0012	Situation of this Project Activity	Yes/ No
1	If the project activity is based on the use of waste pressure to generate electricity, electricity generated using waste pressure should be measurable.	This project activity is not the case of waste pressure.	N/A
2	Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity;	There are no regulations to require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity.	Y
3	The methodology is applicable to both Greenfield and existing waste energy generation facilities. If the production capacity of the project facility is expanded as a result of the project activity, the added production capacity must be treated as a Greenfield facility;	The proposed project is a Greenfield energy generation facility.	Y
4	Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the project facility shall not be included in the emission reduction calculations.	If the project activity is under abnormal operation, the emission reduction produced will not be included in the emission reduction calculation. The Hyundai steel facility will be shut down during the abnormal operation. The DOE can verify the operating record.	Y
5	If multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility, the recovery of any waste gas stream, which would be totally or partially recovered in the absence of the project activity, shall not be reduced due to the implementation of CDM project activity. For such situations, the guidance provided in Annex 3 shall be followed.	For the proposed project, multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility. so the Conservative baseline emissions will be calculated according to Annex 3 of Methodology ACM0012 ver. 4.0	Y

6	The methodology is not applicable to the cases where a WECM stream is partially recovered in the absence of the CDM project activity to supply the heat of reaction, and the recovery of this WECM stream is increased under the project activity to replace fossil fuels used for the purpose of supplying heat of reaction.	The WECM stream recovered in the absence of the project activity are not to supply the heat of reaction.	Y
7	This methodology is also not applicable to project activities where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power. However, the projects recovering waste energy from single cycle and/or combined cycle power plants for the purpose of generation of heat only can apply this methodology.	This project activity is not the case of recovery waste energy from single-cycle power plant.	N/A
8	The emission reduction credits can be claimed up to the end of the lifetime of the waste energy generation equipment. The remaining lifetime of the equipment should be determined using the latest version of the "Tool to determine the remaining lifetime of equipment".	The lifetime of the waste energy generation equipment is estimated as 20 years, and the fixed credits period (10years) is applied by the project activity, therefore, the emission reduction credits can be claimed up to the end of the crediting period.	Y
9	The extent of use of waste energy from the waste energy generation facilities in the absence of the CDM project activity will be determined in accordance with the procedures provided in Annex 1 (for Greenfield project facilities) and in Annex 2 (for existing project facilities) to this methodology.	The extent of use of waste energy from the waste energy generation facilities in the absence of the VCS project activity will be determined in accordance with the procedures provided in Annex 1 (for Greenfield project facilities)	Y

The above comparison clearly justifies the applicability of project activity under the chosen ACM0012 methodology.

2.3 Project Boundary

As per ACM0012, the geographical extent project boundary shall include the relevant WECM stream(s), equipment and energy distribution system in the following facilities:

(1) The "project facility"; which is Hyundai Steel Mill in this project.

(2) The "recipient facility(ies)", which is Hyundai Green Power.

The spatial extent of the grid is as defined in the "Tool to calculate the emission factor for an electricity system".

The relevant equipment and energy distribution system cover:

- In a project facility, the WECM stream(s), waste energy recovery and useful energy generation equipment, and distribution system(s) for useful project energy;

- In a recipient facility, the equipment which receives useful energy supplied by the project, and distribution system(s) for useful project energy.

The geographical extent project boundary shall include the following:

1. The industrial facility where waste energy is generated, including the part of the industrial facility where the waste gas was utilized for generation of captive electricity prior to implementation of the project activity;

2. The facility where process heat in the element process/steam/electricity/mechanical energy is generated (generator of process heat/steam/electricity/mechanical energy). Equipment providing auxiliary heat to the waste energy recovery process shall be included within the project boundary; and

3. The facility/s where the process heat in the element process/steam/electricity/mechanical energy is used (the recipient plant(s)) and/or grid where electricity is exported, if applicable.

Where multiple waste gas streams are available in the project facility, and can be used interchangeably for various applications as a part of energy sources in the facility, the guidance provided in Annex 3 shall be followed to establish the project boundary.

For the proposed project multiple waste gas streams are available in the project facility, So extended boundary of the project described in Annex3 of ACM0012(ver4.0) should be followed.

As per Annex 3, the following steps can be followed

(1) Define an extended boundary of the project

If the waste gas energy recovered under the VCS project is usable in the other applications in the facility either independently, or by mixing with similar other waste gas energy sources in the facility, the project boundary should include the generation of all other waste gas streams and the potential applications.

As a blast furnace energy recovery project in a Greenfield iron & steel plant, an extended boundary for the mixture of waste fuel gases of the proposed project can be defined as follows:

WECM	Extended System Boundary						
	Coke oven	Sinter Plant	Blast Furnace	Casting and Rolling	Flaring	Power generation	Sale to external consumer
Common waste fuel gas (COG, BFG, LD gas combined)	Yes	Yes	Yes	Yes	Yes	Yes	No

(2) Determination of conservative baseline emissions for the VCS project in an existing facility

An energy balance is to be established for the demand and supply of energy in all the applications covered in extended project boundary identified in Step 1 above, based on the historical data of one year prior to implementation of VCS project. This energy balance should be checked by the DOE on-site, and only if it is established that there is no likelihood of decrease in energy recovery of other WECM stream(s) under the extended project boundary, the methodology is deemed applicable to the project.

As for the proposed project, it is a Greenfield facility and there is no historical data, so it is not possible to establish the energy balance for the demand and supply of energy base on the historical data. In order to establish the energy balance, the designed energy balance provided by project owner will be submitted to DOE as an established energy balance. This is conservative, because the designed energy balance considered the maximum recovery of the WECM streams for other internal uses excluding the proposed VCS project. The designed energy balance is as follow:

Waste Gas	For Hyundai Greenpower	For alternative uses (Hyundai Steel)	Total
	Percentage	Percentage	Percentage
COG	10.7%	89.3%	100%
BFG	74.7%	25.3%	100%
LDG	100.0%	0.0%	100%
Total	54.3%	45.7%	100%

The real energy balance will be monitored every year, and the related information will be provided to verifying DOE. If when there is a decrease in the energy recovery of WECM(s) in the extended boundary excluding the project activity WECM without a technical justification, no CERs will be claimed for the rest of the monitoring period.

So, the spatial extent of this project boundary comprises the waste gas or heat sources, power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect and the extended system Boundary described in Annex3 of methodology ACM0012 ver 4.0. The following figure 5 will illustrate the project boundary of the proposed project.

The explanation for the emission sources included or excluded from the project boundary is provided in the table below.

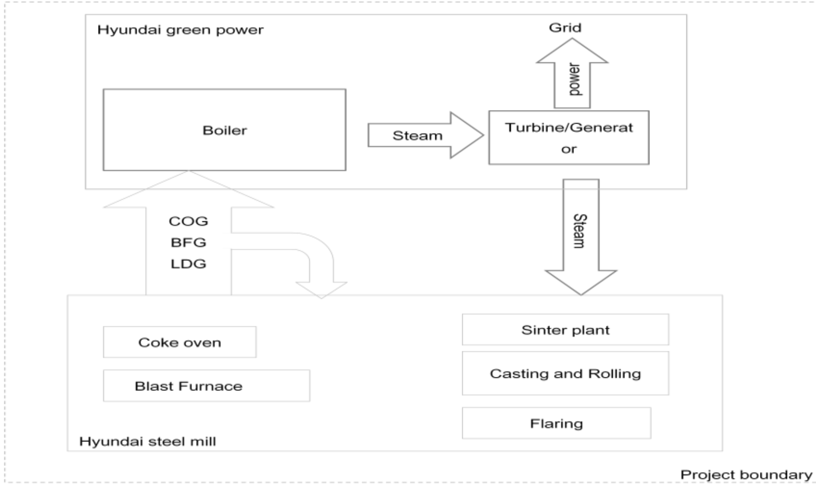


Figure 5. The project boundary of the proposed Project

Table 5. Emission sources included in the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Electricity generation, grid source	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Fossil fuel consumption in element process for thermal energy	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project	Supplemental fossil fuel consumption at the project plant	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification
	Energy consumption for gas cleaning	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification

2.4 Baseline Scenario

According to ACM0012, the baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s).

Realistic and credible alternatives should be determined for:

- Waste energy use in the absence of the project activity;

- Power generation in the absence of the project activity for each recipient facility if the project activity involves electricity generation for that recipient facility;

- Heat generation (process heat and/or heat of reaction) in the absence of the project activity, for each recipient facility if the project activity involves generation of useful heat for that recipient facility; and

- Mechanical energy generation in the absence of the project activity, for each recipient facility if the project activity involves generation of useful mechanical energy for that recipient facility.

For this project, there is no mechanical generation. So the baseline scenario alternatives should include:

- Waste heat use in the absence of the project activity;

- Power generation in the absence of the project activity, and

- Heat generation in the absence of the project activity

According to the methodology, the baseline options following should be excluded, those that

- Do not comply with legal and regulatory requirements; or

- Involve fuels (used for the generation of heat, power or mechanical energy), that are not produced or imported in the host country.

The project participant shall provide evidence and supporting documents to exclude baseline options that meet the above-mentioned criteria.

Determine the most plausible baseline scenario through the application of the following four steps:

Step 1.
Define the most plausible baseline scenario for the generation of electricity using the following baseline options and combinations.

The baseline candidates should be considered for the following facilities:

- For the waste energy generation facility(ies) where the waste energy is generated; and

- For the recipient facility(ies) where the energy is consumed.

As the project activity can be implemented on waste energy generated in an existing or a Greenfield project facility, the following combinations, which represent the baseline scenarios of an existing facility, should be tailored for Greenfield facilities. Therefore, for the Greenfield project facilities, the following baseline scenarios should be analysed based upon the guidelines included in Annex 1. At an existing project facility, if the production capacity is increased after the implementation of the project activities, the scenarios for added capacity may be different from those identified for the capacity which displaces historical consumption of heat or power. The approach for baseline scenarios for added production capacity should be same as that followed for the Greenfield facility.

For the use of waste gas, the realistic and credible alternative(s) may include, inter alia:

Option	Description	Credibility	Conclusion
W1	WECM is directly vented to the atmosphere without incineration;	Venting of waste gas to atmosphere without incineration is restricted by the legal and regulatory requirements of Korea[2].	Not a part of the baseline
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released (or vented) to the atmosphere or waste pressure energy is not utilized;	Without the proposed project the waste gas which will be used in this project will all be released to the atmosphere after incineration.	May be a part of the baseline
W3	Waste gas/heat is sold as an energy source;	There are no users of heat located nearby. Sales of heat to commercial users or local residents are not possible, since it the NCV of the waste gas is very low and the concentration of CO and H_2S is very high.	Not a part of the baseline
W4	Waste energy is used for meeting energy demand at the recipient facility(ies)	This alternative is feasible from technical and legal perspectives and faces no prohibitive barrier. Utilizing the waste heat as an energy source to power generation is included in the project activity, so W4 is a part of baseline scenario.	May be a part of the baseline
W5	A portion of the quantity or energy of WECM is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/ unutilized;	Although a portion of the waste gas produced at the facility is captured and used, the waste gas used in the proposed project is the remaining part of the waste gas after it was recovered for the internal process of heating and other purpose. So without the propose project the waste gas which be used in this project will all be released to the atmosphere after incineration.	Not a part of the baseline
W6	All the waste energy produced at the facility is captured and used for export electricity	Since it is possible to capture the waste energy to generate electricity for any purpose, thus it	May be a part of the baseline

[2] Clean Air Conservation Act
http://likms.assembly.go.kr/law/jsp/Law.jsp?WORK_TYPE=LAW_BON&LAW_ID=A1535&PROM_NO=09931&PROM_DT=20100113&HanChk=Y#

	generation or steam.	is also possible to export the energy to the grid. So this alternative is a plausible scenario for further analysis.	

From the above analysis, we can conclude that the scenario **W2**, Waste gas is released to the atmosphere after incineration or waste heat is released to the atmosphere, **W4** Waste energy is used for meeting energy demand at the recipient facility(ies) and **W6**: All the waste energy produced at the facility is captured and used for export electricity generation or steam are available scenarios for the use of waste gas are plausible.

Further to this, as required under the methodology, Assessment of extent of use of WECM and determination of baseline practice factor for project activity implemented in Greenfield facilities described in Annex 1 of ACM0012 should be followed.

As per annex 1of methodology ACM0004 ver. 4.0, 2 options are provided to do the assessment of extent of use of WECM. For Option 1: Assessment of other existing facilities, it is necessary that at least five facilities are analysed to arrive at “reference facility” practice. But in Korea, there are only two INTEGRATED steel mills, which is the “reference facility” practice(for detail please refer to 2.5, Common practice analysis). So Options 1 of Annex 1 is not available in this project. So, option 2: Assessment of alternative design of the project facility, was chosen to assess the extent of use of WECM and determine the baseline practice factor for the proposed project activity.

According to option 2, the manufacturer of the project facility will be invited to submit an alternative design including the usage of WECM that is recovered under project. For the usage of WECM, all the realistic alternative designs are considered in the baseline scenarios for the use of waste gas which have been analyzed above (baseline scenario fort use of waste gas). According to the analysis, the alternative design of the usage of WECM available is W2, W4/ W6, but after the following investment analysis described in 2.5 of this PD shows that W4/W6 wouldn’t have been the baseline scenario since it is economically unattractive. So the alternative design is W2: Waste gas is released to the atmosphere after incineration or waste heat is released to the atmosphere.

So according to the analysis above, The WECM used by the project will not be used and will be released to the atmosphere after incineration.

For power generation, the realistic and credible alternative(s) may include, inter alia:

Option	Description	Credibility	Conclusion
P1	Proposed project activity not undertaken as a VCS project activity;	Despite the fact that this alternative is economically unattractive, this alternative is a plausible scenario for further analysis.	May be a part of the baseline
P2	On-site or off-site existing fossil fuel fired cogeneration plant;	There is no On-site or off-site existing fossil fuel fired cogeneration plant;	Not a part of the baseline
P3	On-site or off-site	It is not possible to build a	Not a part of the

	Greenfield fossil fuel fired cogeneration plant;	Greenfield fossil fuel fired cogeneration plant since 1. In Korea, construct a new fossil fuel fired power plant is strictly under control, the government is to promote low carbon power generation such as nuclear and renewable energy according to the Law of low carbon & green growth. 2. Local residents strongly object a new fossil fuel power plant so that a new fossil fuel power plant will not be allowed because of the negative stakeholders' comment.	baseline
P4	On-site or off-site existing renewable energy based cogeneration plant;	There is no on-site or off-site existing renewable energy based cogeneration plant;	Not a part of the baseline
P5	On-site or off-site Greenfield renewable energy based cogeneration plant;	There are no renewable energy sources such as wind power, hydro power, biomass power and geothermal power in Hyundai steel mill. Besides, new energy power generation in Korea is still in the demonstration stage, and it has no economic attraction to investor.	Not a part of the baseline
P6	On-site or off-site existing fossil fuel based existing identified captive power plant	There is no on-site or off-site existing fossil fuel based existing identified captive power plant.	Not a part of the baseline
P7	On-site or off-site existing identified renewable energy or other waste energy based captive power plant;	There is no on-site or off-site existing identified renewable energy or other waste energy based captive power plant;	Not a part of the baseline
P8	On-site or off-site Greenfield fossil fuel based captive plant	The power generated by the proposed project will be fully exported to grid, not for internal consuming. So this alternative is not possible.	Not a part of the baseline
P9	On-site or off-site Greenfield renewable energy or other waste energy based captive plant;	There are no renewable energy sources such as wind power, hydro power, biomass power and geothermal power in Hyundai steel mill. Besides, new energy power generation in Korea is still in the demonstration stage, and it has no economic attraction to investor.	Not a part of the baseline
P10	Sourced grid-connected power plants;	The regional power grid is the main electricity supplier in the local area.	May be a part of the baseline

P11	Existing captive electricity generation using waste energy (if the project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity);	There is no existing power generating equipment before the proposed project.	Not a part of the baseline
P12	Existing cogeneration using waste energy, but at a lower efficiency or lower recovery.	There is no existing power generating equipment before the proposed project.	Not a part of the baseline

From the above analysis, we can conclude that the scenario **P1**: Proposed project activity not undertaken as a VCS project activity; and **P10**: Sourced grid-connected power plants are plausible.

For heat generation, although there is heat produced in the proposed project, for conservative and simplification purpose, the PP does not claim any emission reduction from heat generation in the baseline. Therefore, the emission reduction of the project due to the displacement of heat is 0tCO2. But the analysis of baseline scenario for heat generation will be included and the revenue from purchase of heat will still be considered in the investment analysis.

For heat generation, the realistic and credible alternative(s) may include, inter alia:

Option	Description	Credibility	Conclusion
H1	The proposed project activity is not undertaken as a VCS project activity;	This alternative is in compliance with all applicable legal and regulatory requirements. So this alternative is a plausible scenario for further analysis.	May be a part of the baseline
H2	On-site or off-site existing fossil fuel based cogeneration plant;	There is no such on-site or off-site existing fossil fuel based cogeneration plant.	Not a part of the baseline
H3	On-site or off-site Greenfield fossil fuel based cogeneration plant;	It is not possible to build a Greenfield fossil fuel fired cogeneration plant since 1. In Korea, construct a new fossil fuel fired power plant is strictly under control, the government is to promote low carbon power generat ion such as nuclear and renewable energy according to the Law of low carbon & green growth. 2. Local residents strongly object a new fossil fuel power plant so that a new fossil fuel power plant will	Not a part of the baseline

		not be allowed because of the negative stakeholders' comment.	
H4	On-site or off-site existing renewable energy based cogeneration plant;	There is no on-site or off-site existing renewable energy based cogeneration plant.	Not a part of the baseline
H5	On-site or off-site Greenfield renewable energy based cogeneration plant;	There are no renewable energy sources such as wind power, hydro power, biomass power and geothermal power in Hyundai steel mill. Besides new energy power generation in Korea is still in the demonstration stage. and it has no economic attraction to investor.	Not a part of the baseline
H6	An existing fossil fuel based element process;	Hyundai has existing LNG boilers to produce steam, but it is impossible to produce the extra steam which produced by the proposed project.	Not a part of the baseline
H7	A new fossil fuel based element process;	This alternative is in compliance with all applicable legal and regulatory requirements.	May be a part of the baseline
H8	An existing renewable energy or other waste energy based element process to supply heat;	There is no existing renewable energy or other waste energy based element process to supply heat;	Not a part of the baseline
H9	A new renewable energy or other waste energy based element process to supply heat;	There are no renewable energy sources such as wind power, hydro power, biomass power and geothermal power in Hyundai steel mill Besides new energy power generation in Korea is still in the demonstration stage, and it has no economic attraction to investor.	Not a part of the baseline
H10	Any other source such as district heat;	There is no district heat exist in the project site	Not a part of the baseline
H11	Other heat generation technologies (e.g. heat pumps or solar energy);	In Korea It is not economic attractive to produce the amount of steam produced by the proposed project using heat pumps or solar energy.	Not a part of the baseline
H12	Steam/process heat generation from waste energy, but with lower efficiency or lower recovery;	The proposed project activity is to use waste gas for cogeneration, the output is electricity and steam, not only the steam, so steam generation from waste energy is not applicable.	Not a part of the baseline
H13	Cogeneration with waste energy, but at a lower efficiency or lower recovery;	There is no other technology with different efficiency is available for the Project. On the other hand, a lower efficiency technology results less financial attraction than the proposed project not undertaken as a VCS	Not a part of the baseline

		project active.	
H14	On-site fossil fuel consumption to supply heat.	It is not possible to supply steam directly by consuming fossil fuel without a process.	Not a part of the baseline

From the above analysis, we can conclude that the scenario **H1**: Proposed project activity not undertaken as a VCS project activity; and **H7**: A new fossil fuel based element process are plausible.

As for the proposed project, there is no mechanical energy recovered involved in; therefore, the credible alternative(s) for mechanical energy analysis will be skipped.

To sum up, the most plausible scenario matrix obtained from the combinations of the alternatives is presented in the following table 6.

Table 6. Possible combinations of baseline scenarios matrix

Scenario	Baseline options			Description
	Waste gas use	Power generation	Heat generation	
1	W2	P10	H7	Waste gas is released to the atmosphere after incineration or waste heat is released to the atmosphere. The Korea Electricity Power Corporation Grid provides the equivalent electricity. Heat be produced by a new fossil fuel based element process;
2	W4[3] W6	P1	H1	Project activity being implemented without VCS

Step 2. Using step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" to identify the most plausible baseline scenarios by eliminating non-feasible options.

The PD uses the step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" to identify the most plausible baseline scenarios by eliminating non-feasible options.

Scenario 2 (W4/P1/H1) is not economically attractive to the project owner without the VCS. The detailed demonstration is presented in 2.5 Additionality below.

[3] Waste energy being used for power/heat generation is adaptable for both W6 and W4

Therefore Scenario 1 (W2/P10/H7), power imports from the grid combined with the non-utilization of waste heat and heat is produced with new fossil fuel based element process;, is the only scenario that can be selected as the baseline scenario of the project.

Step 3: If more than one credible and plausible alternative scenario remain, the alternative with the lowest baseline emissions shall be considered as the most likely baseline scenario

There is only one baseline scenario left, so this step is skipped. Hence, in this case, the most credible and realistic baseline scenario is identified as:

Scenario	Baseline options			Description
	Waste gas use	Power generation	Heat generation	
1	W2	P10	H7	Waste gas is released to the atmosphere after incineration or waste heat is released to the atmosphere. The Korea Electricity Power Corporation Grid provides the equivalent electricity. Heat be produced by a new fossil fuel based element process;

As per ACM0012, the methodology is only applicable if the baseline scenario for all the waste energy generator(s) and the recipient facility(ies) identified, which is one of the scenarios described in table 2 of the methodology. For the proposed project, the combined baseline scenario falls to Baseline Scenario-2 which is as follow:

Project activity: Cogeneration of energy					
Baseline Scenario	Combination of baseline scenarios				Description of project activity
	Waste energy	Power	Heat	Mechanical Energy	

Baseline Scenario-2 1. The waste energy of WECM(s) recovered in the projects is released to atmosphere/ flared/ unutilised; 2. The electricity is obtained from a Greenfield or identified existing fossil fuel power plant or from the grid; 3. Mechanical energy is obtained from existing/ new electrical motors or fossil fuel based steam turbine; 4. Heat/steam from a existing/new fossil fuel based steam element process	W1, W2	P6, P8, P10,	H6, H7	M2, M3, M7, M8	• Cogeneration of heat and electricity and/or mechanical energy at project facility; • The generation of steam for mechanical energy can be in combination with the generation of steam to meet heat demand.

2.5 Additionality

To prove the additionality of this project, "tool for the demonstration and assessment of additionality (version 5.2.1)" is applied.

Step 1. Identification of alternatives to the project activity consistent with current laws and Regulations.

Define realistic and credible alternatives to the project activities through the following Sub-steps:

Sub-step 1a. Define alternatives to the project activity:

According to the analysis in 2.4 of this PD, the realistic and credible baseline alternatives are as follows:

Scenario	Baseline options			Description
	Waste gas use	Power generation	Heat generation	
1	W2	P10	H7	Waste gas is released to the atmosphere after incineration or waste heat is released to the

				atmosphere. The Korea Electricity Power Corporation Grid provides the equivalent electricity. Heat be produced by a new fossil fuel based element process;
2	W4 W6	P1	H1	Project activity being implemented without VCS

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

The above-mentioned combination alternative is in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Step 2: Investment analysis.

Three analysis methods suggested by Tools for the demonstration and assessment of additionality are simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III).

Option I: Simple cost analysis, does not apply as the project generates economic returns through the sales of electricity to the local grid.

Option II: Investment comparison analysis is not appropriate as the only realistic alternative to the project: The electricity is imported from Korea Electricity Power Corporation Grid (the baseline scenario P10) is not the specific investment project.

Option III: Benchmark analysis is appropriate.

The following analysis will be conducted through Option III of the additionality tool, i.e. Benchmark analysis.

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

Benchmark IRR determination

According to “KPX Knowledge Power 2009” published by Korea power exchange. The project IRR benchmark for power generation project is 7.5%. Hence, the proposed project adopts this benchmark.

Parameters used for calculation of financial indicators

Parameters used for calculation of financial indicators are as follows:

Parameters used for calculation of financial indicators

No.	Item	Value	Unit	Source
1	Installed capacity	400	MW	Hyundai power plant financial analysis
2	Annual electricity generated	2,885,300	MWh/yr	
3	total static investment	525.93	Billion KRW	
4	bus-bar tariff	81	KRW/KWh	
5	heat price	25,000	KRW/ton	
6	income tax	25	%	
	lower than 100miliion	13%	-	
	higher than 100millon	25%	-	
7	depreciation	30	years	
8	Maintenance Cost	2%	-	
9	Insurance	2	Billion KRW	
10	Natural gas cost	583	KRW/Nm^3	
11	Expected VER price	4000	KRW/tCO2e	

Waste gas cost of this project

According to the agreement between project owner and waste gas supplier, the project owner should pay for the waste gas from waste gas supplier. The cost of waste gas is determined by the Revenue of this project, the operation cost, and the Dividends of the capital fund as the profit of this project owner's. So the Cost of waste gas will vary when the Revenue and the operating cost changes.

Profit of the investors

According to the stakeholders' agreement, the annual profits of the investors are the Dividends of the capital fund invested and the carbon credit produced by the project.

Comparison of the project IRR and the financial benchmark

The project IRR with and without VER revenue is as follows:

Financial indicator of this project

Item	Without VERs	With VERs	Benchmark
IRR (Total investment)	5.47%	7.09%	7.5%

The table above shows the project IRR with and without the income from VER revenues. Without VER revenues, the project IRR is 5.47% which is lower than the financial benchmark. So this project is not financial attractive. Even when the VER revenues are considered, the project IRR is only 7.09%, which is still lower than the IRR benchmark. Thus, the proposed project is not financially acceptable. Therefore, the VER revenues are helpful to overcome the investment barriers.

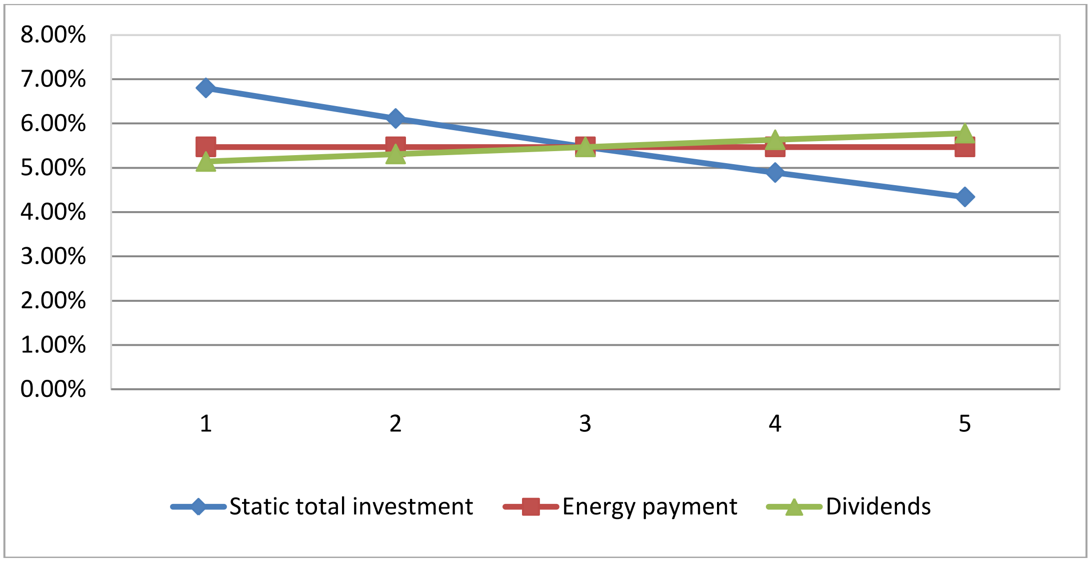
Sensitivity analysis

As it was described above, in this project, since the waste gas cost is determined by the Revenue of this project minus operation cost and 10% of Dividends of the capital fund as the profit of this project, so the project IRR will not change when the parameters vary except the total investment and the dividends change.

Assuming the two factors vary in the range of -10% to 10%, the project IRR (without the income from VER revenue) varies to different extents shown as follows:

Sensitivity analysis of the proposed project

	-10.00%	-5%	0	5.00%	10%
Static total investment	6.80%	6.11%	5.47%	4.89%	4.34%
Energy payment	5.47%	5.47%	5.47%	5.47%	5.47%
Dividends	5.14%	5.31%	5.47%	5.63%	5.78%



The Sensitivity analysis above shows that, when the Total investment， Energy Payment and Dividends are changing within the range of -10% to 10%, the IRR of the proposed project is always lower than the investment benchmark, and lacking of financial attractiveness.

In summary, the project would be lacking financial attractiveness without VER revenues.

Step 3. Barrier analysis.

According to the Tool for the demonstration and assessment of additionality (version 5.2.1), barrier analysis can be passed if the project activity satisfies the conditions for investment analysis. Since this project satisfies the conditions for investment analysis, barrier analysis is not needed.

Step 4. Common practice analysis.

Sub-step 4a. Analyze other activities similar to the proposed project activity

For common practice analysis, we analyzed all waste gas power generation project from steel mills. In Korea, there are only two steel manufactures which use the INTEGRATED steel mill; POSCO and Hyundai. Other remaining steel manufactures use the electric furnace which does not generate/emit the BFG, COG, and LDG during the process. There are totally 3 wasted gas generation projects in Korea including the proposed project. The other two projects in Korea have claimed environmental credit in Korea. All information for the 3 projects are as follows:

Table 7. Comparison of similar projects in Korea, of Republic

The proposed Project	•Scale of Power plant(MW) : 400 (100 MW X 4) •Fuel: BFG, COG, LDG •Usage of power : GRID •Power plant Facility: Subcritical Drum Type •Environmental Credit : VCS is the only consideration
POSCO Guangyang Cogeneration Facility that uses unused waste gas	•Starting date : 2004.11 •Fuel : BFG •Usage of power: Captive power •Power plant Facility: Steam turbine cogeneration •Environmental credit : KCER (Korea Certified Emission Reductions)
POSCO Pohang FINEX power plant	•Starting date : 2004.07 •Scale of power plant (MW) : 145.9 •Fuel : FOG (FINEX off gas) •Usage of power : captive •Environmental Credit : KCER •Power plant Facility : Gas turbine cogeneration

Sub-step 4b: Discuss any similar Options that are occurring:

According to 4a, the other two similar projects in Korea have claimed KCER. It means that without claiming KCER, the two projects will also face the barrier similar with the proposed project. So it can conclude that the proposed project is not a common practice.

In conclusion, based on the analysis above, according to ACM0012 and Combined tool to identify the baseline scenario and demonstration and assessment of additionality, the proposed project fulfils the requirements of additionality, so the proposed project is additional.

2.6 Methodology Deviations

There are no any other methodology Deviations

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

Emission Reduction of the proposed project can be determined as follows

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

Where:

ER_y = Emission Reductions during the year y

BE_y = The total baseline emissions during the year y

PE_y = The total project emissions during the year y

LE_y = The total Leakages during the year y

3.1 Baseline Emissions

According to methodology ACM0012 ver.4.0.0, the baseline emission calculation shall be determined as follows:

$$BE_y = BE_{En,y} + BE_{flst,y} \tag{2}$$

Where:

BE_y	=	The total baseline emissions during the year *y* in tCO_2.
$BE_{En,y}$	=	The baseline emissions from energy generated by the project activity during the year *y* in tCO_2.
$BE_{flst,y}$	=	Baseline emissions from fossil fuel combustion, if any, either directly for flaring of waste gas or for steam generation that would have been used for flaring the waste gas in the absence of the project activity (tCO_2).

As for the proposed project, there is no fossil fuel combusted for flaring the waste gas in the absence of the proposed project. So $BE_{flst,y}$ =0.

1. Baseline emissions from energy generated by the project activity ($BE_{En,y}$).

According to the methodology BE_y of The proposed project should be calculated as follows

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \tag{3}$$

Where:

$BE_{Elec,y}$	=	Baseline emissions from electricity during the year *y* in tCO_2.
$BE_{Ther,y}$	=	Baseline emissions from thermal energy (due to heat generation by elemental processes) during the year *y* (tCO_2).

(a) Baseline emissions from electricity ($BE_{Elec,y}$) generation.

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y}) \tag{4}$$

Where:

$BE_{elec,y}$	=	Baseline emissions due to displacement of electricity during the year *y* (tCO_2)
$EG_{i,j,y}$	=	The quantity of electricity supplied to the recipient *j* by generator, which in the absence of the project activity would have been sourced from source *i* (the grid) during the year *y* in MWh.
$EF_{elec,i,j,y}$	=	The CO_2 emission factor for the electricity source *i* (gr for the grid), displaced due to the project activity, during the year *y* (tCO_2/MWh).
f_{wcm}		Fraction of total electricity generated by the project activity using waste energy. This fraction is 1 if the electricity generation is purely from use of waste energy.
f_{cap}		Factor that determines the energy that would have been produced in project year *y* using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year *y*. The ratio is 1 if the waste energy generated in project year *y* is the same or less than that generated at a historical level.

For f_{wcm} *calculation of* the proposed project, calculating f_{wcm} is not available due to technical constraints; the emissions due to auxiliary fossil fuel combusted will be calculated in project emission according to ACM0012 ver11 equation 41.

As the proposed project is a Greenfield power plant f_{cap} of this project is 1.

For this project, the power will export to gird so $EF_{elec,i,j,y}= EF_{elec,gr,j,y,}$ the CO_2 emission factor of the electricity $EF_{elec,gr,j,y}$ shall be determined following the guidance provided in the "Tool to calculate the emission factor for an electricity system".

According to "Tool to calculate the emission factor for an electricity system" $EF_{elec,gr,j,y,}$ is calculated as following steps:

Step 1. **Identify the relevant electric power system**

Only KPX and its system are operating in South Korea. Therefore the only relevant electricity system in terms of the Project is the KPX grid.

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.

For the proposed project, **Option I** was selected.

Step 3. **Select an operating margin (OM) method**

Calculation of OM emission factor should be based on one of the following four methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch Data Analysis OM, or

(d) Average OM.

The simple OM method can only be used where low-cost/must run resources constitute less than 50% of total grid generation in: (1) average of the five most recent years, or (2) based on long-term normal for hydroelectricity production. Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants. From 2005 to 2009, the low cost must run resources constitute less than 50% of total amount grid generation output. (See Table 7). Therefore, method (a) is applicable for the project.

According to the domestic electric power generation report based on the energy sources by the Host Country (South Korea), the percentage of the generation by low-cost/must-run power pants does not exceed 50% of the whole accumulated generation amount. In fact, according to the data produced in last 5 years (2005-2009), the average percentage of low-cost/must-run is 40.1% (data source: KEPCO). Therefore, the Project can use Option (a) simple OM.

Table 7. The ratio must run/low cost resources constitute of total grid in Korea, Republic (Unit：GWh)

Year	Total Power Generation	Others	Low-cost/Must-run					
			Hydro	Anthracite Coal	Nuclear	Alternative Energy	Total	Ratio (%)
2005	364,638	206,476	5,189	5,790	146,779	404	158,162	43.4%
2006	381,181	220,993	5,219	5,709	148,749	511	160,188	42.0%
2007	403,125	248,253	5,042	6,062	142,937	831	154,872	38.4%
2008	422,355	257,531	5,563	6,930	150,958	1,373	164,824	39.0%
2009	433,604	270,423	5,641	7,978	147,771	1,791	163,181	37.6%
The rate of low cost/ must run power generation (%)								40.1%

Source : Year of Energy Statistics 2010 (KEPCO)

According to "Tool to calculate the emission factor for an electricity system". for the simple OM, the emissions factor can be calculated using either of the two following data vintages:

Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation.

Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

For the proposed project the Ex ante option is adopted.

Step 4.
Calculate the operating margin emission factor according to the selected method (Simple OM)

According to the "Tool to calculate the emission factor for an electricity system", the Simple OM emission factor $EF_{grid\ OM\ simple\ y}$ 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-operating cost and must-run power plants/units, It may be calculated:

- Option A: Based on data on fuel consumption and net electricity generation of each power plant/unit, or

- Option B: Based on data on net electricity generation, the average efficiency of each power unit and the fuel type used in each power unit, or

- Option C: Based on data 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.

In South Korea, it is possible to have access to the data which shows energy consumption and net generation by power plant and by unit therefore the Project can use Option A. Simple OM calculates the output as follows :

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (5)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO2 emission factor in year *y* (tCO2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO2 emission factor of power unit *m* in year *y* (tCO2/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 $EF_{EL,m,y}$

According to the tool 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:

$$EF_{EL,m,y} = \frac{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad (6)$$

Where:

$EF_{EL,m,y}$	=	CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power unit *m* 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)
$EF_{CO2,i,y}$	=	CO2 emission factor of fossil fuel type *i* in year *y* (tCO2/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

- **Option A2.** If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \textbf{(7)}$$

$EF_{EL,m,y}$	=	CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y*(tCO2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
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

- **Option A3.** If for a power unit *m* only data on electricity generation is available, an emission factor of 0 tCO2/MWh can be assumed as a simple and conservative approach.

In Korea, the data on fuel consumption and electricity generation are available for almost all of the power units, so Option A1 was adopted in calculation. However, for the power unit which only data on electricity generation is available, Option A3 was adopted.

In the case of the Project, the values applied to $EF_{CO\ i\ y}$ have been calculated for this PD by using the 2006 IPCC Guidelines. NCV *i y* has been specified by the Country-specific data according to STATISTICS OF ELECTRIC POWER IN KOREA published by KEPCO. Details about the calculation are included in the attached excel file for Emission Factor calculation.

AS a result the OM output value is 0.7224 (tCO_2/MWh)

Step 5: Calculation the Build Margin emission factor ($EF_{grid,BMy}$ ***)***

According to the tool, 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.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*.

For the proposed project, Option1 was chosen.

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 ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEGS_{ET\text{-}5\text{-units}}$, 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}. And determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);.

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%.}$ Select the set of power units that comprises the larger annual electricity generation.

For the proposed project, $SET_{\geq 20\%}$ was selected because it comprises the larger annual electricity generation. Detail information was described in Emission Factor calculation sheet .

According to "Tool to calculate the emission factor for an electricity system", $EF_{grid,BM\,y}$ is determined by the formula as follow:

$$EF_{grid,BM\,y} = \frac{\sum_m EG_{m\,y} \times EF_{EL\,m\,y}}{\sum_m EG_{m\,y}} \quad \textbf{(8)}$$

Where:

$EF_{grid,BMy}$	=	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).
$EF_{ELm,y}$	=	the CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ).
EG_y	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh).
y	=	Most recent historical year for which power generation data is available.

AS a result of BM calculation , $EF_{grid,BMy}$ is 0.6059 (tCO_2e/ MWh).

Step 6. Calculate the combined margin emission factor EF_y.

According to "Tool to calculate the emission factor for an electricity system" $EF_{grid,CMy}$ is calculated using the flowing formula.

EF_y = W_{OM} x $EF_{grid,OMy}$ + W_{BM} x $EF_{Bgrid,BMy}$ **(9)**

$EF_{grid,BMy}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh).
$EF_{grid,OMy}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
W_{OM}	=	Operating margin CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ).
W_{BM}	=	Build margin CO_2 emission factor of power unit m in year y (tCO_2/MWh).

$EF_{grid,CMy}$ = W_{OM} x $EF_{grid,OMy}$ + (W_{BM} x $EF_{Bgrid,BMy}$)

= (0.5 x 0.7224) + (0.5 x 0.6059) = 0.6641 (tCO2/MWh)

Detail information for calculation of EFgrid can be found in attachment EFgrid calculation.

(b) Baseline emissions for generation of thermal energy ($BE_{ther,y}$) and steam-generated mechanical energy

The proposed project will not claim GHG emission reductions from thermal energy for conservative, so this step is skipped.

Ex-ante calculation of Baseline emission reductions:

As detail described above Ex-ante calculation of emission reductions are calculated as follows

$$BE_y = BE_{En,y} + BE_{flst,y}$$

$$= BE_{Elec,y} + BE_{Ther,y} + BE_{flst,y}$$

$$= f_{cap} * f_{wcm} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y}) + BE_{Ther,y} + BE_{flst,y}$$

= 1×1×2,741,035 MWh×0.6641 tCO_{2e}/MWh+0+0

= 1,820,321 (tCO2e)

Detail information for Ex-ante calculation of Baseline Emission calculation can be found in the excel file attachment of "ER calculation sheet".

3.2 Project Emissions

Project Emissions include emissions due to (1) combustion of auxiliary fuel to supplement waste gas/heat, and (2) electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption.

$$PE_y = PE_{AF,y} + PE_{EL,y} \quad \textbf{(10)}$$

Where:

PE_y	=	Project emissions due to the project activity (tCO_2).
$PE_{AF,y}$	=	Project activity emissions from on-site consumption of fossil fuels by the unit process(es).
$PE_{EL,y}$	=	Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (tCO_2).

For $\mathbf{PE_{AF,y}}$, according to methodology, it should be calculated only in two situations: (1) when the auxiliary fossil fuel is used to supplement the waste energy directly in the waste heat recovery combustion systems, where the energy output cannot be apportioned between fossil fuels and the waste energy, and (2) when the calculation of F_{wcm} is practically not possible due to technical constraints.

As for the proposed project, calculation of F_{wcm} is practically not possible due to technical constraints, and calculation of F_{wcm} is skipped in calculation of Baseline emissions on equation 4 in this PD. So $PE_{AF,y}$ should be calculated.

In the proposed project, although LNG is not used for the purpose of generation, LNG will be used for sparking when starting up and in case the NCV of waste gas is too low to burn. The emission due to consumption of LNG will be calculated according to latest approved tool “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”.

According to the tool CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$\mathrm{PE}_{\mathrm{AF,j,y}} = \sum_i AF_{i,j,y} \times COEF_{i,y} \qquad \textbf{(11)}$$

Where:

$\mathrm{PE}_{\mathrm{AF,j,y}}$	=	Are the CO2 emissions from fossil fuel combustion in process j during the year y (tCO2/yr);
$AF_{i,j,y}$	=	Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr);
$COEF_{i,y}$	=	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)
i	=	Are the fuel types combusted in process j during the year y

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

Option A: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i, using the following approach:

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

$$COEF_{j,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad \textbf{(12)}$$

Where:

$COEF_{j,y}$	=	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ)
i	=	The weighted average CO2 emission factor of fuel type I in year y.

For the proposed project Options B was adopted.

As for **$PE_{EL,y}$**, according to Methodology ACM0012, project emissions due to electricity consumption of gas cleaning equipment or other supplementary electricity consumption are calculated by using latest approved tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

According to the Tool, baseline methodology procedure should be followed: first a generic approach to calculate emissions from consumption of electricity is introduced. Then guidance on the determination of the emission factor for electricity generation is provided. Finally, simplified alternative approaches to the generic approach are introduced. These simplified alternative approaches are only applicable to scenario B and to project and leakage emissions.

Generic approach

According to the tool, the project emissions from consumption of electricity are calculated based on the following formula

$$PE_{EL,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \textbf{(13)}$$

Where:

$PE_{EL,y}$	=	Project emissions from electricity consumption in year y (tCO2/yr).
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr).
$EF_{EL,j,y}$	=	Emission factor for electricity generation for source j in year y (tCO2/MWh).
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y.

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

The determination of the emission factors for electricity generation ($EF_{EL,j,y}$) depends on which scenario (A, B or C) applies to the source of electricity consumption:

According to the tool, the proposed project falls to scenario A: Electricity consumption from grid. In case of this scenario 2 options can be chosen:

Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the .Tool to calculate the emission factor for an electricity system. ($EF_{EL,j,y} = EF_{grid,CM,y}$).

Option A2: Use the following conservative default values

- A value of 1.3 tCO2/MWh if

  (a) Scenario A applies only to project and/or leakage electricity consumption sources, but not to baseline electricity consumption sources; or

  (b) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources.

- A value of 0.4 tCO2/MWh for electricity grids where hydro power plants constitute less than 50% of total grid generation in 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production, and a value of 0.25 tCO2/MWh for other electricity grids. These values can be used if

  (a) Scenario A applies only to baseline electricity consumption sources but not to project or leakage electricity consumption sources ; or

  (b) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and leakage sources.

In the proposed project, Option A1($EF_{EL,j,y} = EF_{grid,CM,y}$) was selected.

Alternative approaches for project and/or leakage emissions

As the proposed project is not scenario B, so this step was skipped.

Ex-ante calculation of Project emission reductions:

As detail described above Ex-ante calculation of emission reductions are calculated as follows

$$PE_y = PE_{AF,y} + PE_{EL,y}$$

$$= \sum_i AF_{project,i,y} * NCV_i * EF_{AF,i} + PE_{EL,y}$$

= 12.93 Gg * 50.4TJ/Gg * 58300 kgCO2/TJ/1000 + 9,579 MWh * 0.6641 tCO_{2e}/MWh *(1+20%)

= 45,622 (tCO_2e)

Detail information for Ex-ante calculation of Project Emission calculation can be found in the excel file attachment of “ER calculation sheet”.

3.3 Leakage

In accordance with ACM 0012, no leakage is considered.

3.4 Summary of GHG Emission Reductions and Removals

Years	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year 2010	1,516,934	38,018	0	1,478,916
Year 2011	1,820,321	45,622	0	1,774,699
Year 2012	1,820,321	45,622	0	1,774,699
Year 2013	1,820,321	45,622	0	1,774,699
Year 2014	1,820,321	45,622	0	1,774,699
Year 2015	1,820,321	45,622	0	1,774,699
Year 2016	1,820,321	45,622	0	1,774,699
Year 2017	1,820,321	45,622	0	1,774,699
Year 2018	1,820,321	45,622	0	1,774,699
Year 2019	1,820,321	45,622	0	1,774,699
Year 2020	303,387	7,604	0	295,783
Total (tCO2)	18,203,210	456,220	0	17,746,990

4 MONITORING

4.1 Data and Parameters Available at Validation

Data Unit / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin emission factor
Source of data:	calculated
Value applied:	0.7224 tCO_2 /MWh
Justification of choice of data or description of measurement methods and procedures applied:	The data calculation was done according to “Tool to calculate the emission factor for an electricity system”.
Any comment:	The value numbers were calculated around the time of the submission of the PD and would not change during the accreditation period.

Data Unit / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh

Description:	Build Margin emission factor
Source of data:	calculated
Value applied:	0.6059 tCO_2 /MWh
Justification of choice of data or description of measurement methods and procedures applied:	The data calculation was done according to " Tool to calculate the emission factor for an electricity system".
Any comment:	The value numbers were calculated around the time of the submission of the PD and would not change during the accreditation period.

Data Unit / Parameter:	EF_y
Data unit:	tCO_2/MWh
Description:	Carbon emission factor of Korea National power grid
Source of data:	calculated
Value applied:	0.6641 tCO_2/MWh
Justification of choice of data or description of measurement methods and procedures applied:	The data calculation was done according to " Tool to calculate the emission factor for an electricity system".
Any comment:	The value numbers were calculated around the time of the submission of the PD and would not change during the accreditation period.

Data Unit / Parameter:	$COEF_{j,y}$
Data unit:	kgCO2/TJ
Description:	Weighted average CO2 emission factor of fuel type i in year y
Source of data:	IPCC2006
Value applied:	54,300
Justification of choice of data or description of measurement methods and procedures applied:	-
Any comment:	-

Data Unit / Parameter:	$TDL_{j,y}$

Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption.
Value applied:	20%
Justification of choice of data or description of measurement methods and procedures applied:	Use as default values of 20% for project or leakage electricity consumption sources according to “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.
Any comment:	-

Data Unit / Parameter:	NCV_i (for FE_{grid} calculation)
Data unit:	kcal/l, kcal/kg
Description:	Net calorific value for fuel consumed in OM power plants.
Source of data:	STATISTICS OF ELECTRIC POWER IN KOREA(2007,2008,2009)
Value applied:	See attachment FE_{grid} calculation
Justification of choice of data or description of measurement methods and procedures applied:	-
Any comment:	-

4.2 Data and Parameters Monitored

Data Unit / Parameter:	$EG_{j,y}$
Data unit:	MWh
Description:	Quantity of electricity supplied to the grid by the project activity during the year *y.*
Source of data:	Measurement records
Description of measurement methods and procedures to be applied:	Direct measurement by project participants through standard meter continually. And the data can be monitored by the system of EMS-IRTV.

Frequency of monitoring/recording:	The electricity generation amount will be monitored continuously and record every day.
Value applied:	2,741,035
QA/QC procedures to be applied:	The meters would be calibrated every 3.5 years.
Calculation method:	-
Any comment:	

Data Unit / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Quantity of electricity consumed by the project electricity consumption source j in year y.
Source of data:	Measurement records
Description of measurement methods and procedures to be applied:	Direct measurement by project participants through standard meter continually.
Frequency of monitoring/recording:	Be monitored continuously and record every month.
Value applied:	9,579
QA/QC procedures to be applied:	The meters would be calibrated every 3 years.
Calculation method:	-
Any comment:	

Data Unit / Parameter:	$AF_{i,j,y}$
Data unit:	Nm^3
Description:	LNG consumed on-site for power generation.
Source of data:	Measurement records.
Description of measurement methods and procedures to be applied:	Direct measurement by project participants through standard flow meter continually.
Frequency of monitoring/recording:	Direct measurement by project participants through standard meter continually. And, the data can be monitored by DCS.

Value applied:	18,100,000
QA/QC procedures to be applied:	The meters would be calibrated by LNG supplier when the meter is at abnormal condition.
Calculation method:	-
Any comment:	

Data Unit / Parameter:	NCV_i (for $AF_{i,j,y}$ calculation)
Data unit:	TJ/Gg
Description:	Net calorific value for fuel LNG
Source of data:	IPCC 2006[4]
Description of measurement methods and procedures to be applied:	IPCC default values at the upper limit of the uncertainty at a 95% according to "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".
Frequency of monitoring/recording:	-
Value applied:	50.4
QA/QC procedures to be applied:	-
Calculation method:	-
Any comment:	The value will be upgraded when the value in IPCC changed.

Data Unit / Parameter:	$EF_{CO2,i,y}$
Data unit:	KG/TJ
Description:	CO2 emissions factor for LNG.
Source of data:	Measurement records.
Description of measurement methods and procedures to be applied:	IPCC default values at the upper limit of the uncertainty at a 95% according to "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".
Frequency of monitoring/recording:	-

[4] The NCV_i is used only in calculating project emission caused by LNG consumption. And in the calculation for EFOM and EFBM, the specific NCV of LNG for each power plant was adopted.

Value applied:	58,300
QA/QC procedures to be applied:	-
Calculation method:	-
Any comment:	The value will be upgraded when the value in IPCC changed.

Data Unit / Parameter:	Energy balance of Hyundai Steel Mill
Data unit:	-
Description:	Energy balance of Hyundai Steel Mill including all the internal use of waste gas and waste gas send to Hyundai Greenpower
Source of data:	Measurement records.
Description of measurement methods and procedures to be applied:	Related data directly measured by project participants through standard meter continually. And, the data can be monitored by DCS.
Frequency of monitoring/recording:	Monthly, aggregated annually
Value applied:	-
QA/QC procedures to be applied:	-
Calculation method:	-
Any comment:	-

4.3 Description of the Monitoring Plan

1. Allocation of project management

The Engineering Team at Hyundai Green Power plant is responsible for the monitoring plan of the proposed project. The team manages the measurement and record of all data and the maintenance of equipment associated with the project. Operators under the Engineering Team are composed to implement the accurate monitoring, and are assigned to the task of monitoring as follows;

<VCS Team>

Head of Energy P/T

↓

VCS Manager

↓

Operators

	Tasks
Head of Energy P/T	-Cross-check and management of monthly an annual data related to ER calculation. - Check the annual emission reduction and approve the monitoring report.
VCS Manager	- Check and verification of monthly and annual data related to ER calculation. - Calculation of annual GHG emissions reduction and documentation of monitoring report, and report to Head of Energy P/T.
Operator	Operation of facilities and logging. - Logging and record of daily data related to ER calculation. - Maintenance and management of meters. - report to VCS manager every month about the monitored data.

All of the team members are from Hyundai Green Power and Hyundai Steel Mill. A head of Energy P/T and the VCS Manager who are from Hyundai Green Power are mainly in charge of the monitoring for the proposed project. Some of the operators are from Hyundai Steel mill who are in charge of providing the data of electricity consumed in the proposed project.

All monitored data will be kept during the crediting period and 2 years after the end of crediting period.

2. Management and operational system

2.1 Data collection and storage

For power generation, the data will be monitored and collected by EMS-IRTV system. Also, the data collected by EMS-IRTV will be sent to Korea Power exchange for the purchase of electricity and will be stored for 3 years.

For LNG consumption, the data will be displayed by DCS with accumulated flow; the amount of LNG consumption will be reported every month and will be stored for 3 years.

2.2 Cross checking

The amount of power generation and LNG consumption will be crosschecked with the receipt, if there is any deference between monitored data and receipt, the reason of the deference must be found out. If it cannot be found out, for conservative consideration, the data leading to lower Emission Reductions will be used for calculation.

2.3 Training

Internal training is provided to operational staff to enable them to undertake the tasks required by the monitoring plan and to share the latest information on relevant laws and regulations.

3. Procedures for handling internal auditing and non-conformities

Internal auditing procedures will be followed after the data were collected and the emission reduction was calculated. The procedures of internal auditing are as follows:

(a) Set up an internal audit team, the team members are mainly consisted by the VCS team

(b) Set up an internal auditing plan, the main process of the internal auditing is to check the accuracy of the calculation and data collection. Members should not audit the parts which they are in charge of.

(c) If some non-conformities were found, the one who in charge of it should be informed and be ordered to correct

(d) The Emission Reduction calculation and monitoring report should be revised according to the result of the internal auditing.

5 ENVIRONMENTAL IMPACT

The project performed a test on potential environmental impact on the air, water, and thermal effluent. According to the test, because the project uses waste gas as a fuel in order to produce electricity and steam, in terms of environmental impact, there are more positive aspects than negative ones.

Geographic feature
The by-product gas power plant is located in the area of Dangjin Hyundai Steel Mill and to the north there is a sea port, to the east there are Steel Mill road and the drainage canal, to the west there is a steel mill and to the south there is an oxygen plant. Thus, the project has a plenty of distance from the residential area and between the Project site and the residential areas. Therefore, noise and shaking are considered not to be negative factors.

Atmosphere environment

Because by-product gases go through pre-processing at the steel mill before being supplied, sulphur oxides and dust created from usage of these by-product gases at the mill are expected to be insignificant.

Aquatic environment
Waste water from the plant is planned to be released after being processed through treatment facilities and meeting the effluent quality standard. Further, the waste water is to be released after its quality is above the standard and does not contain any toxic substance or heavy metal element. Therefore, it would have no impact on the aquatic environment.

Warm waste water from the power plant:
Civil complaints are expected, research on the impact of the warm waste water from the power plant is scheduled to be carried out.

6 STAKEHOLDER COMMENTS

Hyundai Green Power the owner of the Project held a series of meetings with local residents for the purpose of informing the local residents about the environmental effects and the development plans, and also received feedbacks from them. The residents expressed their concerns about the noise, pollution, and spreading of thermal effluent which have been taken into consideration. A series of solutions to minimize such civil complaints have been made and implemented.

< Presentation location, date and time>

- Location: Songsan-myun senior hall (Dangjin-goon Songsan-myun)
- Date and Time : 2008/09/09 15:00~~
- Audience: residents, organizations and entities that have their addresses in the region which would environmentally be affected by the implementation of the project.

Figure 6. Stakeholders' meeting

Main comment by stakeholders and the reply from Hyundai green power are as follows:

NO.	comment	Reply from Hyundai
1	Please control the noise made during the construction period.	We will set up a plan to reduce the noise.
2	I am one of the residents within 5km. I know it is impossible that there is totally no pollution by the waste gas power generation plant. I just hope that the measures you promised us to minimize the pollution will be put into practice.	Yes, we will try our best to minimize the pollution and put them into practice.
3	We are worrying about the noise and the dangers caused by the trucks during construction. Please try to control the noise and be careful about the local residents to let them out of danger.	We will set up a plan to reduce the noise and the dust caused by trucks.
4	Please submit the internal environment	Yes, we will submit the internal

	management standard.	environment management standard, which is stricter than the national standard.
5	Please change the condensing technology from warming water emission to condensing tower.	We will submit the comparative study of two technologies and choose the technology of condensing tower.
6	Please do some researches to reuse the waste heat from the project.	We will set up a plan to research to find any technology to improve the efficiency of the power generation, and to reuse the waste heat from the project.

Actions for stakeholders' comments:

A series of actions have been implemented to respond for the stakeholders' comments. The detail actions are as follow:

1. Management to control noise during construction

Noise level has been checked periodically and a noise reducing percussive-rotary drilling (PRD) has been applied during the construction.

2. Plan for minimizing pollutants

Stricter standards than the legal standards for pollutants emission were applied

List		Legal standard	Internal standard
Air	NOx(PPm)	<50	<20
Waste water	pH	5.8~8.6	6.0~8.0
	BOD(mg/L)	<80	<20
	COD(mg/L)	<90	<20
	SS(mg/L)	<80	<20
	T-N(mg/L)	<60	<60
	T-P(mg/L)	<8	<8
	N-H Extracts(mg/L)	<5	<0.5
	Temp. (℃)	<40	<40
Black water	BOD(mg/L)	<20	<20
	SS(mg/L)	<20	<20

3. Noise control and risk management due to trucking

- Applied lots of washing facilities for trucks to reduce the dust

- Added covers for trucks in order to prevent things dropped from trucks to reduce the danger.

- Added lots of speed limit signs to control the speed of trucks.

4. Warm water discharging method analysis

During the construction of Hyundai Green-Power plant No.1-4, Hyundai Green power CO. collected extensive opinions from stakeholders and administrative agencies, and selected a submerged cooling water intake/discharge method that reduced the distance and the diffusion area of mixing the surface layer and the bottom layer. In order to decrease the temperature of heated effluent, the length of drainpipe was extended to 1,570m (existing 600m).

5. Recycling methods of waste energy resource

The researches to recycle the waste energy and improve the efficiency of power generation have been underway. We will try to recycle the waste energy if we find some technology that is adaptable to us.