

VALIDATION REPORT FOR THE HYUNDAI STEEL WASTE ENERGY RECOVERY CO- GENERATION PROJECT PHASE II



First Environment, Inc.
91 Fulton Street
Boonton, New Jersey 07005

Project Title	The Hyundai Steel Waste Energy Recovery Co-Generation Project Phase II
Version	1.1
Report ID	1.0

Report Title	Validation Report for The Hyundai Steel Waste Energy Recovery Co-Generation Project Phase II
Client	CERPD, Inc.
Pages	17
Date of Issue	17-12-2014
Prepared By	First Environment, Inc.
Contact	91 Fulton Street; Boonton, NJ 07005. (973) 334-0003 http://www.firstenvironment.com
Approved By	James Wintergreen
Work Carried Out By	Michael Carim Luca Nencetti Iris Caldwell Howard Kanter

Summary:

The Hyundai Steel Waste Energy Recovery Co-Generation Project Phase II (hereafter, the Project) consists of a 400MW cogeneration plant operated by Hyundai Green Power Co., utilizing waste gases produced by the Dangjin Hyundai Steel Mill facility to generate steam for internal consumption and electricity that is exported to the grid.

The Project achieves GHG emission reductions by avoidance of carbon dioxide emissions from fossil fuel power plants connected to the electricity grid supplied by the project activity.

The validation process consists of the independent third-party assessment of the project design and emission reduction assertion against the criteria stated in the Verified Carbon Standard (VCS) Version 3, 8 October 2013, v3.4 and the approved Clean Development Mechanism (CDM) consolidated methodology ACM0012 "Alternative waste treatment processes," Version 4.0.0.

During the validation process, First Environment, Inc. (First Environment) issued 22 requests for clarification and 18 requests for corrective action, all of which were addressed sufficiently. In summary, First Environment is reasonably assured that the Project meets all relevant VCS Version 3 requirements and correctly applies the VCS-approved CDM methodology ACM0012 (Version 4.0.0).

Table of Contents

1	Introduction.....	1
1.1	Objective	1
1.2	Scope and Criteria	1
1.3	Level of Assurance.....	1
1.4	Summary Description of the Project.....	1
2	Validation Process	2
2.1	Method and Criteria.....	2
2.2	Document Review	3
2.3	Interviews	3
2.4	Site Inspections	4
2.5	Resolution of Findings.....	4
2.6	Forward Action Requests.....	4
3	Validation Findings	4
3.1	Project Details	4
3.2	Application of Methodology	5
3.2.1	Title and Reference	5
3.2.2	Applicability	5
3.2.3	Project Boundary	7
3.2.4	Baseline Scenario	7
3.2.5	Additionality	9
3.2.6	Quantification of GHG Emission Reductions and Removals	11
3.2.7	Methodology Deviations	12
3.2.8	Monitoring Plan	12
3.3	Non-Permanence Risk Analysis.....	12
3.4	Environmental Impact	12
3.5	Comments by Stakeholders	13
4	Validation Conclusion	13

1 INTRODUCTION

This report is provided to Hyundai Green Power and CERPD, Inc. (collectively CERPD) as a deliverable of the Verified Carbon Standard Version 3 project validation process for the Hyundai Steel Waste Energy Recovery Co-Generation Phase II Project (the Project) located in Dangjin Province, Republic of Korea. This report provides a description of the steps involved in conducting the validation and the findings of the validation performed on the basis of the VCS standard, as well as criteria given to provide for consistent project operation, monitoring, and reporting of greenhouse gas (GHG) emission reductions.

As outlined in the VCS Project Document (VCS PD), the VCS-approved methodology applied to the project activity was the approved CDM Methodology ACM0012 Version 4.0.0, *Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects* (ACM0012). The Audit Team was provided the first version of the VCS PD at the onset of validation activities. Based on this documentation, a document review and desktop audit took place which resulted in corrective action requests (discussed later in this report) and revisions to the VCS PD. The final version, Version 3.6 dated November 26, 2014, serves as the basis of the final conclusions presented herewith.

1.1 Objective

The purpose of validation is to have an independent third party assess the Project's design. In particular, the Project's baseline, monitoring plan, and the Project's conformance with VCS requirements are validated. This is to ensure that the VCS PD, as documented, is sound and reasonable and meets the identified criteria. Validation objectives also include an assessment of the likelihood that the Project will achieve the emission reductions estimated by CERPD. Validation is a requirement for all VCS projects and is seen as necessary to provide assurance to stakeholders of the quality of the Project and its intended generation of emission reductions.

1.2 Scope and Criteria

The validation scope is defined as an independent and objective review of the VCS PD. The Audit Team employed a risk-based approach, focusing on the identification of significant risks for project implementation and the generation of emission reductions. The VCS PD was reviewed against the following criteria:

Standard of Validation	- VCS Standard: VCS Version 3, 8 October 2013, v3.4 - Approved CDM Methodology ACM0012 "<i>Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects</i>," Version 4.0.0
Validation Process	- VCS Standard: VCS Version 3, 8 October 2013, v3.4 - VCS Program Guide, Version 3, 8 October 2013, v3.5 - ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions, 2006

1.3 Level of Assurance

First Environment, Inc. (First Environment) and CERPD have agreed that a reasonable level of assurance be applied for the Project.

1.4 Summary Description of the Project

The Project involves the construction of a new 400MW cogeneration power plant to utilize waste gas generated by the new blast furnace No. 3 constructed at the Hyundai Steel Mill (Hyundai Steel) facility in Dangjin, Korea. The furnace produces blast furnace gas (BFG), coke oven gas (COG), and Linz Donawitz Gas (LDG), which are recovered by Hyundai Steel. Some waste gas is utilized at Hyundai Steel for internal uses and the balance is transferred to the project facility operated by Hyundai Green

Power. The waste gas is combusted in boilers by Hyundai Green Power to produce steam. A portion of the steam produced is returned to Hyundai Steel for use in process applications and the rest of the steam is used to produce electricity, which is exported to the Korean national transmission grid. Both end uses displace fossil fuels relative to the baseline scenario; however, for the purposes of GHG emissions accounting, GHG emission reduction credit is only claimed for the displacement of grid electricity generated from fossil fuels.

The Project is owned and operated by Hyundai Green Power. CERPD, Inc. is the carbon consultant and VCS PD developer. The Project became operational on May 17, 2013.

The VCS PD provides additional details regarding the project activity.

2 VALIDATION PROCESS

2.1 Method and Criteria

The following validation process was used:

- conflict of interest review;
- selection of validation team;
- initial interaction with CERPD;
- development of the validation plan;
- desktop review of the project design and the baseline and monitoring methodology and other relevant project documentation;
- site visit;
- follow-up interaction with CERPD for supplemental information and corrective action as necessary; and
- report development and issuance of final validation statement.

The validation process was utilized to evaluate whether the Project's approach, as outlined in the VCS PD, is consistent with the VCS Standard and the ACM0012 methodology. A validation conformance checklist was developed for the Project which summarizes the criteria used to evaluate the Project, the Project's conformance with each criterion, and the Audit Team's validation findings.

Conflict of Interest Review

Prior to beginning any validation project, First Environment conducts an evaluation to identify any potential conflicts of interest associated with the project. No potential conflicts were found for this Project.

Audit Team

First Environment's Audit Team consisted of the following individuals who were selected based on their validation experience, as well as familiarity with renewable energy operations:

Michael Carim - Lead Auditor
 Luca Nencetti - Auditor
 Iris Caldwell - Auditor
 Howard Kanter - Auditor
 James Wintergreen - Internal Reviewer

Audit Kick-off

Prior to commencing validation activities, First Environment confirmed that the Project was listed in the VCS Project Pipeline. The Project was listed in the VCS Project Pipeline on September 24, 2013. The

validation process was initiated with a kick-off conference call on October 3, 2013 between First Environment and CERPD. The communication focused on confirming the validation scope, objectives, criteria, schedule, and the information required for the validation.

Development of the Validation Plan

The Audit Team formally documented its validation plan as well as determined the validation sampling plan. The validation plan was informed by the kick-off meeting where key elements of the validation's scope were discussed including project team members, project level of assurance, materiality threshold, and standards of reporting and validation. The validation plan also provided an outline of the validation process and established project deliverables. A separate sampling plan was designed to review all project elements in areas of potentially high risk of inaccuracy or non-conformance.

Desktop Review

The Audit Team performed a desktop review of the VCS PD and supporting documentation, as further described in Section 2.2 below.

Site Visit

A site visit was not determined to be necessary in order to achieve the validation objectives with a reasonable level of assurance. The primary parameters in the determination of emission reductions generated by the project activity are the quantity of electricity generated and the grid emission factor for power displaced. Power generated and exported to the grid is monitored using a revenue meter; therefore, the risk of error associated with collected data is inherently low. The grid emission factor is calculated ex-ante and does not require on-site inspection in order to be validated.

Other monitored parameters described in the Project's Monitoring Plan will be assessed on site during the first verification and any discrepancy or deviation from the monitoring approach and/or QA/QC requirements defined in the validated VCS PD will require justification.

Corrective Actions and Supplemental Information

The Audit Team requested clarification and supplemental information as well as corrective action during the validation process. The corrective action and clarification requests, and the responses provided, are summarized in Appendix A.

Validation Reporting

Validation reporting, represented by this report for CERPD, documents the validation process and identifies its findings and results. Validation reporting consists of this report and a separate Deed of Representation to be submitted to the VCS Association.

2.2 Document Review

The Audit Team conducted the validation using the VCS Standard and the ACM0012 methodology as the reference criteria. Additionality, eligibility requirements, baseline scenario(s), project emissions, monitoring plan, and other pertinent criteria were assessed to evaluate the Project's approach as outlined in the VCS PD against the validation criteria. Discrepancies between the VCS PD and the validation criteria were considered material and identified for corrective action. Any deviations from the validation criteria required appropriate justification.

2.3 Interviews

Through the course of validation activities, First Environment interviewed the following project personnel to inform the validation assessment:

- Jongbum Kim – CERPD, Inc.
- Mr. Wang Jun

2.4 Site Inspections

As described above, the Audit Team elected not to conduct a site inspection for the validation of this project activity.

2.5 Resolution of Findings

The Audit Team requested supplemental information and issued 18 requests for corrective actions and 22 for clarification during validation performance. The corrective action and clarification requests and the responses provided are summarized in the table found in Appendix A.

2.6 Forward Action Requests

The following forward action requests are issued as a result of the validation findings.

ID No.	Objective	Forward Action Request
1	EC _{PJ,y} - Grid electricity consumption by the project activity	At the time of the first verification, the Project Proponents must provide appropriate specification and identification of the monitoring equipment as well as details on the monitoring procedure utilized to measure EC _{PJ,y} , in accordance to the requirements of ACM0012.
2	Annex 3 - Energy balance	At the time of the first verification, the Project Proponents must provide appropriate specification and identification of the monitoring parameters, measuring equipment and procedure utilized to calculate the energy balance per Annex 3 of ACM0012. Quality assurance measures performed on data collected will also be requested.

3 VALIDATION FINDINGS

3.1 Project Details

The Project is submitted according the approved CDM methodology ACM0012, which is applicable to the project activity because it falls within the scope of the approved methodology. Specifically, the Project activity involves the conversion of waste energy into useful energy for co-generation of electricity and steam. In the absence of the project activity at the Greenfield project facility, waste gas would not be recovered and would be flared, which is within the scope of ACM0012. Prior to the initiation of the Project activity, all excess waste gas generated would be flared and grid electricity would be generated by fossil-fuel fired sources.

The Project is located in Donggok-ri Songsan-myeon Dangjin-gun Chungchongnam-do, Republic of Korea (36°58'58.27" N; 126°42'11.60" E).

The Project proponents are Hyundai Steel and Hyundai Green Power. CERPD is the carbon consultant and VCS PD developer. The Project's power generation permit issued by the Korean government's Ministry of Commerce, Industry, and Energy were reviewed to confirm right of use relative to Hyundai Green Power. Hyundai Steel's annual report was reviewed to confirm right of use relative to Hyundai Steel.

The Project start date is May 17, 2013, which is the date that Unit 5 at Hyundai Green Power started operation and began generating power and exporting electricity to the grid. This date was confirmed through a review of records filed with the Ministry of Knowledge and Economy documenting the start of commercial operations at the facility.

The estimated GHG emission reductions from the Project activity are 14,416,800 metric tonnes CO₂e during the first crediting period, from May 17, 2013 to May 16, 2023. The Project is a large-scale project under the VCS.

The Project complies with all local laws and regulations. The Audit Team reviewed copies of various State and local permits and approvals in order to confirm that necessary regulatory requirements were met.

The Project does not create any other form of environmental credit nor does it participate in any other GHG or emission trading programme. It is not subject to binding limits nor has it previously been rejected by another GHG programme.

Information related to project investment and waste gas utilization quantities was classified as commercially sensitive information in the VCS PD. The Audit Team reviewed all business confidential information and determined that the classification as “commercially sensitive” is reasonable.

Overall, the Project Proponents provided an accurate, complete description of the project providing a comprehensive understanding of the nature of the project.

3.2 Application of Methodology

3.2.1 Title and Reference

The VCS-approved methodology applied to the project activity is the United Nations Framework Convention on Climate Change's (UNFCCC) Clean Development Mechanism (CDM) ACM0012 “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects,” Version 4.0.0.

The following CDM approved methodology tools were applied to the project activity:

- Tool to calculate the emission factor for an electricity system, Version 4.0.0;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 1.0;
- Tool for the demonstration and assessment of additionality, Version 7.0.0;
- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion, Version 2.0;
- Annex 8, Guidelines on common practice, Version 02.0.

3.2.2 Applicability

The Project activity complies with the applicability requirements of ACM0012. The table below lists the ACM0012 applicability requirements and identifies how the Project meets them. Applicability requirements from ACM0012 that are not relevant to the Project are omitted.

ACM0012 Requirement	Project Conformance	Comments/Findings
The consolidated methodology is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified waste energy carrying medium (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;	Yes	Project involves Cogeneration and Generation of electricity from waste gas recovered from Greenfield blast furnace at steel mill.

ACM0012 Requirement	Project Conformance	Comments/Findings
• generation of heat in element process; • generation of mechanical energy; or • supply of heat of reaction with or without process heating.		
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.	Yes	Project meets conditions under (a) because waste gas used in project activity would be flared in the absence of the project activity at the Greenfield project facility.
Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity.	Yes	Regulations only require the flaring of waste gas, not any beneficial reuse.
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	Yes	Project is implemented at a Greenfield waste energy generation facility.
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.	Yes	Waste energy released during abnormal operations will not be counted toward emission reductions
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.	Yes	Multiple waste gas streams are available in the project facility and can be used interchangeably. The baseline emissions are determined according to Annex 3 of ACM0012.
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.	Yes	The WECM stream recovered in the absence of the project activity is not used to supply the heat of reaction.
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	Yes	Project facility is a cogeneration plant utilizing WECM from a steel manufacturing process, not a single cycle power plant.

ACM0012 Requirement	Project Conformance	Comments/Findings
plants for the purpose of generation of heat only can apply this methodology.		
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.”	Yes	Evidence was provided to confirm that the lifetime of project equipment is at least 20 years, which is greater than the first crediting period

Annex 1 from ACM0012 is applied to determine the extent of use of waste energy from the waste energy generation facility in the absence of the project activity. The application of Annex 1 is discussed in the context of the baseline scenario in Section 3.2.4 below.

Annex 3 from ACM0012 is applied because multiple waste gas streams (BFG, COG, LDG) exist at the steel mill in the baseline scenario that can be used interchangeably for various applications at Hyundai Steel. Since the Project is a Greenfield activity, the overall quantity of waste energy generated by the project facility and the total quantity that is available for utilization by the Project is estimated based on the Project design specification and the performance of Phase I of the Project. Based on such data, operations associated with the steel mill consume 39.5 percent of the total waste energy available. The remaining 60.5 percent is consumed by the project activity to produce steam and electricity. In the absence of the Project, this waste gas would be flared.

The values for the baseline utilization of waste gas at the project facility will be monitored throughout the crediting period to determine whether there is a decrease in the utilization of waste gas by other uses at the project facility during any monitoring period. If such a decrease is observed, in Accordance with the ACM0012 the project is no longer eligible to receive VCUs absent sufficient technical justification for the decrease.

3.2.3 Project Boundary

The project boundary is defined by geographical extent of the project facility that generates the WECM—Hyundai Steel the project facility which utilizes the WECM—Hyundai Green Power; and the recipient facility which receives the useful energy generated using waste energy—the grid for the electricity and Hyundai Steel for the steam. For the purposes of calculating the combined margin emission factor, the project boundary includes all the grid-connected power plants in Korea.

The Audit Team reviewed the source, sink, and reservoir (SSR) determination included in the VCS PD and found the justification accurate and in accordance with the applied methodology.

Overall, the Project Proponent(s) provided an accurate description of the project boundary and a comprehensive justification for the project’ SSR.

3.2.4 Baseline Scenario

The step-wise procedure prescribed by ACM0012 is used to determine the baseline scenario. Realistic and credible alternatives in the absence of the project activity are evaluated for the utilization of the waste gas, the generation of electricity and heat for each recipient facility, if the project activity involves electricity or heat generation for that recipient facility.

The baseline scenario is defined as the release of waste gas to the atmosphere after flaring, electricity generation by existing grid-connected power plant, and heat generated from fossil fuel combustion.

Application of the individual steps of the baseline methodology prescribed by ACM0012 is described below.

Step 1: Define the most plausible baseline scenario for the generation of heat, electricity, and mechanical energy using the following baseline options and combinations

All baseline alternatives for waste gas utilization (W1-W6), power generation (P1-P14), and heat generation (H1-H14) are assessed. Although emission reductions are not claimed for the displacement of fossil fuels used to generate heat (steam) in the baseline scenario, baseline alternatives are evaluated to ensure that the project activity would not have occurred anyway by virtue of being the baseline scenario for heat generation. Alternatives related to the generation and utilization of mechanical energy are omitted because these are not within the scope of the project activity.

Several alternatives for each of the waste gas, power generation, and heat generation baseline scenarios are excluded on the basis that they are neither realistic nor credible. The VCS PD provides additional detail on the rationale for the elimination of certain baseline alternatives from consideration. The reasonableness of alternatives eliminated and those considered further were confirmed during the validation process.

The combinations of baseline scenarios remaining for further evaluation are described in Table 6 in the VCS PD:

Scenario	Waste Energy	Power	Heat	Description
1	W2	P10	H7	Waste gas is flared; electricity generated from grid connected sources; heat generated from fossil fuels.
2	W6	P1	H1	Project activity without VCS registration

Because the project activity occurs at a Greenfield recipient facility, Annex 1 from ACM0012 is applied to analyze the selection of the baseline scenario and determine the baseline practice factor. Option 1 of the Annex is not applicable because there are not five facilities in Korea similar to the Project; therefore, the analysis of a “reference facility” is not possible. Evidence was provided to confirm that there are no eligible waste energy project activities at integrated steel mills in Korea.

Option 2 from Annex 1 is applied to determine the extent of waste gas utilization in the baseline scenario at the reference facility. The possible alternative designs for the utilization of waste gas are represented by the baseline scenarios W1-W6. As described above, only W2 and W6 are considered realistic and credible alternatives to the project activity; therefore, these constitute the possible alternative designs for the utilization of waste gas in the baseline. It is demonstrated through the investment analysis applied for the demonstration of additionality that W6 is financially unattractive; therefore, W2 would be the baseline scenario. W2 represents the flaring of all waste gas produced by Hyundai Steel that remains after utilization for internal purposes; therefore, no cap on baseline emissions is required by Annex 1 ($f_{\text{practice}}=1$).

Step 2: Apply Step 2 and/or Step 3 of the Tool for the demonstration and assessment of additionality

Step 2 of the baseline methodology is satisfied through the application of Step 2 from the “Tool for the demonstration of additionality”, Version 7.0.0 (Additionality Tool). The investment analysis is performed in accordance with Step 2 of the Additionality Tool to evaluate the financial attractiveness of implementing the Project without VCS registration and is described in Section 2.5 of the VCS PD. The results of the assessment of additionality are discussed below.

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

The investment analysis shows that Scenario 2 (W6, P1, H1) is economically unattractive and therefore not likely to be the baseline scenario. The only remaining alternative is the combination W2/P10/H7, which corresponds to Baseline Scenario 1, as defined in the PD according to ACM0012:

- the waste energy of WECM(s) recovered in the project is released to atmosphere/flared/unutilized;
- electricity is obtained from a Greenfield or identified existing fossil fuel power plant or from the grid;
- heat/steam from an existing/new fossil fuel based steam element process.

This scenario is selected as the baseline and conforms to the applicability requirements for the baseline scenario defined in Table 2 - Cogeneration of Energy in ACM0012.

The Audit Team reviewed the project description and supporting evidence regarding the technology applied, the modalities of electricity output and connection to the grid, and determined that the baseline determination for the project activity is accurate, justified, and in accordance with the applicable methodology.

3.2.5 Additionality

The Project Proponent demonstrated additionality of the Project through the application of the “*Tool for the demonstration and assessment of additionality*”, version 7.0.0. The VCS PD follows the stepwise procedure as further described below:

Step 1: Identification of Alternatives to the Project Activity Consistent With Current Laws and Regulations

Alternatives to the project activity are identified in the determination of the baseline scenario described above. None of the alternatives identified are mandated by any enforced law, statute, or other regulatory framework, nor is the project activity mandated by any applicable law, statute, or other regulatory framework.

Step 2: Investment Analysis

An investment analysis is applied consistent with the requirements of the Additionality Tool, described below.

Sub-step 2a: Determine Appropriate Analysis Method

The project activity and alternatives identified in Step 1 generate revenues from the sale of electricity, therefore, the Simple Cost Analysis (Option I) cannot be applied.

The Investment Comparison Analysis (Option II) is not applicable because the only realistic alternative to the Project, importing electricity from the grid, is not a possible investment project.

The remaining alternative is the application of Option III: Benchmark Analysis.

Sub-step 2b: Apply Benchmark Analysis (Option III)

The Benchmark Analysis (Sub-step 2b, Option III) is selected for the demonstration of project additionality. The internal rate of return (IRR) is identified as the appropriate financial indicator and the benchmark IRR is established at 6.5 percent. The benchmark IRR was obtained from the Korean Power Exchange (KPX) 2011 Power Knowledge Report, which indicates that, according to Korea's Power

Supply Master Plan, the standard investment evaluation criteria for new domestic power generation projects assumes the discount rate of 6.5 percent,

The approach to calculate the benchmark IRR is consistent with the requirements of Paragraph 38 in Sub-step 2b of the Additionality Tool because it is a government/official approved benchmark for decision making in power plant construction.

Sub-step 2c: Calculation and Comparison of Financial Indicators

Without revenues from the sale of VCUs, the Project's IRR is calculated as 5.46 percent; therefore, it cannot be considered financially attractive because it does not meet the benchmark of 6.5 percent. The inclusion of carbon revenue improves the Project's IRR to 6.51 percent, making the Project financially attractive and justifying the investment decision.

First Environment reviewed evidence for a risk-based sample of inputs to the financial model to assess the calculation of the financial indicator. First Environment also reviewed evidence provided by project proponents to show early consideration of carbon finance to help achieve acceptable return on the investment.

Sub-step 2d: Sensitivity Analysis

A sensitivity analysis is performed to determine whether variation in several of the key inputs to the Project's financial model has a significant effect on the project IRR. An analysis is performed on the following inputs: investment cost, dividends, payments received for electricity sales, operation, and maintenance cost. The sensitivity analysis is carried out for variation of ± 10 percent in the value of each of these underlying parameters. The results show that while the Project's IRR (without the VCU revenue) may increase as a result of variation in these parameters, it still cannot achieve the benchmark IRR required to be considered financially attractive. Therefore, the variation of these parameters does not affect the conclusion that the Project is not financially attractive.

Step 3: Barriers Analysis

Because Step 2 shows that the project activity is unlikely to be the most financially or economically attractive alternative, a subsequent barriers analysis is not required per the Additionality Tool.

Step 4: Common Practice Analysis

The VCS PD demonstrates that the Project is not common practice in its geographic region by applying the CDM "Guidelines on common practice analysis," Version 2.0.

Following the Guidelines' stepwise approach, the Project Proponents identify similar projects, located in Korea, which apply the same technology measures, utilize the same energy source, and provide the same output services (grid electricity), with output capacity within a $\pm 50\%$ range of the Project and which started operation before the Project's start date or publication for stakeholder's consultation, whichever is first. The Project Proponent identified only four similar projects in Korea, including the Project. Of these, two are registered with the Korea Certified Emission Reduction (KCER), a voluntary GHG emission reduction trading scheme implemented by the Korean government, and therefore are eliminated from consideration in the common practice analysis. The third project, Hyundai Steel Phase I, is registered with VCS; therefore, it is eliminated as well. As there are no other similar activities occurring in the project's geographic region, the subsequent steps of the Guidelines justify the conclusion that the Project does not represent common practice.

The VCS PD provides additional details and data on the application of the Guidelines.

In conclusion, First Environment reviewed the additionality demonstration and verified the supporting evidence provided including data, parameters, and assumptions relevant to the financial analysis, baseline selection, and common practice analysis and found them adequate and sufficient to justify the additionality of the project activity.

3.2.6 Quantification of GHG Emission Reductions and Removals

Emission reductions are quantified in accordance with the procedures described in the ACM0012 methodology and relevant CDM tools. The equations were correctly identified and applied and the calculation of GHG emission reductions is presented in a transparent manner, incorporating all relevant GHG sources, sinks, and reservoirs. The Audit Team performed a review of the VCS PD to confirm that it lists all relevant assumptions and data including references and sources for the quantification of GHG emission reductions. On the basis of this review, the Audit Team also concluded that the values assigned to data and parameters in the VCS PD are reasonable in the context of the Project.

Baseline emissions are quantified according to the equations in Section 1.1.1 of ACM0012. The selection of equations from Section 1.1.1 is appropriate and consistent with the guidance in ACM0012 because there is no recovery of the WECM in the absence of the project (it would be flared) and baseline was determined to be Baseline Scenario 2 (W2/P10/H7), as defined by ACM0012.

The baseline capping factor (f_{CAP}) prescribed by ACM0012 is assigned a value of one because the project activity occurs at a Greenfield project facility. Due to technical constraints, the fraction of total electricity generated using waste energy (f_{WCM}) is assigned a value of one.

Natural gas (referred to by the project proponent as “LNG”) is co-fired in small quantities as auxiliary fuel to increase the heating value of the WECM when required or as startup fuel for the boilers. However, since it is not possible to determine the quantity of power produced from LNG as it is used as a supplemental fuel, then, as a conservative approach, all emissions associated with LNG combustion are accounted for as project emissions.

Baseline emissions are estimated ex-ante based on the quantity of electricity generated by the project multiplied by the Combined Margin CO₂ emission factor, as determined from “Tool to calculate the emission factor for an electricity system,” (Version 4.0.0). The Audit Team confirmed through review of calculation spreadsheets, underlying raw data, and publicly available utilities databases that the combined margin emission factor is calculated in accordance with the aforementioned Tool. The Simple OM method was selected for the calculation of the operation margin, resulting in 0.7177 tCO₂/MWh and the build margin is calculated as 0.5514 tCO₂/MWh. The weighted combined margin is 0.6345 tCO₂/MWh and is calculated as using a 50 percent operating margin weight and a 50 percent build margin weight as required by the Tool.

Total baseline emissions can be estimated using the data and parameter values provided in the VCS PD.

Project emission sources consist of purchased electricity used to power waste gas conditioning equipment and natural gas that is combusted in boilers to boost the calorific value of waste gas. Electricity consumption is continuously monitored through internal meters while natural gas fuel consumption is measured by a revenue meter maintained by the supplier. Emissions are quantified as the product of activity data by an emission factor and are determined according to the CDM “Tool to calculate baseline/project and/or leakage emissions from electricity consumption” or the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion,” as appropriate.

No leakage emission sources are accounted for under ACM0012.

Total emission reductions are calculated as the difference between baseline emissions less project emissions.

The Project does not claim credit for the displacement of fossil fuels used to generate steam at the project facility or any steam (generated from fossil fuels) that is used to assist the flaring of waste gas in the baseline scenario.

After reviewing the quantification procedure and supporting evidence, the Audit team concluded that the methodologies and the applicable tools have been applied correctly to calculate baseline emissions, project emissions, leakage, and net GHG emission reductions and removals.

3.2.7 Methodology Deviations

No deviations were identified between the VCS PD and the validation criteria.

3.2.8 Monitoring Plan

The Project applies the approved monitoring methodology described in ACM0012. The primary variables measured in order to determine and account for emission reductions are shown below.

Parameter	Method of Estimation	Frequency of Measurement	Unit of Measurement
Electricity exported to the grid ($EG_{i,v}$)	Metered	Continuous	MWh
Electricity consumed from the grid ($EC_{PJ,v}$)	Metered	Continuous	MWh
Natural gas (LNG) consumed by the project ($AF_{i,j,v}$)	Metered	Continuous	Nm ³

The Combined Margin emission factor for displaced grid electricity is calculated ex-ante for the entire crediting period; therefore, ongoing monitoring is not required relative to this parameter.

The Project includes a complete monitoring system involving staff training and the development and implementation of a monitoring plan, along with QA/QC procedures, to maintain the performance of equipment as well as to ensure the accuracy of measurements and data reported.

The monitoring plan specified within the VCS PD includes all relevant data and parameters required to obtain a reliable result of generated emission reductions and meets the requirements of the ACM0012. The details of the monitoring plan are described in Sections 4.1, 4.2, and 4.3 of the VCS PD where there is a complete description of the frequency, responsibility, and authority for recording, monitoring, measurement, and reporting activities. The monitoring plan described in the VCS PD ensures the adequate measurement of emissions occurring from GHG sources through the installation of appropriate equipment and devices required for the final balance of emission reductions generated.

The Audit team concluded that the monitoring plan included in the VCS PD is adequate and in accordance with the guidelines and requirements of the ACM0012 methodology.

3.3 Non-Permanence Risk Analysis

Not Applicable - The project activity does not require a non-permanence risk analysis.

3.4 Environmental Impact

An environmental impact assessment was conducted by Hyundai Green Power to evaluate the Project's effects on a variety of media. Evidence of governmental approval of the assessment was provided during the validation process.

3.5 Comments by Stakeholders

A stakeholder consultation meeting was held on December 21 and 22, 2010 in Dangjin. Several comments were received from local stakeholders; the VCS PD provides additional detail on the comments received and the actions taken in response.

4 VALIDATION CONCLUSION

First Environment has performed a validation of the Project's approach, as outlined in the VCS PD, as part of the VCS validation process. The validation was informed by the requirements stated in the VCS Standard, Version 3; the VCS Program Guide, 8 October 2013, v3.5; and the ISO 14064-3 standard. The VCS PD was assessed against the criteria in the VCS Standard, and the approved CDM consolidated methodology ACM0012, "*Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects*," Version 4.0.0.

The review of the VCS PD and the resolution of all corrective action and clarification requests have provided First Environment with sufficient evidence to determine the fulfilment of stated criteria.

The Project correctly applies the approved CDM baseline and monitoring methodology, ACM0012, as well as the relevant CDM tools referenced therein. By producing renewable energy and displacing electricity that would otherwise have been generated through the combustion of fossil fuels, the project activity results in reductions of greenhouse gas emissions that are real, measurable, and give long-term benefits to the mitigation of climate change. An analysis of the additionality test demonstrates that the proposed project activity is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project.

The total emission reductions from the Project are estimated to be 14,416,800 metric tonnes of CO₂e over the selected 10-year crediting period. The emission reduction forecast has been checked, and it is deemed likely that the stated amount will be realized given that the underlying assumptions do not change.

In summary, it is First Environment's opinion that The Hyundai Steel Waste Energy Recovery Co-Generation Project Phase II in Dangjin Province, Republic of Korea, as described in the VCS PD of November 26, 2014, meets all relevant VCS 3 requirements and correctly applies the CDM Methodology ACM0012.

The validation of the Project is based on the information made available to us and the engagement conditions detailed in this report. First Environment cannot guarantee the accuracy or correctness of this information. Hence, First Environment cannot be held liable by any party for decisions made or not made based on this report or opinion.

APPENDIX A Resolution of Findings Tables

Corrective Action Request	Summary of Participant Response	Validation Conclusion
Please provide further definition of the "project facility" in the VCS PD given the multiple industrial processes occurring at the Hyundai Steel Mill and identify the related facilities in relation to the production of WECM.	PD Sections 1.8 and 2.3 were revised to more accurately identify the processes pertaining to the waste heat generating facility, the project facility, and the recipient facility.	Response is acceptable
Scenario W4 is incorrectly included as part of the baseline alternatives.	PD was revised to exclude scenario W4 as part of the baseline alternatives.	Response is acceptable
Considering the requirements of ACM0012/Annex I and the determination of a value for the parameter 'f_practice', please justify why scenario W5 should be excluded from consideration in the baseline scenario.	PD Section 2.4, Step 1 was revised to provide a more detailed justification for the exclusion of scenario W5.	Response is acceptable
The stepwise approach and applicable CDM guidelines in the Additionality Tool for the assessment on common practice are not applied in the VCS PD.	PD was revised to include the stepwise approach for evaluation of common practice as outlined in the CDM guidelines.	Response is acceptable
Please provide justification that Anthracite coal fuelled plants can still be considered "low-cost/must-run" generation resources because of Korean regulations.	CERPD provided evidence (Ministry of Economy guidelines for the operation of domestic power plants) regarding the prioritization of consumption of domestic supply of anthracite coal.	Response is acceptable
Please provide justification for why the most recently available data from KPX from 2012 have not been used for the determination of "low-cost/must-run" generation resources and the operating and build margin emission factors.	The grid Emission Factor calculation was revised to include electricity and power plant data from the 2012 KPX report	Response is acceptable
The CDM "Tool to calculate the emission factor for an electricity system" referred to in the PD, is not the most current version	PD was revised to reference the most current version of the Tool.	Response is acceptable
PD, Section 2.3: the "project facility" and "recipient facility" identified are not consistent with the definitions provided in ACM0012 methodology.	The descriptions of project facility and recipient facility in the PD, Section 2.3 were revised to be consistent with the definitions provided in the methodology.	Response is acceptable
PD, Section 2.3: the description of the geographical extent of the boundary only repeats the methodology language and does not identify the project specific waste energy generation facility, project facility, and recipient facility.	PD Section 2.3, has been revised correctly identify the waste energy generation, project and recipient facilities in accordance with the definitions in ACM0012.	Response is acceptable
Please update Figure 5 identifying Phase I and Phase II diagrams.	PD was revised with and updated diagram.	Response is acceptable

Corrective Action Request	Summary of Participant Response	Validation Conclusion
The exclusion of scenario W5 and of parameter f-practice is not sufficiently justified: please further identify the internal use of WECM by Hyundai Steel Mills, justifying why it should not be considered a partial WECM recovery, as described in alternative W5.	PD Section 2.4, Step 1 was revised to provide a more detailed description of the WECM use in the baseline scenario and to justify the exclusion of scenario W5 from the baseline alternatives.	Response is acceptable
PD Section 2.5, Sub-step 2b does not identify if the proposed benchmark is project IRR or equity IRR or if it is pre- or post-tax.	CERPD provided additional evidence confirming that the benchmark selected is project IRR, after tax.	Response is acceptable
Vintage of data analyzed for OM determination in PD Section 3.2, Step 3 is incorrect.	PD was revised to correct the dates of the vintage of data analyzed for the OM determination.	Response is acceptable
PD Section 4.2: description of auxiliary fuel consumption parameter AF _{j,y} does not include type/model of meter and QA/QC procedures involving crosscheck with fuel billing records.	Parameter description in PD section 4.2 was revised adding information on the fuel meter and QA/QC procedures.	Response is acceptable
PD Section 4.2 does not include parameter pi,y (density of auxiliary fuel), which is required for PE calculation.	Since NCV of fuel is provide on a normal volume basis instead of mass, the density parameter is not necessary.	Response is acceptable
PD Section 4.2: the values from IPCC sources for NCV and EF_CO2 for the auxiliary fuel (LNG) are incorrect because they do not correspond to Liquefied Natural Gas.	PD was revised correcting the value for NCV and EF_CO2 of the auxiliary fuel (LNG).	Response is acceptable
Annex 3: the WECM applications listed in the extended boundary table are inconsistent with those listed in the energy balance provided.	PD Section 2.3 was revised to he extended boundary table and energy balance table have been revised.	Response is acceptable
Annex 3: PD does not identify the parameters and monitoring procedures that will be required calculate a new energy balance each year.	PD was revised to include the outline the process to monitor the energy balance each year.	Response is acceptable

Clarification Request	Summary of Participant Response	Validation Conclusion
Sections 1.10 and 2.2 of the VCS PD appear to provide conflicting information about whether the WECM will be partially recovered and utilized in the absence of the project activity. Please confirm the correct disposition of the WECM in the baseline scenario.	The PD Sections were revised to more accurately describe scenario in absence of the project activity.	Response is acceptable
Please clarify why baseline scenario W3 does not include selling gas to the existing Hyundai cogeneration project.	PD Section 2.4, Step 1 was revised to clarify that the existing Hyundai waste heat cogeneration plant (Phase I) does not have extra capacity and cannot accept additional WECM.	Response is acceptable
Please clarify the exclusion of H6 scenario considering the pre-project for steam generation described at Section 1.10 of the VCS PD	PD Section 2.4, Step 1 was revised to clarify that the existing LNG boiler at Hyundai Steel does not have enough	Response is acceptable

Clarification Request	Summary of Participant Response	Validation Conclusion
	capacity to provide additional steam generation.	
Please clarify the value of f_practice determined in the application of ACM0012/Annex I.	PD Section 2.4, Step1 was revised to clarify the determination procedure and resulting value for f_practice.	Response is acceptable
Relative to the demonstration of additionality, please explain why operating cost is not included in the sensitivity analysis.	PD and financial additionality calculation were revised to include the operation and maintenance cost in the sensitivity analysis.	Response is acceptable
Please explain why energy generated by Hallim C/C is not included in operating margin calculation for 2009.	Grid emission factor calculation was revised to correct the issue.	Response is acceptable
Please clarify the project activity start date and provide supporting evidence if project has started.	CERPD provided evidence and revised PD to include the correct project start date.	Response is acceptable
Please clarify the technical constraints which make the calculation of f_wcm unfeasible.	CERPD provided a description of the process parameters that they are unable to measure, in order to determine f-WCM.	Response is acceptable

Financial Analysis Assessment Clarification Request	Summary of Participant Response	Validation Conclusion
Evidence of investment decision date: Please provide pdf original of document on company letterhead.	CERPD provided revised evidence.	Response is acceptable
Please provide supporting evidence for: KEPCO usage rate used to estimate gross electricity production. Please clarify why Hyundai Green Power operating data show higher electricity output from similar installed capacity (400 MW)	CERPD provided supporting evidence requested and clarified the difference with Phase I electricity output.	Response is acceptable
Please clarify why the value of electricity internal consumption percentage is based only on 2011 data and not 2012.	CERPD clarified that investment analysis was completed with data available at the time of investment decision.	Response is acceptable
Please confirm the date of execution of the PPA agreement and clarify the agreed price for electricity.	CERPD provided evidence of original PPA between Hyundai GP and KEPCO, as well as evidence supporting electricity tariff.	Response is acceptable
Please clarify if a steam price agreement is available.	CERPD clarified that the steam price is the same as in Phase I and provided supporting evidence.	Response is acceptable
Please clarify why the CPI index is based only on 2010 data and not 2011 or 2012.	CERPD revised the PD and financial analysis calculations to include the CPI index for 2011, which is the year when the investment decision took place.	Response is acceptable

Financial Analysis Assessment Clarification Request	Summary of Participant Response	Validation Conclusion
Please clarify the cost details shown on the LNG gas bill.	CERPD provided a revised and better translated evidence for the cost of LNG.	Response is acceptable
Please clarify and provide evidence regarding the number of employees of Hyundai GP included in the labor expense summaries for 2011-12. Please justify the 10% CPI for labor expenses.	CERPD provided evidence for the determination of the number of employees and the increase in labor cost.	Response is acceptable
Please provide evidence supporting G&A expenditure estimate (26% of labor cost).	CERPD provided evidence supporting the calculation of the administrative cost, revising the calculation.	Response is acceptable
Please clarify the calculation of the annual maintenance cost, specifically the use of the 2% factor.	CERPD revised the calculation of the maintenance cost removing the 2% factor.	Response is acceptable
Please clarify the calculation of the land/office lease cost. The evidence total is not consistent with value in financial analysis spreadsheet.	CERPD clarified the procedure used to establish the office lease cost.	Response is acceptable
Please clarify the cost for the Technical advisory fee for the current project: the evidence provided shows different values (Extensional power generation project) than those used.	CERPD provided evidence supporting the cost of the technical advisory services.	Response is acceptable
Please clarify the discrepancy between the total investment cost in the financial analysis and the evidence provided.	CERPD clarified that the discrepancy in the final investment cost is due to additional expenses, such as construction labor cost, not included in the original budget provided as evidence.	Response is acceptable
Please clarify the source of the evidence provided for the debt/equity ratio.	CERPD provided evidence supporting the debt/equity ratio used in the financial analysis.	Response is acceptable