



**Verified Carbon
Standard**

CHOL CHAROEN GROUP WASTEWATER TREATMENT WITH BIOGAS SYSTEM I (KHONKAEN)



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Summary:

4KES, commissioned by South Pole Carbon Asset Management Ltd. has performed independent verification of the project activity “Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen), Thailand”, against VCS Version 4.1 and all applicable requirements therein.

The purpose of the proposed project activity involves the installation and operation of a methane recovery and utilisation system to an open anaerobic effluent treatment system(converted 2 open lagoons) at Kean Charoen Co., Ltd. The project activity involves the installation two anaerobic covered lagoons continues to flow to a series of remaining 9 open lagoons. The implementing system enables recovery of biogas that would have been released into the atmosphere and utilise it for thermal and electricity generation. In the case of thermal energy generation, the captured biogas has been co-fired in existing heat generating devices for the process of drying the wet starch (displacing fuel oil under the previous system). In addition, the power produced by this captured biogas was not only facilitated the electricity requirement of the plant, but also be fed to national grid under the pending power purchase agreement with the Provincial Electricity Authority (PEA).

The objective of the verification is to have an independent review of ex-post determination of the monitored GHG emission reductions, Verification was conducted using 4KES procedures in line with the requirements specified in the VCS program guide v 4.0, VCS standard v4.0, CDM M&P, the latest version of the VCS Validation and Verification manual v3.2 and relevant decisions of the COP/MOP and the CDM EB and applying standard auditing techniques. The verification consisted of desk review, online interviews and the resolution of outstanding issues and the issuance of the final verification report and certification.

The verification shall ensure that reported emission reductions are complete and accurate in accordance with applicable VCS / CDM requirements in order to be certified.

The project was renewed by Carbon Check (validation report N° CCIPL 774, version 1.1 of 20/05/2020), which is registered under the VCS registration reference N° 427.

The GHG emission reductions were calculated on the basis of the applied baseline and monitoring methodology AMS-III.H. version 19, AMS-I.C. version 21 and AMS-I.D. version 18.0 and the monitoring plan included in the updated registered Project Description, version 03 of 14/05/2020.

During this verification, 00 Corrective Action Request (CAR) and 04 Clarification Requests (CLs) were identified related to operation, GHG emission reduction estimation, monitoring and baseline scenario of the VCS project activity in relation to all relevant VCS requirements for the project activity and the applied baseline and monitoring methodology, and these CARs and CLs are successfully closed after necessary corrections/clarifications by the client. The same has been discussed in Appendix B of this verification report.

In conclusion, it is 4KES's opinion that the project activity "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen), VCS project ID 427, meets all relevant requirements for VCS standard and guidelines and correctly applies the baseline and monitoring methodology AMS-III.H. version 19, AMS-I.C. version 21 and AMS-I.D. version 18.0. The monitoring system is in place and the emission reductions are calculated without material misstatement. Hence, 4KES is able to certify that the emission reductions from the project during the monitoring period 03/03/2020 to 31/03/2021 (both days included) amount to 58,819 tCO₂e.

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INTRODUCTION

1.2 Objective

4KES has been commissioned by “South Pole Carbon Asset Management Ltd.” to perform an independent verification of its VCS project, “Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen), already registered under VCS with Project ID. 427 for the reported GHG emission reductions for the given monitoring period 03/03/2020 up to 31/03/2021 (both dates included) under the second crediting period from 15/07/2019 to 14/07/2029. The VCS projects must undergo independent third-party verification and certification of emission reductions as the basis for issuance of Voluntary Emission Reductions (VERs/VCUs).

The objective of this verification exercise are, by review of objective evidence, to establish that:

- The project activity has been implemented and operated as per the project description (PD) and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;*
- Monitoring report and other supporting documents are complete;*
- The data is recorded and stored as per the monitoring methodology and approved monitoring plan.*
- To confirm that the monitoring system is implemented and fully functional to generate Voluntary Emission Reductions (VERs/VCUs) without any double counting, and*
- To establish that the data reported are accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation.*

1.3 Scope and Criteria

The verification scope is:

- to verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan.
- to evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement.
- to verify that reported GHG emission data is sufficiently supported by evidence.

The project is assessed against the of VCS program guide v 4.0, VCS standard v4.1. 4KES has, based on the recommendations in the latest version of VCS Validation and Verification Manual v 3.2, and employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

Verification is not meant to provide any consultancy towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the monitoring.

1.4 Level of Assurance

The final verification report before being submitted to the client were subjected to an independent internal technical review to confirm that all verification activities had been completed according to the pertinent 4KES instructions, with reasonable level of assurance.

The technical review was performed by a technical reviewer(s) qualified in accordance with 4KES qualification scheme for VCS and CDM validation and verification.

The verification team and the technical reviewers consist of the following personnel.

Role	Last Name	First Name	Country
Team Leader, Technical Expert and Host country Expert	Menon	Rekha	India
Technical Reviewer	C	Indumathi	India

1.5 Summary Description of the Project

Project Proponent	Kean Chareon Co., Ltd.
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<i>Title of the project activity</i>	<i>Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)</i>
<i>Baseline and monitoring methodology</i>	AMS-III.H “Methane recovery in wastewater treatment”, version 19. AMS-I.C “Thermal energy production with or without electricity”, version 21. AMS-I.D “Grid connected renewable electricity generation”, version 18.
<i>Location of the project activity</i>	The proposed project activity is located at Kean Charoen Co., Ltd, in Kranuan district, Khonkaen province, situated in the northeast region of Thailand, approximately 450 km from Bangkok. Project’s coordinates: Latitude 16° 48.498’N and Longitude 103° 05.148’E
<i>Brief description of the project</i>	The purpose of the proposed project activity involves the installation and operation of a methane recovery and utilisation system (an open anaerobic effluent treatment system) at Kean Charoen Co., Ltd. The project activity involves the installation two anaerobic covered lagoons continues to flow to a series of remaining 9 open lagoons. The implementing system enables recovery of biogas that would have been released into the atmosphere and utilise it for thermal and electricity generation. In the case of thermal energy generation, the captured biogas has been co-fired in existing heat generating devices for the process of drying the wet starch (displacing fuel oil under the previous system). In addition, the power produced by this captured biogas was not only facilitated the electricity requirement of the plant, but also be fed to national grid under the pending power purchase agreement with the Provincial Electricity Authority (PEA).
<i>Projects crediting period</i>	<i>15/07/2019 to 14/07/2029</i>
<i>Monitoring Period</i>	<i>03/03/2020 to 31/03/2021</i>

VERIFICATION PROCESS

1.6 Method and Criteria

Verification was conducted using 4KES procedures in line with the requirements specified in the VCS Requirements and VVB guidance, i.e. VCS Program Guide, Version 4.0 of 19/09/2019, VCS Standard, Version 4.1 of 22/04/2021 and Validation and Verification Manual, VCS Version 3.2 of 19/10/2016. The GHG emission reductions are on the basis of the approved Baseline and monitoring methodology “AMS-III.H “Methane recovery in wastewater treatment”, version 19, AMS-I.C “Thermal energy production with or without electricity”, version 21 and AMS-I.D “Grid connected renewable electricity generation”, version 18.

The verification consisted of the following three phases

- Document review;
- Desk assessment including online Interviews;
- Resolution of Any Material Discrepancy and the issuance of the final verification report and certification.

The following sections outline each step in more detail.

1.7 Document Review

The updated PD, version 03 of 14/05/2020 /03/, the Monitoring report, version 03 of 02/07/2021 /01/, the emission reduction calculations provided in the form of a spreadsheet (VCS427KK_WWT_TH_ER_MP3PAF03032020to31032021_v03 02072021.xlsx) /02/ and the documents listed in the table below, were reviewed during the remote – audit.

/01/	South Pole Carbon Asset Management Ltd.: VCS-MR for the project activity “ Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”, version 03 of 02/07/2021
/02/	South Pole Carbon Asset Management Ltd.: Emission reduction spread sheets “ VCS427KK_WWT_TH_ER_MP3PAF03032020to31032021_v03 02072021.xlsx.
/03/	South Pole Carbon Asset Management Ltd – VCS-PD for the project activity “ Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”, version 03 of 14/05/2020
/04/	TUV Nord: Validation report (validation report N° 53208409-09/309 of 17/11/2009) for the project activity “ Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”, of 17/11/2009 – first crediting period.
/05/	Carbon Check : Validation report (validation report N° CCIPL 774) for the project activity “ Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”, of 20/05/2020 – Second crediting period.
/06/	Carbon Check : Verification report (verification report N° CCIPL 774) for the project activity “ Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”, of 19/05/2020
/07/	Kean Chareon Co Ltd: log sheets for the following period 03/03/2020 to 31/03/2021 Wastewater flow meter reading

	Methane content in the biogas COD measurements Biogas consumption in boiler 2 and gas engines. Biogas consumption in flare. Quantity of starch produced and sales records. Quantity of fuel oil consumed. Quantity of electricity produced.
/08/	Calibration report: 1. Endress&Hauser: wastewater flow meter , se.no LA020720000 , dated 18/05/2017 and 23/10/2020. 2. Endress&Hauser: wastewater flow meter , se.no N4065620000 , dated 14/06/2018. 3. Endress&Hauser: wastewater flow meter , se.no M102FC200000 , dated 19/05/2017 and 30/01/2021 4. Endress&Hauser: wastewater flow meter , se.no N308AD20000 , dated 08/05/2020. 3. Hanna Instruments : Spectrophotometer, se.no HI9945I, dated 12/12/2018. 4. MIT : Biogas flow meter (GM4), se.no: N1-V905-9663007, dated 11/01/2018, 15/06/2021. 5. MIT : Biogas flow meter (GM3), se.no: 5314, dated 29/11/2018. 6. MIT : Biogas flow meter (GM2), se.no: 7568, dated 28/04/2016 and 28/04/2020. 7. MIT: Fuel oil meter (OM2), se.no:5449943, dated 29/11/2018. 8. Central Bureau of Weights and Measures : Weighing scale, se.no: 0008666, dated 04/06/2019. 9. QED Environmental Systems Ltd: Portable gas analyser, se.no: G503004, dated 12/06/2018, 30/03/2021.
/09/	List of accredited laboratories: 1) COD analysis (colorimeter): Hanna Instruments (manufacturer) https://hannathai.com/ 2) Quantity of wastewater (FM): Endress Hauser (manufacturer) https://www.th.endress.com/ 3) Quantity of biogas (GM) & Quantity of fuel oil (OM): MIT https://www.mit.in.th/ Certified ISO17025 and Thai Industrial Standards Institute (TISI) certification no: 21C005/0842 4) Methane analyzer: i. Geotech: UKAS 4533 ii. QED Environmental System Ltd.: https://www.qedenv.com/about/certifications/ Certified: UKAS 4533 & ISO 9001 5) Weighbridge: Central Bureau of Weights and Measures under Department of Internal trade Ministry of Commerce http://www.cbwmthai.org/
/10/	Environment & Laboratory Co Ltd: COD analysis report for the year 2020 and 2021
/11/	VCS: VCS Program Guide, VCS Version 4.0 of 19/09/2019
/12/	VCS: VCS Standard, VCS Version 4.1 of 22/04/2021
/13/	CDM Executive Board: Approved consolidated baseline and monitoring methodology “AMS”-III.H, Methane Recovery in Wastewater Treatment, version 19.
/14/	CDM Executive Board: AMS-I.C ‘Thermal energy production with or without electricity’ version 21
/15/	CDM Executive Board: AMS-I.D ‘Grid connected renewable electricity generation’ version 18
/16/	VERRA: https://verra.org/covid-19-travel-guidance/ last accessed on 11/05/2021

/17/	CDM Executive Board: "Project emissions from flaring", version 3.0 (Tool06)
/18/	CDM Executive Board: "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", version 3.0 (Tool03)
/19/	CDM Executive Board: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" version 3.0 (Tool05)
/20/	CDM Executive Board: "Tool to calculate the emission factor for an electricity system" version 7.0 (Tool07)
/21/	ERPA between Chol Charoen Group and South Pole Carbon Asset Management Ltd, dated 14/03/2008
/22/	Kean Chareon Co Ltd: Training documents for the year 2020
/23/	Kean Chareon Co Ltd: Decommissioning of gas engine 1, dated 13/06/2020.
/24/	Commissioning certificate for engine no 1462410 issued by INNIO- Jenbacher Waukesha, dated 09/01/2021
/25/	Kean Chareon Co Ltd: Complaint register, complaint receipt and monthly complaints for the year 2020 and 2021.

1.8 Interviews

The key personnel interviewed, and the main topics of the interviews are summarized in the table below.

	Date	Name and Role	Organization	Topic
1.	12/05/2021	Mr. Preecha Suwanasim (Factory manager)	Kaen Charoen Co Ltd	Description of the project activity, process involved in the starch factory, working of boilers and gas engine, biogas sale and implementation status of the project. Necessary clearances and approval requirement for the proposed project.
2.	12/05/2021	Ms. Kwanruen Somchob – (Head of Biogas)		Project technology, operation and maintenance, Project approval and implementation status, Baseline and monitoring plan and

				<i>monitoring arrangements, roles and responsibilities, emergency procedures, data recording and storage procedures.</i>
3.	12/05/2021	Ms. Nawarut Phiansumrit – Manager, Project Development	South Pole Carbon Asset Management Ltd.	<i>Project implementation status, project boundary, deviation, Data and parameters monitored and Emission reductions calculations.</i>
4	12/05/2021	Ms. Sirinut Raya – Project Manager	South Pole Carbon Asset Management Ltd.	
5	12/05/2021	Mr. Chanchal Khumkhoon	Local farmer, village 11, Kranuan district, Khonkaen	<i>Stakeholder consultation and grievance mechanism</i>
6	12/05/2021	Mr. Keerati Tunsrichon	Local farmer, village 2, Kranuan district, Khonkaen	
7	12/05/2021	Mr. Anusorn Saengpha	Local farmer, village 10, Kranuan district, Khonkaen	

1.9 Site Inspections

The verification team could not visit the site due to COVID-19 pandemic and subsequent travel restrictions. As per the Emission Reduction Purchase Agreement (ERPA) dated 14/03/2008 /21/, the client is committed to deliver the VERs every year.

Based on the above-mentioned justification, the DOE could not postpone the site visit. The same is as per the VCS- COVID travel guidance (<https://verra.org/covid-19-travel-guidance/>) /16/.

All information provided in the VCS-MR /01/ was verified during the desk-review phase against credible sources, and interviews with concerned stakeholders. Since an onsite inspection is avoided, the verification team decided to carry out the audit by other means of standard auditing techniques, which included video conference calls, videos of the site, videos of the equipment's installed and measuring devices in place, pictures of the meters, emails, raw data and telephonic interviews.

During the desk assessment of the project, the verification team assessed the implementation and operation of the proposed project activity, the wastewater treatment facility, reviewed the information flows for generating, aggregating and reporting the monitoring parameters, interviewed key personnel of the plant to confirm the operational and data collection procedures, cross-checked between information provided in the monitoring report and data plant. The values used in the ER calculations were confirmed by means of checking the records provided by the client. Checked the quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

1.10 Resolution of Findings

The objective of this phase of the verification is to resolve any outstanding issues which need to be clarified for 4KES's positive conclusion on the project description. To guarantee transparency any findings raised during the verification are incorporated in the Appendix B to this report. A corrective action request (CAR) is raised if one of the following occurs:

- The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions.*
- The VCS Version 4.1 standard have not been met.*
- There is a risk that the emission reductions cannot be monitored or calculated.*

A clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable VCS Version 4.1 standard have been met.

The No. of CARs/CLs raised by 4KES are the following

CAR:0, CL: 04 and FAR: 0

The above-mentioned CARs/CLs have been successfully closed. More information on the same is provided in Appendix-B of this report.

1.10.1 Forward Action Requests

Based on the review of the previous verification report /06/, no FAR was raised during the previous verification.

No FARs raised during this verification

1.11 Eligibility for Validation Activities

4KES is accredited for validating and verifying GHG emission reduction project activities falling under sectoral scope 13 and 1, waste handling and disposal and Energy industries (renewable - / non-renewable sources).

VALIDATION FINDINGS

1.12 Participation under Other GHG Programs

Since this is a verification activity, this section is not applicable.

1.13 Methodology Deviations

It is checked that project involves the following deviation and the same was also approved during the renewal of the crediting period, which was checked from the updated PD and accepted.

As per the methodology AMS-I.C, version 21 para 34, the baseline emissions from the heat displaced by the project activity $BE_{thermal,CO2,y}$, is estimated through an alternative equation against the prescribed equation by the applied methodology.

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

Since there is no metering mechanism for measurement of net quantity of heat supplied by the project activity ($EG_{Thermal,y}$), an alternative approach is used. This approach is based on the amount of heat required for starch drying, which is estimated on heat requirements per tonne of starch when only fuel oil was used.

The approach compensates the fuel oil usage from total fuel oil requirement (in baseline) and conservatively estimates the fuel oil replaced by biogas, irrespective of quantity of biogas combusted. The deviated approach ensures that efficiency lost in system due to dual fired system is conservatively adjusted in the baseline emissions.

The deviated approach described in the section 3.6, of the final PD version 3 is verified by the validation team (during for crediting period) and found to be conservative as efficiency loss due to dual fired system is accounted in biogas usage, thereby estimating lower fuel oil replacement for baseline emission estimation. In fact, for the proposed verification, the verification team requested the PP to estimate the thermal energy produced based on the quantity of biogas consumed in the boilers, NCV of biogas and the boiler efficiency. It is confirmed that the values of $EG_{thermal,y}$ is conservative based on the historical data approach and thus the same is used in ER calculations, which was accepted by the team of 4KES.

1.14 Project Description Deviations

Noted that the following deviation from the first verification is also applicable to the proposed monitoring period.

The boiler 1 was replaced by the new bigger one. The capacity of thermal energy output was changed from 3.488 to 4.070 MW_{th}. As per description in FAR M3 of the validation report, if existing boiler is replaced with a new one during any verification no emission reduction shall be granted for heat displacement. Hence the heat displacement at this boiler was neglected from the emission reductions.

It is checked that the emission reductions from the boiler 1 have been excluded in the current verification. The same is as per the deviation requested and approved in the first verification, which is conservative and accepted.

1.15 Grouped Project

The verification team confirms that the project is not a grouped project and hence this is not applicable to the project activity.

VERIFICATION FINDINGS

1.16 Project Implementation Status

On the basis of the online interviews and the reviewed project documentation, the verification team confirms that the project was implemented as described in the updated VCS PD version 03. All the physical components and project boundary are in conformity with the description in updated VCS PD. Based on the VCS PD and the available information at VCS database it is confirmed that the project's first crediting period was from 15/07/2009 to 14/07/2019. It is checked that all the verifications under first crediting period is completed and the second crediting period under VCS is from 15/07/2019 – 14/07/2029 and this is the 2nd verification assessment under the second crediting period covering monitoring period 03/03/2020 to 31/03/2021.

The project activity involves the installation and operation of a methane recovery and utilization system (covered lagoon system). The captured methane (biogas) is utilized as fuel in dual fire boilers replacing fossil fuel (i.e. HFO) and gas engines for electricity generation. As per the registered VCS PD, there are two dual fired boilers of 3.488 MW_{th} and 3.78 MW_{th} capacities. However, from first verification onwards, the boiler with capacity 3.488 MW_{th} was replaced with a new boiler of capacity 4.070 MW_{th}. As discussed above in the deviation section, PP decided not to claim emission reduction from the new boiler, which is conservative. The second boiler capacity is changed to 6.16 MW_{th} as per the VCS-PD applicable for second crediting period /03/. According to the VCS PD, the captured biogas is also utilised in two gas engines each having a capacity of 952 kW_e. From first verification onwards it was noted that two additional gas engines of 450 kW_e have also been installed. The baseline emissions on account of biogas utilisation in these two gas engines have not been included in the emission reduction calculation. It was noted that generator no.'s 1 was decommissioned on 13/06/2020 /23/ and generator no's 2 was stopped operation on 26/12/2020 /07/. This is confirmed based on the review of log sheets provided to support the ER calculations, virtual inspections of site, videos and pictures of the site, revised figure 3 : Project boundary in the updated MR and interactions with the project proponent /01/. It is also checked that new gas engine with the installed capacity of 1.5 MW_e was commissioned on 09/01/2021 /24/. It is also confirmed that change in the capacity is still below the installed capacity discussed in the registered PD.

The project boundary is the physical, geographical site where the wastewater treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place. Based on document review and off-site interview and video call, it is confirmed that all the emission sources within the boundary have been considered appropriately.

Methodology deviations and project description deviations have been discussed in more detail in section 3.2 and 3.2.

The verification team confirms that for the proposed crediting period there is no other form of GHG-related environmental credit generated by the project activity /01/. PP has also confirmed that that this project is not being used to create other forms of environmental credits /01/.

Data parameters fixed ex-ante and available at validation are given below:

DATA/PARAMETER & Unit	Source of data	Reported value for the project period	Assessment/Observation
Global Warming Potential for Methane (GWP_{CH_4}) in tCO_2e/tCH_4	Data based on renewed PD /03/ and validation report /05/	25	The value is ex-ante fixed for 10 years crediting period as per the registered PD. The value considered is appropriate.
Methane producing capacity of the wastewater ($B_{0,ww}$); $kg CH_4/kg COD$	Data based on registered PD /03/ and validation report /05/	0.25	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology /13/.
Model correction factor to account for model uncertainties (UF_{BL})	Data based on registered PD /03/ and validation report /05/	0.89	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology /13/.
Model correction factor to account for model uncertainties (UF_{PJ})	Data based on registered PD /03/ and validation report /05/	1.12	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology /13/.
Methane correction factor for baseline wastewater treatment systems ($MCF_{ww,treatment, BL,Lagoon}$)	Data based on registered PD and renewed /03/ and validation report /05/	0.8	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
Methane correction	Data based on registered PD	0.8	The value is ex-ante fixed for 10 years crediting period as

factor for project wastewater treatment systems k ($MCF_{ww,treatment,PJ,Lagoon}$)	/03/ and validation report /05/		per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (CFE_{ww})	Data based on registered PD /03/ and validation report /05/	0.9	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
COD removal efficiency of baseline treatment system for the starch plant ($\eta_{COD,BL,i}$; %)	Data based on registered PD, /03/ and validation report /05/	87.16%	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
Destruction efficiency of the electricity generator (DE ; %)	Data based on registered PD /03/ and validation report /05/	100%	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
Combined margin CO_2 emission factor for grid power generation in year y ($EF_{grid,CM,y}$; tCO_2/MWh)	Data based on registered PD, /03/ and validation report /05/	0.5637	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE.
Emission factor of fossil fuel replaced – Residual Fuel oil ($EF_{HFO,CO2}$; tCO_2/TJ)	Data based on registered PD /03/ and validation report /05/	77.4	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.

Density of methane gas at reference conditions (ρ_{CH_4}); kg/m ³	Data based on registered PD /03/ and validation report /05/	0.716	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /13/.
NCV of fuel oil i.e. fossil fuel displaced by biogas (NCV _{HFO}); GJ/ton	Data based on registered PD /03/ and validation report /05/	42.763	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE.
NCV of biogas (NCV _{biogas}) in MJ/Nm ³	Data based on registered PD /03/ and validation report /05/	20.93	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool.
Liters of fossil fuel required per tonne of dry starch historically (Q _{FO,starch}); L/tonne	Data based on registered PD 03/ and validation report /05/	39.6	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE.
Density of fuel oil (D _{FO}); Kg/litre	Data based on registered PD 03/ and validation report /05/.	0.93	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE .
Total electrical capacity of the equipment installed in the project activity (P _{el} ; kW)	Data based on registered PD 03/ and validation report /05/.	458 kW	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE.

4KES is able to confirm that the Data and Parameters fixed ex-ante have been implemented In full compliance with registered monitoring plan.

Parameters monitored Ex-post

The ex-post parameters that are mentioned in the methodology are included in the PDD and are provided in compliance with the methodology, and they will be monitored during the crediting period:

Data/Parameter	Assessment			
Data Unit	$Q_{ww,y}; m^3$			
Description	Volume of wastewater treated in the year y			
Source of data to be used	Measured – Volumetric flow meters-FM1 and FM2			
Value of monitored parameter for the monitoring period	Period	Value (m³) Lower	Value (m³) Higher	
	03/03/2020 to 31/12/2020	387,301	387,697	
	01/01/2021 to 31/03/2021	263,114	263,114	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily logbook reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.			
Monitoring equipment	Magnetic flow meter. The meter with tag FM1 and FM2 measures the wastewater treated in the year y from the starch plant, entering to biogas system of the project.			
	Tag	FM1		
	Serial number	LA020720000		
	Model	Endress & Hauser		
	Tag	FM2		
	Serial number	M102FC20000		
	Model	Endress & Hauser		
	Magnetic flow meter. The meter with tag FM1 was replaced on 30/06/2020 and FM2 was replaced on 01/09/2020			
	Tag	FM1		
	Serial number	N4065620000		
	Model	Endress & Hauser		
	Tag	FM2		
	Serial number	N308AD20000		
	Model	Endress & Hauser		
	Accuracy of the monitoring equipment	PP has installed electromagnetic flow meter with an accuracy class of ±0.50% respectively. The accuracy of the meters represents good monitoring practice.		
	Measuring/Reading/Recording	Continuous monitoring, record on the daily basis. The		

frequency	practice found to be followed in the log records during the online interviews and consistent with registered monitoring plan.	
Calculation method (if applicable)	N/A	
Calibration		
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years, this is also consistent with registered monitoring plan and the previous verifications. Hence accepted.	

Does the calibration cover the monitoring period? Has the calibration frequency been respected?			
	Tag	Calibration dates	Calibration entity
	FM1	18/05/2017	Endress & Hauser
		23/10/2020	NO, Valid until 17/05/2020 /08/ Valid until 22/10/2023 /08/ Calibration gap noted from 17/05/2020 to 30/06/2020
	FM1 (New one)	14/06/2018	Endress & Hauser
	FM2	19/05/2017	Endress & Hauser
		30/01/2021	No, Valid until 18/05/2020 /08/ Valid until 29/01/2024 /08/ Calibration gap noted from 18/05/2020 to 31/08/2020
Noted that PP has applied maximum permissible error for the dates when the calibration was delayed. Same has been checked and confirmed from the ER spread sheets.			
Calibration certificates	Please refer above		
Does the calibration of meters	Endress & Hauser is the manufacturer of the flow meters		

have be done by an accredited person or institution?	and accredited to do calibration /09/.
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Data/Parameter	Assessment			
Data Unit	COD _{ww,untreated,y} ; tCOD/m ³			
Description	COD of wastewater before entering covered lagoon reactor system.			
Source of data to be used	Measured using colorimetric method			
Value of monitored parameter for the monitoring period	Period	Value		
		Lower	Higher	
	03/03/2020 to 31/12/2020	0.0381	0.0435	
	01/01/2021 to 31/03/2021	0.0475	0.0541	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information. During the audit, it was checked that COD samples are sent to external lab once in a year /10/. Based on the results obtained, it was checked that the most conservative values were used in the ER calculations.			
Monitoring equipment	Colorimeter with Se. No : H19945I and model : Hanna			
Accuracy of the monitoring equipment	10 mg/l (HR) 1 mg/l (LR)			
Measuring/Reading/Recording frequency	Daily. However, PP has done periodic analysis following 90/10 confidence/precision level which is consistent with the applied methodology AMS-III.H, version 19. Hence, accepted. The Colorimetric method is well documented and well accepted by international standards.			
Calculation method (if applicable)	N/A.			
Calibration				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Calibration frequency is defined least once in every 3 years. This is consistent with registered monitoring plan and previous verifications and hence accepted.			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Se.no	Calibration dates	Calibration entity	Does it cover the MP
	H19945I	12/12/2018	HANNA Instruments	Yes, valid until 11/12/2

			021/08/
Calibration certificates	Please refer above.		
Does the calibration of meters have be done by an accredited person or institution?	HANNA Instruments (Thailand) Ltd is an accredited laboratory to perform the calibration /09/.		

Data/Parameter	Assessment		
Data Unit	COD _{ww,treated,y} ; tCOD/m ³		
Description	The chemical oxygen demand of the wastewater after the treatment system affected by the project activity .		
Source of data to be used	Measured using colorimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	03/03/2020 to 31/12/2020	0.0012	0.0014
	01/01/2021 to 31/03/2021	0.0013	0.0016
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information. During the audit, it was checked that COD samples are sent to external lab once in a year /08/. Based on the results obtained, it was checked that the most conservative values were used in the ER calculations.		
Monitoring equipment	Colorimeter with Se. No : H19945I and model : Hanna		
Accuracy of the monitoring equipment	10 mg/l (HR) 1 mg/l (LR)		
Measuring/Reading/Recording frequency	Daily. However, PP has done periodic analysis following 90/10 confidence/precision level which is consistent with the applied methodology AMS-III.H, version 19. Hence, accepted. The Colorimetric method is well documented and well accepted by international standards.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Calibration frequency is defined least once in every 3 years. This is consistent with registered monitoring plan and previous verifications and hence accepted.		

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Se.no	Calibration dates	Calibration entity	Does it cover the MP
	H19945I	12/12/2018	HANNA Instruments	Yes, valid until 11/12/2021/08/
Calibration certificates	Please refer above.			
Does the calibration of meters have be done by an accredited person or institution?	HANNA Instruments (Thailand) Ltd is an accredited laboratory to perform the calibration /09/.			

Data/Parameter	Assessment		
Data Unit	COD _{discharge,PJ,y} ; tCOD/m ³		
Description	The chemical oxygen demand of water after the secondary treatment process, before being reused.		
Source of data to be used	Measured using colorimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	03/03/2020 to 31/12/2020	0.0001	0.0001
	01/01/2021 to 31/03/2021	0.0001	0.0001
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information. During the audit, it was checked that COD samples are sent to external lab once in a year /10/. Based on the results obtained, it was checked that the most conservative values were used in the ER calculations.		
Monitoring equipment	Colorimeter with Se. No : H19945I and model : Hanna		
Accuracy of the monitoring equipment	10 mg/l (HR) 1 mg/l (LR)		
Measuring/Reading/Recording frequency	Daily. However, PP has done periodic analysis following 90/10 confidence/precision level which is consistent with the applied methodology AMS-III.H, version 19. Hence, accepted. The Colorimetric method is well documented and well accepted by international standards.		
Calculation method (if applicable)	N/A.		

Calibration				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Calibration frequency is defined least once in every 3 years. This is consistent with registered monitoring plan and previous verifications and hence accepted.			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Se.no	Calibration dates	Calibration entity	Does it cover the MP
	H19945I	12/12/2018	HANNA Instruments	Yes, valid until 11/12/2021/08/
Calibration certificates	Please refer above.			
Does the calibration of meters have be done by an accredited person or institution?	HANNA Instruments (Thailand) Ltd is an accredited laboratory to perform the calibration /09/.			

Data/Parameter	Assessment								
Data Unit	$S_{final, PJ, y}$ tonnes								
Description	Amount of dry matter in the sludge								
Source of data to be used	Plant records								
Value of monitored parameter for the monitoring period	Zero (0). No sludge was removed during the monitoring period. This is confirmed through onsite interviews.								
Monitoring equipment	<table> <tr> <td>Tag</td><td>Weighbridge</td></tr> <tr> <td>Brand</td><td>Commandor</td></tr> <tr> <td>Model</td><td>HP-05K</td></tr> <tr> <td>Serial number</td><td>0008666</td></tr> </table>	Tag	Weighbridge	Brand	Commandor	Model	HP-05K	Serial number	0008666
Tag	Weighbridge								
Brand	Commandor								
Model	HP-05K								
Serial number	0008666								
Accuracy of the monitoring equipment	±20 kg								
Measuring/Reading/Recording frequency	Whenever the sludge is removed, the quantity shall be recorded and documented. However, no sludge was removed during the monitoring period.								
Calcualtion method (if applicable)	N/A.								
Calibration									
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The calibration and the accuracy of weighbridge is controlled and verified by Central Bureau of Weights and Measures. The calibration certificate is valid for 2 years.								

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Se.no	Calibration dates	Calibration entity	Does it cover the MP
	0008666	04/06/2019	Central Bureau of Weights and Measures	Yes, valid until 03/06/2021/08/
Calibration certificates	Please refer above.			
Does the calibration of meters have be done by an accredited person or institution?	Central Bureau of Weights and Measures is an accredited entity to perform such calibrations /09/.			

Data/Parameter	Assessment	
Data Unit	BG _{burnt,,y} ; Nm ³	
Description	Amount of biogas combusted for gainful use in the year y	
Source of data to be used	Measured using Gas flow meters at boiler (GM4) and gensets GM 3)	
Value monitored	Total (BG to boiler + BG to genset)	
	Monitoring Period	
	Total Value in Nm ³	
	03/03/2020 to 31/12/2020	
	3,053,277	
	01/01/2021 to 31/03/2021	
	2,225,429	
	GM4 – BG to boiler-2	
	Monitoring Period	
	Total Value in Nm ³	
	03/03/2020 to 31/12/2020	
	1,975,926	
	01/01/2021 to 31/03/2021	
876,926		
GM3 – BG to genset		
Monitoring Period		
Total Value in Nm ³		
03/03/2020 to 31/12/2020		
1,077,351		
01/01/2021 to 31/03/2021		
1,348,503		
Total biogas combusted in boiler 2 (GM4) and gas engine		

	(GM3) is considered. Monitored values of GM 4 and GM 3 mentioned in the monitoring report and ER sheet have been verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.			
Monitoring equipment	Tag No.	Serial Number	Model	
	GM4	N1-V905-9663007	Siemens	
	GM3	5314	FOX	
Accuracy of the monitoring equipment	GM4 – $\pm 0.075\%$ GM3- $1\%R + 0.2\%FS$			
Measuring/Reading/Recording frequency	Continuous monitoring and daily recording for emission reduction calculation.			
Calculation method (if applicable)	N/A.			
Calibration				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years as per registered monitoring plan.			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Tag	Calibration dates	Calibration entity	Does it cover the MP
	GM4	11/01/2018 /08/ 15/06/2021 /08/	MIT	No, is valid until 10/01/2021 Valid until 14/06/2024. Calibration delay noted from 11/01/2021 to 31/03/2021.
	GM3	29/11/2018 /08/	MIT	Yes, is valid until 28/11/2021
Calibration certificates	Please refer above.			
Does the calibration of meters have be done by an accredited person or institution?	MIT is an accredited entity for calibration /09/.			

Data/Parameter	Assessment		
Data Unit	$BG_{\text{burnt,Flare},y}/F_{\text{CH}_4,\text{RG},m}; \text{Nm}^3$		
Description	Amount of biogas sent to flare system in the year y		
Source of data to be used	Measured using Gas flow meters (GM2)		
Value of monitored parameter for the monitoring period	0 (Zero). During the monitoring period no flaring was recorded as verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	Tag no.	Se.No.	Brand
	GM2	7568	FOX
Accuracy of the monitoring equipment	1%R + 0.2%FS		
Measuring/Reading/Recording frequency	Continuous monitoring and daily recording.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years as per registered monitoring plan.		
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Tag	Calibration dates	Calibration entity
	GM2	28/04/2016 28/04/2020 /08/	MIT
			Does it cover the MP
			NO. since no flaring was carried out in this period the same was accepted.
Calibration certificates	Please refer above.		
Does the calibration of meters have be done by an accredited person or institution?	MIT is an accredited entity for calibration /09/.		

Data/Parameter	Assessment
Data Unit	$W_{\text{CH}_4,y}; \%$
Description	Methane content in the biogas in the year y

Source of data to be used	Measured using portable gas analyzer (MS)			
Value of monitored parameter for the monitoring period				
	Period	Lower Value		Higher value
	03/03/2020 to 31/12/20210	58%		59%
	01/01/2021 to 31/03/2021	56%		58%
	The average value mentioned in the monitoring report and ER sheet have been verified with the daily reports /07/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.			
Monitoring equipment	Serial number	G503004		
	Model/Brand	BIOGAS 5000/ Geotech		
Accuracy of the monitoring equipment	VCS PD does not specify the accuracy of monitoring equipment. However, the accuracy of gas analyzer is 0.5% as per the specification of the equipment.			
Measuring/Reading/Recording frequency	Periodic using a portable gas analyzer. Measurement follows 95% confidence interval which is consistent with the applied methodology.			
Calculation method (if applicable)	N/A.			
Calibration				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The analyzer is calibrated at least once every 3 years as per registered monitoring plan.			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Tag	Calibration dates	Calibration entity	Does it cover the MP
	MS	12/06/2018 /08/	QED Environmental System Ltd	Yes, valid until 11/06/2021
		30/03/2021 /08/	QED Environmental System Ltd	valid until 29/03/2024.
Calibration certificates	Please refer above.			
Does the calibration of meters have be done by an accredited person or institution?	QED Environmental Systems Ltd. is accredited to calibrate the gas analyser /09/.			

Data/Parameter	Assessment
Data Unit	$\eta_{\text{Flare-m}}$; %
Description	Flare efficiency in the minute <i>m</i>
Source of data to be used	Default value as per “Tool to determine project emissions from flaring gases containing methane” for the first crediting period and for the second crediting period as per Project emissions from flaring” version 02.0.0.
Value of monitored parameter for the monitoring period	0%. The flare efficiency shall be determined based on the flame detection period. According to the monitoring plan of the VCS PD, “The default factor of 50% might be only applied if a flame is detected at the flare for more than 20 minutes in hour <i>h</i> , whenever biogas is sent to the flare system. If these conditions are not met, 0% default value should be used for this period”. Since no flaring was done during the monitoring period, 0% flare efficiency is considered conservatively as per the tool.
Monitoring equipment	N/A
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	N/A
Calculation method (if applicable)	N/A
Calibration	
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A
Calibration certificates	N/A
Does the calibration of meters have been done by an accredited person or institution?	N/A

Data/Parameter	Assessment
Data Unit	EC_y ; MWh
Description	Electricity consumption by wastewater treatment plant in year <i>y</i>

Source of data to be used	Maximum rated consumption is calculated by multiplying total electrical capacity with actual operational days and 24 hours each day and 20% additional factor to be conservative for the second crediting period.								
Value of monitored parameter for the monitoring period		<table><tr><th>Period</th><th>Value (MWh)</th></tr><tr><td>03/03/2020 to 31/12/2020</td><td>2,955</td></tr><tr><td>01/01/2021 to 31/03/2021</td><td>1,095</td></tr></table>	Period	Value (MWh)	03/03/2020 to 31/12/2020	2,955	01/01/2021 to 31/03/2021	1,095	
Period	Value (MWh)								
03/03/2020 to 31/12/2020	2,955								
01/01/2021 to 31/03/2021	1,095								
Monitoring equipment	N/A								
Accuracy of the monitoring equipment	N/A								
Measuring/Reading/Recording frequency	N/A								
Calculation method (if applicable)	N/A.								
Calibration									
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A								
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A								
Calibration certificates	N/A								
Does the calibration of meters have be done by an accredited person or institution?	N/A								

Data/Parameter	Assessment		
Data Unit	EG _{PJ,y} ; MWh		
Description	Net electricity production by the generators during year y		
Source of data to be used	Electricity meters installed at the gensets		
Value of monitored parameter for the monitoring period		Monitoring period	Value monitored (MWh)
		03/03/2020 to 31/12/2020	0
		01/01/2021 to 31/03/2021	2,052
	Continuously monitoring and daily recording /07/. Since the electricity meters for the proposed monitoring period are not		

	calibrated. The value for the same is considered as 0, which is conservative and accepted. However, noted that new as engine with meter was installed on 07/01/2021 as per the log sheets and commissioned on 09/01/2021 as per the commissioning report /24/.	
Monitoring equipment		
	Type	Energy Meter
	Model	X20CM0985-1
	S.no	N/A
Accuracy of the monitoring equipment	±0.5%	
Measuring/Reading/Recording frequency	Continuously measured and daily recorded.	
Calculation method (if applicable)	N/A.	
Calibration		
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Once in 3 years. The energy meters are not calibrated in the proposed monitoring period.	
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A	
Calibration certificates	N/A	
Does the calibration of meters have be done by an accredited person or institution?	N/A	

Data/Parameter	Assessment		
Data Unit	$q_{FO,y}$; Liters/y		
Description	Quantity of fossil fuel used in boiler in year y		
Source of data to be used	Measured by continuous Fuel oil meter		
Value of monitored parameter for the monitoring period	Monitoring period	Value monitored (Litres)	
	03/03/2020 to 31/12/2020	57,510	
	01/01/2021 to 31/03/2021	141,485	
	The reported values were checked during site visit from log book records /07/.		
Monitoring equipment	Tag No.	Serial Number	Model
	OM 2	5449943	CONTOIL

Accuracy of the monitoring equipment	±1% as per equipment specification.								
Measuring/Reading/Recording frequency	Defined frequency is continuous measurement and monthly recording.								
Calculation method (if applicable)	N/A.								
Calibration									
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Calibration frequency is once in three years.								
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	<table><tr><td>Tag</td><td>Calibration date</td><td>Does it cover the MP</td></tr><tr><td>OM2</td><td>29/11/2018</td><td>Yes, valid until 28/11/2021/08/</td></tr></table>			Tag	Calibration date	Does it cover the MP	OM2	29/11/2018	Yes, valid until 28/11/2021/08/
Tag	Calibration date	Does it cover the MP							
OM2	29/11/2018	Yes, valid until 28/11/2021/08/							
Calibration certificates	Refer above.								
Does the calibration of meters have been done by an accredited person or institution?	Miracle International Technology Co. Ltd. is accredited to calibrate the flow meter /09/.								

Data/Parameter	Assessment								
Data Unit	$Q_{starch,y}$ Tonnes								
Description	Quantity of dry starch produced								
Source of data to be used	Based on operational log sheet at the plant								
Value of monitored parameter for the monitoring period	<table border="1"> <tr> <th>Period</th><th>Total Value (Ton)</th></tr> <tr> <td>03/03/2020 to 31/12/2020</td><td>46,059</td></tr> <tr> <td>01/01/2021 to 31/03/2021</td><td>24,270</td></tr> </table> This was checked with the starch production log book records and cross checked with sales records /07/	Period	Total Value (Ton)	03/03/2020 to 31/12/2020	46,059	01/01/2021 to 31/03/2021	24,270		
Period	Total Value (Ton)								
03/03/2020 to 31/12/2020	46,059								
01/01/2021 to 31/03/2021	24,270								
Monitoring equipment	<table border="1"> <tr> <td>Tag</td><td>Weighbridge</td></tr> <tr> <td>Brand</td><td>Commandor</td></tr> <tr> <td>Model</td><td>HP-05K</td></tr> <tr> <td>Serial number</td><td>0008666</td></tr> </table>	Tag	Weighbridge	Brand	Commandor	Model	HP-05K	Serial number	0008666
Tag	Weighbridge								
Brand	Commandor								
Model	HP-05K								
Serial number	0008666								
Accuracy of the monitoring equipment	Same as $S_{final,PJ,y}$ parameter referred above.								
Measuring/Reading/Recording frequency	Same as $S_{final,PJ,y}$ parameter referred above.								

Calculation method (if applicable)	N/A.
Calibration	
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Same as $S_{final,PJ,y}$ parameter referred above.
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Same as $S_{final,PJ,y}$ parameter referred above
Calibration certificates	Same as $S_{final,PJ,y}$ parameter referred above.
Does the calibration of meters have be done by an accredited person or institution?	Same as $S_{final,PJ,y}$ parameter referred above.

It is to be noted that since no biogas is flared in the current monitoring period, the monitoring parameter associated with the flare parameters $\eta_{flare,m}$ and $Flame_m$ is not included.

1.17 Safeguards

1.17.1 No Net Harm

The project activity”, involves the installation and operation of a biogas recovery and utilization system (an open anaerobic effluent treatment system) at Kaen Charoen Co. Ltd., a tapioca starch factory in Khonhaen. The biogas captured from the treatment system is used replacing the HFO from boilers. Thus, the project avoids methane and CO₂ emissions. Thus, the project will not result in negative environmental impacts. Moreover, the project has positive socio- economic impacts by creating jobs to the villagers, supporting the locals by purchasing the cassava and many several CSR activities. The same was confirmed by interviewing the project owner and local villagers.

1.17.2 Local Stakeholder Consultation

Local stakeholder consultation is not applicable for the project proponent during verification. PP organized stakeholders’ consultation during validation of the project activity, which was validated by the validating VVB /05/. As per the site visit observation, the PP has provided the phone number accessible to local stakeholders, wherein they can provide their feedback. It is also checked that the grievance can be directly communicated to the plant manager, who in turn records the complaints. The verification team interacted with local stakeholders via online interview and confirmed the same. It is also confirmed that there was no negative comment or feedback from local stakeholders.

1.18 AFOLU-Specific Safeguards

The project does not implement AFOLU activity. Thus, this section is not applicable.

1.19 Accuracy of GHG Emission Reduction and Removal Calculations

GHG emissions reductions for the project and the baseline scenario were correctly calculated using the formulae described in the applied methodology for this project. The verification team has reviewed the emission reduction (ER) spread sheet and checked all the formulae and found they are correct and in line with the monitoring plan of the registered PD and the applied monitoring methodology.

The emission reduction due to methane capturing and utilization in onsite boilers was estimated by measuring the required parameters using appropriate monitoring equipment and using the formulae described in the methodologies; AMS III.H., version 19 and the VCS PD. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 4.1 of this report. It is confirmed that all the ex-ante parameters have been correctly used in the emission reduction calculation. According to the applied methodologies, the conservativeness of the achieved emission reduction was checked, and the calculation has been transparently provided in the ER sheet.

Baseline Emissions:

Baseline emissions related to methane avoidance as per AMS-III.H, version 19 is calculated as below:

$$BE_y = BE_{power,y} + BE_{ww, treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$$

As per the registered PD, the parameter of $BE_{power,y}$ $BE_{s,treatment,y}$ $BE_{ww,discharge,y}$ and $BE_{s,final,y}$ are considered to be zero. Thus, the baseline emission can be summarised as following;

$$BE_y = BE_{ww,treatment,y}$$

$$BE_{ww, treatment, y} = \sum Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,i} * MCF_{ww, treatment, BL, i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

Parameter	Details	Quantification
$BE_{ww, treatment, y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO ₂ e)	03/03/2020 to 31/03/2021 = 105,848
$Q_{ww, i, y}$	Volume of wastewater treated in baseline wastewater treatment system i in year y (m ³)	03/03/2020 to 31/12/2020 = Lower: 3,87,301 higher: 3,87,697 01/01/2021 to 31/12/2021 = Lower / higher: 2,63,114
$COD_{inflow, i, y}$	Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y. Average value may be	03/03/2020 to 31/12/2020 = 38, 193 01/01/2021 to 31/12/2021 = 47,500

Parameter	Details	Quantification
	used through sampling with the confidence/precision level 90/10 (t/m ³)	
$\eta_{\text{COD,BL},i}$	COD removal efficiency of the baseline treatment system I	87%
$MCF_{\text{ww,treatment,BL},i}$	Methane correction factor for the baseline treatment system I	0.8
i	Index for baseline wastewater treatment system	-
$B_{\text{o,ww}}$	Methane producing capacity of the wastewater	0.25
UF_{BL}	Model correction factor to account for model uncertainties	0.89
GWP_{CH_4}	Global Warming Potential for methane	25

According to AMS-III.H, version 19, emission reduction achieved by the project activity is limited to the ex-post calculated baseline emissions minus project emission using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,\text{ex-post}} = \min((BE_{y,\text{ex-post}} - PE_{y,\text{ex-post}} - LE_{y,\text{ex-post}}), (MD_y - PE_{\text{power},y} - PE_{\text{biomass},y} - LE_{y,\text{ex-post}}))$$

As per paragraph 46 of AMS III.H., in case of flaring/combustion MD_y will be measured using the conditions of the flaring process:

$$MD_y = BG_{\text{bunt},y} * W_{\text{CH}_4,y} * D_{\text{CH}_4} * FE * GWP_{\text{CH}_4}$$

Where:

Parameter	Details	Quantification
MD_y	Methane captured and destroyed/gainfully used by the project activity in the year y (tCO ₂ e)	03/03/2020 to 31/12/2020 = 31,623 01/01/2021 to 31/12/2021 = 22,283

$W_{CH_4, y}$	Methane content in the biogas in the year y (mass fraction)	03/03/2020 to 31/12/2020 = 58% (lower) and 59% (upper) 01/01/2021 to 31/12/2021 = 56%(lower) and 58% (upper)
D_{CH_4}	Density of methane at the temperature and pressure of the biogas in the year y (kg/m ³)	0.72
GWP_{CH_4}	Methane producing capacity of the wastewater	25
$BG_{burnt, flare, y}$	Biogas sent to flared in year y (Nm ³)	0
$BG_{burnt, combusted, y}$	Biogas volume in year (utilized for gainful use) (Nm ³)	03/03/2020 to 31/12/2020 = 30,53,277 01/01/2021 to 31/12/2021 = 22,25,428
$\eta_{flare, m/ FE}$	Flare efficiency in year y	0%

Baseline emissions calculation as per AMS I.C

For thermal energy produced using fossil fuels and/or grid electricity the baseline emissions are calculated as follows:

$$BE_{thermal, CO_2, y} = (EG_{thermal, y} / \eta_{BL, thermal}) * EF_{FF, CO_2}$$

As explained in section 3.2 of this report (deviation 2), $BE_{thermal, CO_2, y}$ is determined from the amount of fossil fuel consumed in boiler for starch production and quantity of starch production.

$$BE_{thermal, CO_2, y} = (Q_{starch} * Q_{FO, starch} * \%B2 - q_{FO, y, Boiler2}) * D_{FO} * NCV_{FO} * EF_{CO_2} / 10^6$$

Where:

Parameter	Details	Quantification
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$BE_{thermal,CO_2,y}$	Baseline emissions from thermal energy displaced by the project activity during the year y (t CO ₂)	03/03/2020 to 31/12/2020 = 4,135 01/01/2021 to 31/12/2021 = 2,520
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year y (TJ)	03/03/2020 to 31/12/2020 $EG_{thermal,y}$ – Historical data = 53.43 $EG_{thermal,y}$ – biogas delivered = 56.92 01/01/2021 to 31/12/2021 $EG_{thermal,y}$ – Historical data = 32.57 $EG_{thermal,y}$ – biogas delivered = 40.11
EF_{FF,CO_2}	CO ₂ emission factor of the fossil fuel that would have been used in the baseline plant. IPCC default emission factors can be used (t CO ₂ /TJ)	77.40
$Q_{starch,y}$	Quantity of dry starch produced in year y (tonnes)	03/03/2020 to 31/12/2020 $Q_{starch,y}$ – lower = 46,059 01/01/2021 to 31/12/2021 $Q_{starch,y}$ – lower = 24,270
$q_{FO,starch}$	Quantity of fossil fuel per unit of dry starch (liter/tonne)	39.60
$q_{FO,y}$	Quantity of fossil fuel used in the project activity (litre)	03/03/2020 to 31/12/2020 = 57,510 01/01/2021 to 31/12/2021 = 1,41,485
NCV_{FO}	Net calorific value of the fuel oil (TJ/tonne)	0.04
D_{FO}	Density of fuel oil in the year y (tonnes/m ³)	0.93

Baseline emissions calculation as per AMS I.D

Baseline emissions include only CO₂ emissions from electricity generation in power plants that are displaced due to the project activity.

$$BE_y = BE_{gen,y} = EF_y * EG_y$$

Where:

Parameter	Details	Quantification
$BE_{gen,y}$	Baseline emissions in year y (t CO ₂ e)	1156

EG_y	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh)	03/03/2020 to 31/12/2020 = 0 01/01/2021 to 31/12/2021= 2,052
EF_y	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO ₂ e/MWh)	0.5637

Project Emissions:

Project emissions related to methane avoidance component as per AMS-III.H, version 18 is calculated as below:

$$PE_{,y} = \{PE_{power,y} + PE_{ww,treatment} + PE_{s,treatment} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}\}$$

Since the project activity does not involve sludge treatment, $PE_{s,treatment}$, $PE_{s,final,y}$ are considered to be zero.

In the proposed project activity, there is no treated water discharged to sea, river and lakes. Thus, $PE_{ww,discharge,y}$ is considered to be 0.

Emissions from electricity consumption in the year y ($PE_{power,y}$) is calculated as follows:

$$PE_{power,y} = \sum P_{el} * (100\% + TDL_{j,y}) * 8,760 * EF_{EL,j,y} / 1000$$

Electricity consumed by biogas system is considered as per AMS-III.H considering maximum connected load and entire monitoring period with operation for 24 hours each day. Accordingly, electricity consumption during the monitoring period from 03/03/2020 to 31/03/2021 is 4,049 MWh which accounts 20% transmission and distribution loss. Grid emission factor is 0.5637 tCO₂e/MWh /02/. Therefore $PE_{power,y}$ is estimated to be 2,284 tCO₂e.

2. Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation ($PE_{ww,treatment,y}$)

Methane emissions from wastewater treatment systems affected by the project activity and not equipped with biogas recovery in the project The following equation is used.

$$PE_{ww,treatment,y} = \sum (Q_{ww,y} * COD_{ww,treated,y} * \eta_{PJ,k,y} * MCF_{ww,treatment,PJ,k}) * B_{o,ww} * UF_{PJ} * GWP_{CH4}$$

Parameter	Details	Quantification
$PE_{ww, treatment, y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation (tCO _{2e})	03/03/2020 to 31/03/2021= 4,875
$Q_{ww, k, y}$	Volume of wastewater treated in project wastewater treatment system k in year y (m ³)	03/03/2020 to 31/12 /2020=3,87,697 01/01/2021 to 31/12/2021= 2,63,114
$COD_{removed, PJ, k, y}$	COD of the wastewater inflow to the baseline treatment system i in year y (t/m ³). An average value may be used through sampling with a confidence/precision level of 90/10	03/03/2020 to 31/12 /2020=0.00122 01/01/2021 to 31/12/2021= 0.00151
$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.25 kg CH ₄ /kg COD)	0.25
$MCF_{ww, treatment, PJ, k}$	Methane correction factor for the project wastewater treatment system k	0.8
UF_{PJ}	Model correction factor to account for model uncertainties	1.12
GWP_{CH_4}	Global Warming Potential for methane	25

3. Methane fugitive emissions on account of inefficiencies in capture systems ($PE_{fugitive, y}$)

Project activity emissions from methane release in capture systems are determined as per AMS III.H as given below.

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$$

$$PE_{fugitive,ww,y} = (1 - CEF_{ww,y}) * MEP_{ww,treatment,y} * GWP_{CH4}$$

$$MEP_{ww,treatment,y} = Q_{y,ww} * B_{o,ww} * UF_{PJ} * \Sigma COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}$$

Where:

Parameter	Details	Quantification
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year y (tCO _{2e})	03/03/2020 to 31/03/2021= 16,949
$PE_{fugitive,ww,y}$	Fugitive emission through capture inefficiencies in the anaerobic wastewater treatment in the year y (tCO _{2e})	03/03/2020 to 31/03/2021= 16,949
$PE_{fugitive,s,y}$	Fugitive emission through capture inefficiencies in the anaerobic sludge treatment in the year y (tCO _{2e})	There is no sludge treatment in the project activity.

$CFE_{ww,y}$	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	0.9 (default value)
$COD_{removed, PJ, k, y}$	The chemical oxygen demand removed by the treatment system k of the project activity equipped with biogas recovery in the year y (tonnes/m ³)	03/03/2020 to 31/12 /2020=0.0423 01/01/2021 to 31/12/2021= 0.0527
$MEP_{ww, treatment,y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (t)	03/03/2020 to 31/12 /2020=3,671 01/01/2021 to 31/12/2021= 3,108

Since there is no sludge generation in this monitoring period, the emission from sludge treatment is not considered in the calculations thus $PE_{s, treatment}$ and $PE_{s, final, y}$ is considered zero “0” in project activity. In addition, $PE_{ww discharge, y}$ is also considered “0”, since the project doesn’t the treated water into river, sea or lake.

4. Methane emissions due to incomplete flaring ($PE_{flaring, y}$)

Project emissions from flaring is considered 0. Since there was no flaring in the current monitoring period.

Leakage Emissions

In line with applied methodologies and registered VCS-PD, there is no leakage emissions. Hence, LE_y is zero.

Emission Reductions:

$$ER_{y,ex post} = \min((BE_{y,ex post} - PE_{y,ex post} - LE_{y,ex post}), (MD_y - PE_{power,y} - LE_{y,ex post}))$$

$$= \min(81,7140), (51,622)+7,197$$

$$=58,819 \text{ tCO}_2\text{e}$$

1.20 Quality of Evidence to Determine GHG Emission Reductions and Removals

During the desk review, all relevant documents were checked to assess the correctness and quality of data submitted by the project participants, which are used to determine emission reductions. Inlet and outlet COD, quantity of wastewater, biogas production, biogas consumption for boilers, biogas for flaring, methane concentration of biogas, electricity consumption, electricity generation etc. were verified with the logbook values and external lab reports to ensure that there is no over estimation of the VCU. The provided data was found to be of adequate quality.

All records needed for monitoring are archived in line with the requirements of the registered monitoring plan. No significant, lack of evidence and missing data were detected during onsite verification. Hence, the verification team confirms that the monitoring system ensures required quality of the monitoring system to ensure the quality of the monitored data. All internal data are subjected to QA/QC measures. All the roles and responsibilities for monitoring and reporting have been clearly defined. Based on document review /01/ to /23/ and interview, it was found that the management and operational structure is in line with that stated in the registered monitoring plan.

All the meters (wastewater flow meter, biogas flow meters, COD values, and power meter, gas analyser, fuel oil meter and weighbridge) were calibrated at appropriate calibration frequency (described in section 4.1) to ensure the quality of the data. For any delay in calibration, maximum error factor of the instrument is applied over the measured value to estimate emission reductions conservatively.

It was verified through online interviews that the plant's team involved in the monitoring of project activity is well experienced. Hence, the verification team concludes that competent staff is employed by the project proponent to carry out the relevant tasks with sufficient accuracy.

4KES is of the opinion that this method of estimation is accurate and results in conservative estimation of emission reduction and is line with the applicable VCS requirements.

1.21 Non-Permanence Risk Analysis

The project is not a forestry project. Hence this section is not applicable

5 VERIFICATION CONCLUSION

4KES has performed verification of the emission reductions reported for the project activity "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)", in Thailand, VCS Registry Project ID 427, for the period 03/03/2020 to 31/03/2021 (both dates included), with regard to the relevant requirements for VCS activities. The project participants of the "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)" are responsible for:

- the preparation of greenhouses gas emissions data and the reported greenhouse gas emission reductions from the project on the basis set out in the monitoring plan contained in the registered VCS PD, version 3.0 of 14/05/2020.
- the development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of greenhouse gas emission reductions of the project.

It is the responsibility of 4KES to express an independent verification opinion about the project's conformity with the requirements of VCS Standard version 4.1 and GHG program applied, on the reported greenhouse gas emission reductions from the project.

Based on documented evidence and corroborated by an online interview with stakeholders, 4KES can confirm that:

- the project has been implemented and operated as per the registered VCS-PD;
- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable VCS Standard version 4.0 and program guide v4.1;
- the monitoring is in place as per the applied baseline and monitoring methodology;
- the monitoring plan in the registered VCS-PD is as per the applied baseline and monitoring methodology.

It is 4KES's opinion that the GHG emission reduction stated in the monitoring report version 03 of 02/07/2021 for the "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)", in Thailand for the period 03/03/2020 to 31/03/2021 are fairly stated.

The GHG emission reductions are calculated on the basis of approved methodology AMS-III.H version 19 and AMS-I.C version 21 and the monitoring plan included in the registered Project Design Document, version 03.0 of 14/05/2020.

Verification period: From [03-March-2020] to [31-March-2021]

Verified GHG emission reductions and removals in the above verification period:

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
03/03/2020 to 31/12/2020	35,758	1,844	0	33,914
01/01/2021	25,959	1,054	0	24,905

21 to 31/03/20 201				
<i>Total</i>	61,717	2,898	0	58,819

Approved by

Chandrakala R.

Director



4K Earth Science Private Limited

Date: 20-July-2021

Place: Bangalore, India

APPENDIX A: <TITLE OF ABBREVIATIONS>

Abbreviations	Full texts
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM M&P	Modalities and Procedures CDM
CER(s)	Certified Emission Reduction(s)
CH ₄	Methane
CL	Clarification Request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reductions
FAR	Forward Action Request
GHG(s)	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MoV	Means of Verification
MR	Monitoring Report
NGO	Non-governmental Organization
NR	Nepalese Rupee
ODA	Official Development Assistance
PDD	Project Design Document
PE	Project Emission
PEA	Provincial Electricity Authority
PP(s)	Project Participant(s)
PPA	Power Purchase Agreement
Ref.	Document Reference
SS(s)	Sectoral Scope(s)
TA(s)	Technical Area(s)
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard

APPENDIX B: <CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUEST>

Table 1. Remaining FAR from validation and/or previous verifications

FAR ID	N/A	Section no.		Date: 15/05/2021
Description of FAR				
Project participant response				Date: dd/mm/yyyy
Documentation provided by project participant				
DOE assessment				Date: dd/mm/yyyy

Table 2. CL from this verification

CL ID	01	Section no.	3.2	Date: 15/05/2021
Description of CL				
<i>PP is requested to also calculate the net quantity of heat generated on the basis of measurement of the volume of biogas captured and used for heat generation multiplied by the methane content of the gas, NCV methane, and the efficiency of the boiler during the project (i.e. with biogas) and select the most conservative value in ER calculations.</i>				

Project participant response	Date: 02/07/2021
The ER has been updated and the calculation of heat generated based on amount of biogas utilization has been compared with the historical approach. Lower result which is based on historical records fossil fuel used per tonne of starch production has been selected for the emission reduction calculation, for the monitoring period from 03/03/2020 to 31/03/2021. Kindly refer to the updated cell I47-I49 and J47 – J49 under ER calculation sheet.	
Documentation provided by project participant	
VCS427KK_WWT_TH_ER_MP3PAF03032020to31032021_V02 14062021	
DOE assessment	Date: 03/07/2021
The revised ER spread sheets and MR checked and noted that the heat generated is also calculated based on the biogas combusted. However, lower value resulted using historical approach, which is used in calculations. Since the same is conservative it is accepted. CL 01 is closed.	

CL ID	02	Section no.	4.1	Date: 15/05/2021
Description of CL				
1. PP is requested to provide the plant shut down and maintenance details. 2. As per the audit observations, the gas engines 1 and 2 of Gauscor (each capacity of 952 kW_{el}) were replaced with 1 Jenbacher gas engine of 1.5 MW on 07/01/2021. PP is requested to provide the commissioning certificates of the same along with the technical specifications and the same is not transparent in section 1.1. Also provide evidence on the decommissioning of gas engine 1 and 2.				
Project participant response				Date: 02/07/2021

1. During the monitoring period there are 12 public holidays in 2020 and only one(new year) public holidays in 2021. The supportive document can be found under the Employee and workplace status annual report 2020(Att05 subfolder 4 HR data and Kor Ror 11 document), which has been submitted to the Department of Labor Protection & Welfare and the summary of the maintenance and shut down period can be found in the Att01 Log Sheet sub document 1.4 record of starch. There are total of 2 maintenance periods: 05/07/2020 to 08/07/2020 and 21/09/2020 to 23/09/2020.
2. The commissioning certificates of the new gas engine have been provided along with the specification of machine. The information under section 1.1. of the MR has also been updated. Further evidence of the decommissioning of the gas engine 1 & 2 could be found in the last page of each engine's log sheet.

Documentation provided by project participant

Att01 Log sheet (sub document 1.4 Record of starch)

Att06 Specification (commissioning certificate of JB02)

Att05 EHS (sub folder 4 HR data, Kor Ror 11 document)

VCS427KK_WWT_TH_MR_MP3PAF03032020to31032021_V02 14062021

DOE assessment

Date: 03/07/2021

1. Operation and maintenance records were checked with log sheets of starch production.
 2. commissioning certificate for engine no 1462410 issued by INNIO- Jenbacher Waukesha, dated 09/01/2021 checked. From the log sheets it was confirmed that engine 1 was decommissioned on 13/06/2020 and engine 2 on 26/12/2020. Section 1.1 of the MR has been updated.
- CL02 is closed.

CL ID	03	Section no.	4.2.2	Date:	15/05/2021
Description of CL					
1. Section 2.2 of the MR is not transparent on, how due account of all and any input received during ongoing communication has been taken. Include details on any updates to the project design or justify why updates are not appropriate. 2. PP is requested to provide evidence of the on-going communication and evidence of any comments received for the proposed monitoring period.					
Project participant response					Date:
					02/07/2021

1. Since no negative comment received in monitoring period, the section update is not necessary. The ongoing communication has already been in-placed and records are controlled by the HR team.
2. Further clarification on no grievance received during the monitoring period has also been prepared, Att10 EHS.

Documentation provided by project participant

Att10EHS (07 Justification, Clarification document)

VCS427KK_WWT_TH_MR_MP3PAF01012020to02032020_V02 14062021

DOE assessment

Date: 03/07/2021

1. Updated MR checked and accepted.
 2. The verification team cross checked complaint register form, receipt form and the monthly complaint received. Noted that the Project has not received any complaints in the proposed MP.
- CL03 is closed.

CL ID	04	Section no.	4.4	Date: 15/05/2021
Description of CL				

1. As per the discussions during the remote audit, it was confirmed that once in a month COD tests are carried out by external labs. However, the same is not transparent in the MR and ER sheet. PP is requested to clarify if the COD values used in the ER sheets are conservative. Also provide the test reports carried out by external labs.
2. PP is requested to provide the pictures of the flare flow meter.
3. It is further checked that the tagging for GM2 and GM4 is not correct.
4. As per the ER spread sheets an additional factor of 20% is used in ECy calculations. However, as per the MR section 4.2 an additional factor of 10% is used in the calculations.
5. As per the MR FM1 (LA020720000) was replaced on 30/06/2020 with a new meter. However, it is notice that the calibration validity of FM1 meter was only until 17/05/2020. Not clear on how the delay in calibration gap is accounted. It is the same with FM2 (M102FC20000), which was replaced on 01/09/2020. However, the calibration validity is only until 18/05/2020.
6. PP is requested provide the calibration certificate of GM1 and GM4 for the proposed Monitoring Period.
7. PP is also requested to provide the accreditation details of the calibration entities.
8. The calibration dates of the GM2 provided in the MR is not as per the calibration certificates provided. PP is further requested to provide the relevant calibration certificates covering the proposed Monitoring Period.
9. Section 4.2 of the MR is not transparent on the details of the OM1.
10. $EG_{PJ,y}$ is not transparent on the new energy meter installed on 07/01/2021. PP is requested to provide the pictures of the meter along with the specifications. Also provide calibration certificate of the same.

11. As per the audit observation, there has been changes in the installation and commissioning of boilers and gas engines. PP to clarify if this has led to change in the auxiliary electrical capacity. If

Project participant response	Date: 02/07/2021
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1. The ER has been updated with the value of COD external value. The values have been compared on each specific day and conservative value has been selected for the calculation.
2. The flare flow meter has been provided in Att09
3. The GM2 represents the gas meter at the flaring system while GM4 represents the gas meter at the boilers. The tagging of GM2 and GM4 has been revised throughout the ER & MR.
4. Regarding section 4.2 of the MR, an additional factor which is used in the calculation of EC_y has been updated to 20% which is in accordant with throughout MR, ER and in the registered RCP PD.
5. There is a calibration gap of FM1 during 17/05/2020 to 30/06/2020, the maximum error as per the equipment specification has been selected to adjust with the monitored value. The same approach has been used for the FM2 during the calibration gap from 18/05/2020 to 31/08/2020. Then the lower value has been selected for the baseline emission calculation while higher value has been used for the project emission calculation. This approach is conservative. Evidence of the maximum permissible error has been provided in the Att06 Technical Specification.
6. The calibration certificates of the GM1 & GM4 has been provided in Att02. Though the calibration gap has been identified for both meters.
 - a) GM1 calibration gap is from 11/01/2021 to 31/03/2021, the maximum error as per calibration certificate has been applied to the monitored value. The lower bound of the value has been selected for the baseline emission calculation.
 - b) GM4 calibration gap is from 10/01/2021 to 31/03/2021, the maximum error as per calibration certificate has been applied to the monitored value. The same approach as mentioned above (point a) has been used and this is conservative.
7. All the calibration entities which ensuring the accuracy of test equipment are provided in the Att02 folder.
 - 6) COD analysis (colorimeter): Hanna Instruments (manufacturer) <https://hannathai.com/>
 - 7) Quantity of wastewater (FM): Endress Hauser (manufacturer) <https://www.th.endress.com/>
 - 8) Quantity of biogas (GM) & Qunatity of fuel oil (OM): MIT <https://www.mit.in.th/> Certified ISO17025 and Thai Industrial Standards Institute (TISI) certification no: 21C005/0842
 - 9) Methane analyzer:
 - i. Geotech: UKAS 4533
 - ii. QED Environmental System Ltd.: <https://www.qedenv.com/about/certifications/> Certified: UKAS 4533 & ISO 9001
 - 10) Weighbridge: Central Bureau of Weights and Measures under Department of Internal trade Ministry of Commerce <http://www.cbwmthai.org/>
8. The calibration of GM2 which is the meter monitoring biogas sent to flare has been provided and the ER & MR has been updated; 28/04/2016 & 28/04/2020. Please refer to the calibration certificate in Att02.
9. The oil meter at boiler 1 or OM1 is not relevant to the project activity as there is no emission reduction claimed from that particular boiler. Though it was found that the oil meter has been maintenance and is in good used condition.

Documentation provided by project participant

Att02Calibration

Att06 Technical Specification

Att07 Auxiliary list

Att09 Pic & VDO

Att10EHS

VCS427KK_WWT_TH_MR_MP3PAF01012020to02032020_V02 14062021

VCS427KK_WWT_TH_ER_MP3PAF01012020to02032020_V02 14062021

DOE assessment**Date:** 03/07/2021

1. The COD results have been updated for external labs. Noted that conservative values were used in the ER calculation.
2. The pictures of flare flow meter crosschecked with calibration certificate and accepted.
3. The tagging of GM2 and GM4 has been corrected in the ER sheet and MR as well.
4. additional factor has been updated with 20% throughout the MR and ER sheets and the same is accepted.
5. Maximum permissible error is applied for the delayed calibration for FM1 from 17/05/2020 to 30/06/2020 and 18/05/2020 to 31/08/2020 for FM2. Same was checked from the ER spread sheets and latest calibration certificates and accepted.
6. The calibration certificate issued by MIT Co Ltd for GM4 dated 11/01/2018 and 15/06/2021 and GM1 dated 12/01/2018 and 15/06/2021 provided. Checked and accepted. Also noted that maximum error has been applied for the days when calibration delay was noted.
7. accreditation of the calibration entities checked with the links provided by the PP and the same has been accepted.
8. The calibration dates of GM2 and delay in the calibration dates has been updated in the revised MR. Same checked with calibration certificates and accepted.
9. Since OM1 is used in the Monitoring Period, the details of the same is not included in the MR, which is accepted.
10. The new energy meter installation has been made transparent in the updated PDD along with the calibration details. The verification confirmed the same with log sheets and commissioning reports. Electricity generation is claimed only from 07/01/2021.
11. Though there was a change in the auxiliary list. Noted that the list fixed ex-ante is conservative and the same has been used in the ER calculations, which is conservative.
12. *The notations used in parameters monitored in section 4.2 of the MR is has been consistent with the ER spread sheets.*
13. It is checked that since no calibration was performed, the PP has not calculated electricity generation. However, the same is calculated from 01/01/2021 to 31/03/2021. Since new meter and engine was installed.
14. The O&M structure has been updated the revised MR.
15. The verification team checked the biogas operational manual, 2013 and the training records for operation procedure of the smart supplier 4.0 program, dated 30/06/202, Refreshing training of the Internal QC system regarding GMP HACCP, dated 25/03/2020 and Safety at work, dated 15/05/2020.
16. It is checked that figure 3 is updated. Boiler 1, 2 and generator 3 and 4 has been excluded from the project boundary. Which is also as per the registered RCP-PD and thus accepted.

Table 3. CAR from this verification

CAR ID	N/A	Section no.		Date: dd/mm/yyyy
Description of CAR				
N/A				
Project participant response				Date: dd/mm/yyyy
Documentation provided by project participant				
DOE assessment				Date: dd/mm/yyyy

Table 4. FAR from this verification

CAR ID	N/A	Section no.		Date: dd/mm/yyyy
Description of CAR				
No FAR raised during this verification				
Project participant response				Date: dd/mm/yyyy
Documentation provided by project participant				

DOE assessment	Date: dd/mm/yyyy

APPENDIX C: <COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS>

<u>Certificate of Competence</u>						
Name	☐ Mr. ☒ Ms.	Rekha Menon				
Qualification Procedure	Fulfills the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.					
Appointed to work as:						
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert
<i>Appointed</i>	Yes	Yes	Yes	Yes	Yes	No
<i>Appointed Date</i>	01-10-2019					
Authorized to work as Technical Expert for:						
<i>Authorized</i>	Sectoral Scope	TA Code	Technical Area within the scope			

Technical Area	Energy industries (renewable - / non-renewable sources)	1.1	Thermal energy generation
	Energy industries (renewable - / non-renewable sources)	1.2	Renewables
	Energy demand	3.1	Energy demand
	Waste handling and disposal	13.1	Solid waste and wastewater
	Afforestation and reforestation	14.1	Afforestation and reforestation
Authorized to work as Local Expert for:			
Country/Countries	India		
Compliance check by: Anand S. R.			

Certificate of Competence												
Name	☐ Mr. ☒ Ms.	Indumathi .C										
Qualification Procedure	Fulfils the requirement as per the appointment of personnel procedure of 4KES for Validation and Verification of CDM/VCS/GS/GHG Projects.											
Appointed to work as:												
	CDM Validator/Verifier	Team Leader	Team Member	Technical Expert	Technical Reviewer	Financial Expert						
Appointed	Yes	Yes	Yes	Yes	Yes	No						
Appointed Date	29-07-2019											
Authorized to work as Technical Expert for:												

Authorized Technical Area	Sectoral Scope	TA Code	Technical Area within the scope
	Energy industries (renewable - / non-renewable sources)	1.1	Thermal energy generation
	Energy industries (renewable - / non-renewable sources)	1.2	Renewables
	Energy demand	3.1	Energy demand
	Waste handling and disposal	13.1	Solid waste and wastewater
Authorized to work as Local Expert for:			
Country/Countries	India		
Compliance check by: Anand S. R.			