



SD BIOSUPPLY WASTEWATER TREATMENT AND BIOGAS UTILIZATION PROJECT



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Summary:

“SD Biosupply Co., Ltd.” has commissioned the “KBS Certification Services Pvt. Ltd.” (KBS) to carry out the periodic verification of the project - “SD Biosupply Wastewater Treatment and Biogas Utilization Project” (Project ID 0416), with regard to the relevant requirements of VCS Standard Version 4.0.

The project activity involves the installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) biogas reactor technology, which tends to replace the open anaerobic lagoon-based system for treating the wastewater generated by the starch plant. The Upflow Anaerobic Sludge Blanket (UASB) biogas reactor generates and recovers biogas for energy generation purposes and the methane captured by the system is consumed partially in the hot oil boilers for thermal utilization in starch drying process. The project activity is located in Karasin province, northeast of Thailand and has been implemented at Somdej Flour Mill Co. Ltd since 18th August 2005.

A risk-based approach has been followed to perform this verification. In the course of the verification, 07 Corrective Action Requests (CAR) & 02 Clarification request (CL) was raised and successfully closed out. No Forward Action Request (FAR) was raised.

The verification is based on the VCS PD, proof of title, proof of right, additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and supporting documents made available to the verification team by project proponent.

As a result of the verification, the verification team confirms that:

- The project fulfils criteria of VCS Standard Version 4.0.
- The project is in line with all relevant VCS requirements.
- Relevant decisions, clarifications and guidance from the CMP and the CDM Executive Board and VCS Association;
- All information and references relevant to the project activity resulting in emission reductions;
- The monitoring is transparent, adequate and in line with applied baseline and monitoring methodologies of AMS-I.C.: Thermal energy production with or without electricity --- Version 20.0 and AMS-III.H.: Methane Recovery in Wastewater Treatment--- Version 18.0.
- Based on the information seen and evaluated we confirm that the implementation of the project has resulted in 133,473 tCO₂e emission reductions during the monitoring period 01/01/2017 to 31/12/2019.

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1 INTRODUCTION

1.1 Objective

“SD Biosupply Co., Ltd.” has commissioned “KBS Certification Services Pvt. Ltd.” to perform the periodic verification of the project, “SD Biosupply Wastewater Treatment and Biogas Utilization Project” (Project ID 0416), with regard to the relevant requirements for Verified Carbon Standard (VCS) Project Activity (PA); to attain real, measurable, additional and permanent emission reductions for (01/01/2017 to 31/12/2019) this monitoring period.

The VCS project is verified under third party independent verification and certification of emission reductions as the basis for issuance of Voluntary Carbon Units (VCUs). The objectives of this verification exercise are, by review of objective evidence, to establish that:

- The project meets the VCS verification requirements as per the VCS rules;
- The project activity has been implemented and operated as per the validated VCS PD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- To verify Monitoring report and other supporting documents are complete;
- The actual monitoring systems & procedures and monitoring report conform the requirements of approved monitoring plan and the approved monitoring methodology;
- The data recorded will be stored as per the monitoring methodology and approved monitoring plan.

1.2 Scope and Criteria

The scope of the verification is an autonomous and objective review and ex-post determination of the monitored reductions in GHG emission by the project activity. The verification is based on the VCS PD/01/, registered monitoring plan and the monitoring report/02/ and approved VCS Validation report/01/. The project is evaluated against the requirements of VCS Rules/requirements.

KBS has conducted the verification, based on the recommendations in the recent and latest version of VCS Standard, Version 04 and VCS Program Guide, Version 04. The VCS rules employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

1.3 Level of Assurance

☒ Reasonable level of assurance

The verification report is based on VCS-MR, monitoring plan, supporting documents made available to the verifier and information collected through performing interviews and during the remote audit

assessment. Based on the process and procedures conducted, KBS confirms that the information in the MR:

- is materially correct and shows a fair representation of the achieved emission reductions with accurate calculations, and
- is prepared in accordance with VCS requirements, the registered VCS-PD and the applied CDM methodology for information pertaining to GHG quantification, monitoring and reporting.

The verification work is carried out by the team members referred in Appendix 3 of this report as per this requirement and the verification opinion is reasonably assured.

1.4 Summary Description of the Project

The project activity involves installation of an anaerobic wastewater treatment facility at Somdej Flour Mill. The starch plant has a total production capacity of 300 tons of native starch per day generating approximately 2000 m³ of wastewater every production day. Prior to project implementation, the waste water was treated with 8 open lagoon-based pond system with gravitational flow (cascading flow through 8 lagoons). The minimum depth of these ponds being more than 2 m and the average atmospheric temperature in the region about 28°C, these conditions resulted in anaerobic environment within the ponds resulting in methane generation from the organic content of the wastewater, characterized by its COD (Chemical Oxygen Demand), which was released into the atmosphere.

The use of UASB technology to treat wastewater enables not only the avoidance of methane into the atmosphere, but also capturing of methane produced and meeting the effluent standards. The captured methane (or biogas) is utilized as fuel in existing heat generating devices (boilers) in the plant replacing heavy fuel oil. The surplus biogas, if any, is flared into the atmosphere through an open flare, thereby contributing to greenhouse gas (GHG) emission reduction.

There are two boilers at the starch factory with a total installed capacity of 7.268 MWth in which the biogas is used as fuel along with heavy fuel oil (HFO) as verified from the registered PD/01/. The boilers were retrofitted to fire dual fuel during the project implementation.

The location of the project activity, as mentioned in the PD (project description) was cross-verified by the assessment team and further checked with statutory clearance i.e. consent to establish and functional or the operation licence/09/. The project was commissioned on 16/09/2005 based on the date when emission reductions began which is considered as start date of the project activity under VCS scheme. The same is verified through reviewing the commissioning supportive documents/12/.

The first crediting period of the project activity starts from 28/03/2006 to 27/03/2016, while the second crediting period continues from the end date of the first crediting period i.e. 28/03/2016 to 27/03/2026. This is the second monitoring period of the second crediting period i.e. 01/01/2017 to 31/12/2019.

2 VERIFICATION PROCESS

2.1 Method and Criteria

The project activity applies approved CDM methodologies “Thermal energy for user with or without electricity”, AMS-I.C. version 20, categorized under sectoral scope 1 “Energy Industries” and AMS III.H: Methane Recovery in Wastewater Treatment, version 18, categorized under sectoral scope 13: “Waste Handling and Disposal”/06/ along with the tool 06: “Project emissions from flaring”, Version 03/06/. The verification consisted of the following phases:

- Completeness check and desk review of the monitoring report
- Document desk review
- Resolution of findings followed by preparation of the final verification report and opinion.

Timeline of verification

Date of signing contract	18/02/2020
On-site verification	Conducted remote auditing on 27/05/2020
(Draft) Reporting	23/06/2020
(Final) Reporting	03/07/2020

2.2 Document Review

A desk review is undertaken, involving but not limited to,

- A review of the data and information presented to verify their completeness
- A review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the quality assurance and quality control procedures
- An evaluation of data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions

The list of documents review is included in the section “References”

2.3 Interviews

Please refer section 2.4, where complete list of interviewed personnel and key points discussed is provided.

2.4 Site Inspections

As a result of the COVID-19 pandemic, taking into account the rules of relevant national and local authorities (local to the VVB offices as well as to locality of the site visits), World Health Organization (WHO) recommendations, policies of the VVB and other relevant travel restrictions and guidance (for example, a requirement to self-isolate upon return from specific countries), the VVB (Validation and Verification Body) has skipped the on-site visit. However, the VVB may use other standard auditing techniques for validation or verification as referred to in VCS Rules/requirements.

Verification team has used the following alternative means for its assessment and to justify that they are sufficient for the purpose of verification. Along with desk review, audit team has conducted remote audit interview as follows:

- A complete desk review of the Monitoring report (MR), as well as all applicable country legal requirement and supportive evidences have been checked by the verification team.
- Verification team has performed Google meet interview with Project Proponent (PP) in order to check implementation, project boundary, current situation, monitoring and metering equipment, monitoring procedures, calibration etc.
- Verification team has performed Google meet interview with randomly selected Local stakeholders to check the Local stakeholder consultation process.
- Cross-check evaluation, for information received from interviews, under the scope of all information and references provided in MR and supporting documents.

Details of interviewees, topics covered and additional information are presented below:

Dates:	27/05/2020 (Remote audit conducted through Google Meet application by Chetan Swaroop Sharma and Deboshmita Dey)	
Key points discussed:	Name of person, interviewed	Designation, Organization
Project description	Mr. Narong Tiyananich	SD Plant Manager
Monitoring and VCS Requirements	Miss Supunnee Fakklang	SD Biogas Manager
Baseline and Monitoring plan	Mr. Suchai Rattananadhekul	Manager, Papop Co. Ltd., Technology provider
Calibration and monitoring frequency	Miss Ubonwan Utachkul	Senior Coordinator, Papop Co. Ltd., Technology provider
Stakeholder consultation	Mrs. Bussaba Nakhathong	Born Village (around 2 km from the plant) - Farmer
	Miss Boonthun Ratchboonyo	Born Village (around 2 km from the plant) - Farmer

2.5 Resolution of Findings

KBS applies the risk-based approach aimed at focusing on high risk issues to the verification results whilst not omitting any part of the mandatory processes. A few discrepancies were found during the verification and the verification report was submitted to the project proponent, indicated under the titles corrective action requests (CARs) and clarification requests (CLs). CARs and CLs require the PP to take relevant actions. Criteria for judging items as CAR or CL are as follows:

CAR (Corrective Action Request):

- project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions
- the Voluntary Carbon Standard's requirements have not been met, or
- there is a risk that emission reductions cannot be monitored or calculated

Clarification request (CL)

Information is insufficient or not sufficiently clear to determine whether the applicable VCS requirements have been met

Forward Action Request (FAR) is to be raised to highlight issues related to project implementation that requires review during the first verification of the project activity. FAR does not relate to VCS requirements for registration.

CARs and CLs are to be resolved or closed out if the PP modifies the project description, rectifies the MR or provides adequate additional explanations or evidence that satisfies the concerns. If this is not completed, the project activity cannot be recommended for issuance under VCS registry.

The monitoring report was revised addressing the CARs & CLs issued by KBS. After reviewing the revised and resubmitted MR/2/, resolving the CARs & CLs raised and outstanding concerns, KBS issues this final verification report and opinion.

07 Corrective Action Requests (CAR) & 02 Clarification request (CL) found during verification and closed satisfactorily. The list of CARs/CLs raised and the response provided, the means of verification, reasons for their closure and references to correction in the MR are provided in Appendix 2 of this report. The revised MR/2.2/ with changes incorporated as per the issues raised were rechecked with the documentary evidences and found to be inline.

2.5.1 Forward Action Requests

No FAR was raised during the monitoring period.

2.6 Eligibility for Validation Activities

The validation is separately conducted by independent VVB and the separate validation report issued and approved by the VCS association.

3 VALIDATION FINDINGS

3.1 Participation under Other GHG Programs

The project is already registered under VCS program. It has been confirmed by the project participant that the VERs (Voluntary emission reductions) will be claimed only from the VCS programme. The declaration is submitted from the project participant during the validation that the project will not claim any ERs from any other programme.

3.2 Methodology Deviations

The verification team confirms that the VCS PD (project description) complies with the requirements in the applied monitoring methodologies AMS-I.C., ver.20 and AMS-III.H, ver. 18. However, a methodology deviation has been applied during the monitoring period which is as follows:

According to paragraph 33 of the AMS I.C version 20/06/, the baseline emissions are calculated as;

$$BE_{\text{thermal, CO}_2, y} = (EG_{\text{thermal, y}} / \eta_{\text{BL, thermal}}) \times EF_{\text{FF, CO}_2}$$

The heat generation is determined based on the mass (or volume) flows and the temperatures. However, the project proponent is not able to conduct the measurement of temperature (in and out) and the flow of the thermal fluid as per the applied methodology/06/ due to which a deviation has been applied.

PP has applied production historical data and actual fuel energy input for the monitoring of the parameter $EG_{\text{thermal, y}}$. The conservativeness of the historical data of Somdej Flour Mill Co., Ltd is used for 3 years (2002-2004) on starch production and heavy oil consumption.

Based on the historical data, the project has considered the most conservative average specific energy consumption during 2002-2004, which is 33.8 litre of HFO/tonne of dry starch in year 2002.

As per the published data at Thai Tapioca Starch Association website¹, the average of 33.6 litre of HFO/ tonne of dry starch (range: 25.9-39.4) is used, which is found to be acceptable by the verification team.

3.3 Project Description Deviations

The verification team confirms that the project activity description is completely in line with the information described in the approved VCS PD/1/. Hence there are no project description deviations.

3.4 Grouped Project

The project activity is not identified as a grouped project as per the description in the approved VCS PD/1/.

¹ Source: <http://www.thaitapiocastarch.org/article05.asp>

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

The project activity involves installation of an anaerobic wastewater treatment facility at Somdej Flour Mill. The starch plant has a total production capacity of 300 tons of native starch per day generating approximately 2000 m³ of wastewater every production day. Prior to project implementation, the waste water was treated with 8 open lagoon based pond system with gravitational flow (cascading flow through 8 lagoons). There are two boilers at the starch factory with a total installed capacity of 7.268 MWth in which the biogas is used as fuel along with HFO as verified from the registered PD/01/. The project was registered on 06/05/2010. The project is implemented and operated in accordance with the registered VCS PD/01/ and there has been no emergency cases which might have led to significant changes in the emission reductions of this monitoring period as verified from the remote audit (Google meet video conferencing).

Ownership and other programs:

The PP declared that the project is not registered under any other mechanism apart from VCS. Thus emission reductions generated by project will be solely claimed by PP and PP has the right of use of ERs and hence accepted. Net GHG emission reductions or removals generated by this project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions as the host country i.e. Thailand is not a participant in any emission trading programs or nor does it have any binding limits.

PP will not claim the carbon credits under any other GHG emission reduction scheme for the crediting period under VCS and PP has provided declaration on the same during the validation. Hence there is no possibility of double counting. Apart from VCS, it has neither applied nor been rejected under any other GHG program.

Findings: CAR 01, CAR 02 and CAR 07 was raised and successfully closed. Refer to appendix 2 for further details.

4.2 Safeguards

4.2.1 No Net Harm

No negative environmental and socio-economic impacts identified by the project proponent. Verification team confirms that the project doesn't include any such impacts.

4.2.2 Local Stakeholder Consultation

Local stakeholder consultation was conducted during validation of project activity. Validating VVB has reported the same in its validation report/01/. The report has been reviewed by the verification team and concluded that it complies with the requirements of VCS.

4.3 AFOLU-Specific Safeguards

Not Applicable since the project involves installation of an anaerobic wastewater treatment facility and is not an AFOLU project.

4.4 Accuracy of GHG Emission Reduction and Removal Calculations

Monitored Parameters:

Assessment of monitoring procedures for all monitoring parameters is discussed below:

Data/Parameter: $Q_{ww,y}$ Volume of wastewater treated in year y

	<i>Discussion and verification assessment</i>		
Purpose of data	Baseline and project emissions		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From flow meter having accuracy class of 0.5% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done on yearly basis as per the manufacturer's specification/18/.		
Measuring/Reading/Recording frequency	Continuous monitored This is consistent with registered monitoring plan/01/ and hence accepted.		
Data collection (from data generation, aggregation, to recording, calculation and reporting)	It is continuously monitored by a calibrated flow meter. The readings reported during the day are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.		
Verified value	Monitoring period	Value monitored (m ³) Lower	Value monitored (m ³) Higher
	01/01/2017 to 31/12/2017	626,452	630,046
	01/01/2018 to 31/12/2018	401,890	430,570
	01/01/2019 to 31/12/2019	392,398	392,414
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/. However, for the calibration delay error factor has been applied and corrected values are reported for emission reduction calculations.		
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.		

QA/QC procedures applied	The calibration detail of the flow meters used is mentioned in the below section 4.5. The calibration dates of the meter has been checked with calibration records/20/ and found consistent. Endress + Hauser is the manufacturer of the flow meter and it has been accredited by Miracle International Technology Co., Ltd. (MIT) for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI)/31/. During this monitoring period, there has been a replacement of the old meter (Serial no. EB011320000) with a new meter (Serial no. 6B00F220000) of the same brand and model on 20/04/2017 as verified by the verification team from the log sheet data/15/. The replacement of the meter was due to the malfunctioning of the old meter as verified from the interviews and the log sheet data/15/. Also, there has been two calibration gaps during this monitoring period; i.e. from 20/04/2017 to 17/05/2018 and 16/05/2019 to 07/06/2019 as verified from the calibration certificates/20/. The verification team has observed that the maximum error of 0.50 % has been applied to the monitored data for the delayed calibration. The error applied was based on the latest calibration conducted during this monitoring period. Hence, the conservative value has been applied for calculating emission reduction in the ER sheet/03/ as verified by the verification team.
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Data/Parameter: COD_{ww,untreated,y} The chemical oxygen demand of the wastewater before and after the treatment system affected by the project activity

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From colorimetric equipment having accuracy class of 0.24% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done on yearly basis as per the registered PD/01/.
Measuring/Reading/Recording frequency	Continuous monitored on daily basis (Samples and measurement were ensured a 90/10 confidence/precision level.) This is consistent with registered monitoring plan/01/ and hence accepted. The standard deviation method was used to ensure the confidence/ precision level of 90/10. The adjustment has been applied to the average COD value and the conservative result from adjustment has been used for ER calculation as verified by the verification team.
Data collection (from data generation, aggregation, to	The readings reported during the day are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager.

recording, calculation and reporting)	The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.		
Verified value		Monitoring period	Value monitored (tCOD/m ³)
			Lower Higher
		01/01/2017 to 31/12/2017	0.027 0.029
		01/01/2018 to 31/12/2018	0.026 0.027
		01/01/2019 to 31/12/2019	0.027 0.028
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports approved by the Plant Manager/15/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information/15/. However, for the calibration delay error factor has been applied and corrected values are reported for emission reduction calculations.		
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.		
QA/QC procedures applied	The calibration detail of the equipment used is mentioned in the below section 4.5. The calibration dates of the meter has been checked with calibration records/20/ and found consistent. There has been two calibration gaps during this monitoring period; i.e. from 01/01/2017 to 1/11/2017 and 31/10/2018 to 11/01/2019 as verified from the calibration certificates/20/. The verification team has observed that the maximum error of 0.90 % has been applied to the monitored data for the delayed calibration. The error applied was based on the latest calibration conducted during this monitoring period. Hence, the conservative value has been applied for calculating emission reduction in the ER sheet/03/ as verified by the verification team.		

Data/Parameter: COD_{ww,treated,y} The chemical oxygen demand of the wastewater after the treatment system affected by the project activity

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From colorimetric equipment having accuracy class of 0.24% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done on yearly basis as per the manufacturer's specification/18/.
Measuring/Reading/Recording frequency	Continuous monitored on daily basis (Samples and measurement were ensured a 90/10 confidence/precision level.) This is consistent with registered monitoring plan/01/ and hence accepted. The standard deviation method was used to ensure the

	confidence/ precision level of 90/10. The adjustment has been applied to the average COD value and the conservative result from adjustment has been used for ER calculation as verified by the verification team.			
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The readings are taken three times a day and the readings reported are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.			
Verified value		Monitoring period	Value monitored (tCOD/m³)	
			Lower	Higher
		01/01/2017 to 31/12/2017	0.0007	0.0008
		01/01/2018 to 31/12/2018	0.0008	0.0009
		01/01/2019 to 31/12/2019	0.0007	0.0008
		The values mentioned in the monitoring report and ER sheet have been verified with the daily reports approved by the Plant Manager/15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/. However, for the calibration delay error factor has been applied and corrected values are reported for emission reduction calculations.		
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.			
QA/QC procedures applied	The calibration detail of the equipment used is mentioned in the below section 4.5. The calibration dates of the meter has been checked with calibration records/20/ and found consistent. There has been two calibration gaps during this monitoring period; i.e. from 01/01/2017 to 1/11/2017 and 31/10/2018 to 11/01/2019 as verified from the calibration certificates/20/. The verification team has observed that the maximum error of 0.90 % has been applied to the monitored data for the delayed calibration. The error applied was based on the latest calibration conducted during this monitoring period. Hence, the conservative value has been applied for calculating emission reduction in the ER sheet/03/ as verified by the verification team.			

Data/Parameter: $S_{final,PJ,y}$ Amount of dry matter in the sludge

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency,	Monitoring: From two weighbridges having accuracy class of 0.01% each by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done at least once every three years based on relevant national requirements.

date of last calibration, validity)									
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 as verified by the verification team during the remote auditing (Google meet video conferencing).								
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The project proponent did not envisage the generation of any sludge during the monitoring period. Whenever sludge was removed from the reactor the practice of final disposal was monitored by keeping written evidence of the amount of sludge removes and its application which has been verified during the remote auditing (Google meet video conferencing).								
Verified value	<table border="1"> <thead> <tr> <th>Monitoring period</th><th>Value monitored (ton)</th></tr> </thead> <tbody> <tr> <td>01/01/2017 to 31/12/2017</td><td>0</td></tr> <tr> <td>01/01/2018 to 31/12/2018</td><td>0</td></tr> <tr> <td>01/01/2019 to 31/12/2019</td><td>0</td></tr> </tbody> </table> No sludge was removed during the monitoring period. This is confirmed through remote audit interviews (Google meet video conferencing).	Monitoring period	Value monitored (ton)	01/01/2017 to 31/12/2017	0	01/01/2018 to 31/12/2018	0	01/01/2019 to 31/12/2019	0
Monitoring period	Value monitored (ton)								
01/01/2017 to 31/12/2017	0								
01/01/2018 to 31/12/2018	0								
01/01/2019 to 31/12/2019	0								
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.								
QA/QC procedures applied	There are two weigh bridges used in this project activity. The calibration details of the weighbridges used is mentioned in the below section 4.5. The calibration dates of the weighbridges has been checked with calibration records/15/ and found consistent. During this monitoring period, there has been a replacement of the old weigh bridge (Serial no. 2006068) with a new weigh bridge (Serial no. 2015024) of the same brand on February, 2017 as verified by the verification team from the log sheet data/15/. The replacement of the weigh bridge was due to the malfunctioning of the old weigh bridge as verified from the interviews and the log sheet data/15/. There were two calibration gaps during this monitoring period. Since there was no sludge being removed from the project activity, so the error from the calibration gap was not applied since it would not affect the emission reduction calculation as verified by the verification team through remote audit interviews (Google meet video conferencing).								

Data/Parameter: BG _{burnt,y} Biogas volume in year y

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline and project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency,	Monitoring: From biogas flow meter (GM 1) having accuracy class of 1.5% by qualified and trained operator. Responsibility: Plant Operator/Technician

date of last calibration, validity)	Calibration frequency: Calibration is done once in 2 years as per the equipment's specifications (Operating Instructions document, page 68 ²).		
Measuring/Reading/Recording frequency	Continuous monitored and hourly measurements undertaken. This is consistent with registered monitoring plan/01/ and hence accepted.		
Data collection (from data generation, aggregation, to recording, calculation and reporting)	It is continuously monitored by a calibrated flow meter. The readings reported during the day are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.		
Verified value	Monitoring period	Value monitored (Nm ³)	
	01/01/2017 to 31/12/2017	5,537,776	
	01/01/2018 to 31/12/2018	3,180,893	
	01/01/2019 to 31/12/2019	3,420,709	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/.		
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.		
QA/QC procedures applied	The calibration detail of the flow meter used is mentioned in the below section 4.5. The calibration was conducted by the project participant for the flow meter in accordance with the frequency defined in the registered VCS PD/01/. The calibration of flow meter covers the monitoring period. The calibration frequency of the meter has been checked with calibration records/15/ and found consistent. Endress + Hauser is the manufacturer of the flow meter and it has been accredited by Miracle International Technology Co., Ltd. (MIT) for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI)/31/.		

Data/Parameter: W_{CH4} Methane content in the biogas in the year y

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency,	Monitoring: From portable gas analyzer having accuracy class of 0.9% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done annually as per the equipment's specifications/18/.

² <https://www.instrumart.com/assets/Proline-T-Mass-65F-65I-manual.pdf>

date of last calibration, validity)				
Measuring/Reading/ Recording frequency	Continuous monitored on daily basis. This is consistent with registered monitoring plan/01/ and hence accepted.			
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The measured data is logged in daily basis (seven times a day and taken average) and reported to Biogas Supervisor. The Biogas Supervisor checks the values and enters the data in another sheet that consist of daily values of the parameters. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.			
Verified value	Monitoring period	Value monitored		The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/.
		Lower	Higher	
	01/01/2017 to 31/12/2017	61.9%	62.5%	
	01/01/2018 to 31/12/2018	60.5%	61.2%	
	01/01/2019 to 31/12/2019	61.9%	62.5%	
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.			
QA/QC procedures applied	The calibration detail of the gas analyzer used is mentioned in the below section 4.5. The calibration was conducted by the project participant in accordance with the frequency defined in the registered VCS PD/01/. The calibration covers the monitoring period. The calibration frequency of the gas analyzer has been checked with calibration records/20/ and found consistent. Draeger Safety (Thailand) Ltd. Is the manufacturer of the portable gas analyser and therefore credible for calibration/20/.			

Data/Parameter: BG_{combusted,y} Amount of biogas sent to boiler in year y

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From biogas flow meter (GM 2) having accuracy class of 1.5% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done once in 2 years as per the equipment's specifications (Operating Instructions document, page 68³).

³ <https://www.instrumart.com/assets/Proline-T-Mass-65F-65I-manual.pdf>

Measuring/Reading/Recording frequency	Continuous monitored and hourly measurements undertaken. This is consistent with registered monitoring plan/01/ and hence accepted.		
Data collection (from data generation, aggregation, to recording, calculation and reporting)	It is continuously monitored by a calibrated flow meter and reported manually into the log sheet. The readings reported during the day are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.		
Verified value	Monitoring period	Value monitored (Nm ³)	
	01/01/2017 to 31/12/2017	5,115,245	
	01/01/2018 to 31/12/2018	3,144,477	
	01/01/2019 to 31/12/2019	3,406,947	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/.		
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.		
QA/QC procedures applied	The calibration detail of the flow meters used is mentioned in the below section 4.5. The calibration was conducted by the project participant for the flow meter in accordance with the frequency defined in the registered VCS PD/01/. The calibration of flow meter covers the monitoring period. The calibration frequency of the meter has been checked with calibration records/15/ and found consistent. Endress + Hauser is the manufacturer of the flow meter and it has been accredited by Miracle International Technology Co., Ltd. (MIT) for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI)/31/.		

Data/Parameter: V_{RG,h} Volumetric flow of the residual gas on dry basis at reference conditions in the minute m

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency,	Monitoring: From gas flow meter (GM 3) having accuracy class of 1.5% by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done once in 2 years as per the equipment's specifications (Operating Instructions document, page 68 ⁴).

⁴ <https://www.instrumart.com/assets/Proline-T-Mass-65F-65I-manual.pdf>

date of last calibration, validity)									
Measuring/Reading/Recording frequency	Continuous monitored (at least hourly measurements are undertaken) This is consistent with registered monitoring plan/01/ and hence accepted.								
Data collection (from data generation, aggregation, to recording, calculation and reporting)	It is continuously monitored by a calibrated gas flow meter which is connected to a SCADA system and reported manually into the log sheet as well. The readings reported during the day are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.								
Verified value	<table border="1"> <thead> <tr> <th>Monitoring period</th><th>Value monitored (Nm³)</th></tr> </thead> <tbody> <tr> <td>01/01/2017 to 31/12/2017</td><td>0</td></tr> <tr> <td>01/01/2018 to 31/12/2018</td><td>3,431</td></tr> <tr> <td>01/01/2019 to 31/12/2019</td><td>517</td></tr> </tbody> </table> The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/.	Monitoring period	Value monitored (Nm ³)	01/01/2017 to 31/12/2017	0	01/01/2018 to 31/12/2018	3,431	01/01/2019 to 31/12/2019	517
Monitoring period	Value monitored (Nm ³)								
01/01/2017 to 31/12/2017	0								
01/01/2018 to 31/12/2018	3,431								
01/01/2019 to 31/12/2019	517								
Cross checks	The verified values were crosschecked from the plant data /15/. The verification team concludes that the reported value is comparable.								
QA/QC procedures applied	The calibration detail of the gas flow meters used is mentioned in the below section 4.5. The calibration was conducted by the project participant for the flow meter in accordance with the frequency defined in the registered VCS PD/01/. The calibration of flow meter covers the monitoring period. The calibration frequency of the meter has been checked with calibration records and found consistent. During this monitoring period, there has been a replacement of the old gas flow meter (Serial no. EJ-10209) with a new meter (Serial no. N413E702000) of the same brand on 12/07/2018 as verified by the verification team from the log sheet data/15/. The replacement of the meter was due to the malfunctioning of the old meter as verified from the interviews and the log sheet data/15/. Endress + Hauser is the manufacturer of the gas flow meter and it has been accredited by Miracle International Technology Co., Ltd. (MIT) for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI)/31/.								

Data/Parameter: FC_{HFO,y} Quantity of fuel type i (HFO) combusted in process j during the year y

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From two oil meters (OM 1 and OM 2) having accuracy class of 1.0% each by qualified and trained operator. Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done once in 2 years as per the equipment's specifications/18.		
Measuring/Reading/Recording frequency	Continuous monitored This is consistent with registered monitoring plan/01/ and hence accepted.		
Data collection (from data generation, aggregation, to recording, calculation and reporting)	It is continuously monitored by two calibrated oil meters. The readings are recorded manually into the log sheet and are crosschecked at end of the day by biogas plant supervisor and approved by assistant plant manager. The practice was confirmed during the remote auditing (Google meet video conferencing) and was found consistent with registered monitoring plan/01/.		
Verified value	Monitoring period	Value monitored (Litres)	
	01/01/2017 to 31/12/2017	0	
	01/01/2018 to 31/12/2018	0	
	01/01/2019 to 31/12/2019	0	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /15/. The reported values in the MR and ER sheet were found to be consistent with the daily reports/15/. There were no fuel purchase and stock records since no fuel consumption has occurred during this monitoring period.		
Cross checks	There were no fuel purchase and stock records since no fuel consumption has occurred during this monitoring period.		
QA/QC procedures applied	The calibration detail of the oil meters used is mentioned in the below section 4.5. There are two boilers being used in this monitoring period, thus two gas meters were used during this monitoring period. A proper record of all the fossil fuel consumed was maintained at the project site as verified by the verification team through remote auditing. The calibration was conducted by the project participant for the oil meters in accordance with the frequency defined in the registered VCS PD/01/. The calibration of oil meter covers the monitoring period. The calibration frequency of the meter has been checked with calibration records/20/ and found consistent. ABB is the manufacturer of the oil meters and it has been accredited by Miracle International Technology Co., Ltd. (MIT) for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI)/31/.		

Data/Parameter: EG_{thermal,y} Net quantity of thermal energy supplied by the project activity during the year y

	<i>Discussion and verification assessment</i>																
Purpose of data	Baseline																
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable as this is a calculated value based on the other monitored parameters BG_{combusted}, and Q_{starch}. The value applied is based on the calculation as per the deviation approach mentioned in section 3.2 of this report. The root parameters to derive this are verified separately.																
Measuring/Reading/Recording frequency	Continuous monitoring, aggregated annually. This is consistent with registered monitoring plan/01/ and hence accepted.																
Data collection (from data generation, aggregation, to recording, calculation and reporting)	Not applicable as this is a calculated value based on the other monitored parameters BG_{combusted}, and Q_{starch}. The value applied is based on the calculation as per the deviation approach mentioned in section 3.2 of this report. The root parameters to derive this are verified separately.																
Verified value	Biogas Approach <table border="1"> <thead> <tr> <th>Monitoring period</th><th>Value monitored (TJ)</th></tr> </thead> <tbody> <tr> <td>01/01/2017 to 31/12/2017</td><td>113.33</td></tr> <tr> <td>01/01/2018 to 31/12/2018</td><td>68.07</td></tr> <tr> <td>01/01/2019 to 31/12/2019</td><td>75.50</td></tr> </tbody> </table> Historical Approach <table border="1"> <thead> <tr> <th>Monitoring period</th><th>Value monitored (TJ)</th></tr> </thead> <tbody> <tr> <td>01/01/2017 to 31/12/2017</td><td>83.29</td></tr> <tr> <td>01/01/2018 to 31/12/2018</td><td>52.93</td></tr> <tr> <td>01/01/2019 to 31/12/2019</td><td>47.04</td></tr> </tbody> </table> The values in the MR and ER sheet were verified with the log records starch production/15/ and average HFO consumption for starch production as estimated conservatively from historical data.	Monitoring period	Value monitored (TJ)	01/01/2017 to 31/12/2017	113.33	01/01/2018 to 31/12/2018	68.07	01/01/2019 to 31/12/2019	75.50	Monitoring period	Value monitored (TJ)	01/01/2017 to 31/12/2017	83.29	01/01/2018 to 31/12/2018	52.93	01/01/2019 to 31/12/2019	47.04
Monitoring period	Value monitored (TJ)																
01/01/2017 to 31/12/2017	113.33																
01/01/2018 to 31/12/2018	68.07																
01/01/2019 to 31/12/2019	75.50																
Monitoring period	Value monitored (TJ)																
01/01/2017 to 31/12/2017	83.29																
01/01/2018 to 31/12/2018	52.93																
01/01/2019 to 31/12/2019	47.04																
Cross checks	The verified values were crosschecked from the plant records/15/. The verification team concludes that the reported value is comparable. Based on the local and sectoral expertise verification team considered it appropriate.																
QA/QC procedures applied	Not applicable being a calculated parameter.																

Data/Parameter: EC_y Quantity of electricity consumed by the project electricity consumption source j in year y

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: From import electricity meter by PEA officials. The accuracy of the energy meter is 0.5s. The meter is owned by PEA and hence accuracy complies with the national standard. Responsibility: PEA officials Calibration frequency: Since the meter is owned by the PEA, the calibration is carried out by the PEA. It is also confirmed from the remote audit verification (Google meet video conferencing) that the meter is well secured and sealed by the PEA. The PP is not authorized to touch the meter.														
Measuring/Reading/Recording frequency	The parameter is measured continuously by energy meter provided at the point of supply to the wastewater treatment plant. This is consistent with registered monitoring plan/01/ and hence accepted.														
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The monitoring was done by the import power meter, which is under PEA asset as verified by the verification team through interviews. The following are the specifications of the meter: <table><tr><td>PEA Number</td><td>6001693334</td></tr><tr><td>Manufacturer</td><td>TTC</td></tr><tr><td>Spec</td><td>110V</td></tr><tr><td>Phase</td><td>3-WIRE</td></tr><tr><td>Model</td><td>ST-33TL</td></tr><tr><td>Accuracy</td><td>0.5%</td></tr></table>			PEA Number	6001693334	Manufacturer	TTC	Spec	110V	Phase	3-WIRE	Model	ST-33TL	Accuracy	0.5%
PEA Number	6001693334														
Manufacturer	TTC														
Spec	110V														
Phase	3-WIRE														
Model	ST-33TL														
Accuracy	0.5%														
Verified value	<table><tr><td>Monitoring period</td><td>Value monitored (MWh)</td></tr><tr><td>01/01/2017 to 31/12/2017</td><td>863.7</td></tr><tr><td>01/01/2018 to 31/12/2018</td><td>704.3</td></tr><tr><td>01/01/2019 to 31/12/2019</td><td>882.4</td></tr></table> The values in the MR and ER sheet have been verified with the monthly invoices sent by the PEA which are more authentic /07/. The reported values have been found correct.	Monitoring period	Value monitored (MWh)	01/01/2017 to 31/12/2017	863.7	01/01/2018 to 31/12/2018	704.3	01/01/2019 to 31/12/2019	882.4						
Monitoring period	Value monitored (MWh)														
01/01/2017 to 31/12/2017	863.7														
01/01/2018 to 31/12/2018	704.3														
01/01/2019 to 31/12/2019	882.4														
Cross checks	The verified values were crosschecked from the invoices/07/. The verification team concludes that the reported value is comparable. Based on the local and sectoral expertise verification team considered it appropriate.														
QA/QC procedures applied	Not applicable.														

Data/Parameter: $TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to source j in year y

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/Reading/Recording frequency	Annually checked for the latest data of world bank. This is consistent with registered monitoring plan/01/ and hence accepted.
Data collection (from data generation, aggregation, to recording, calculation and reporting)	Not applicable.
Verified value	6.11 % ⁵ The reported value have been found correct with the source used ⁶ .
Cross checks	The verified values were crosschecked from the World bank database (Thailand 2014). This is annual average value based on the most recent data available within the hot country. The verification team concludes that the reported value is comparable. Based on the local and sectoral expertise verification team considered it appropriate.
QA/QC procedures applied	Not applicable.

Data/Parameter: Flame_m Flame detection of flare in the minute m

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Monitoring: It is measured using a fixed installation optical flame detector: Ultraviolet detector or Infra-Red or both as verified by the verification team through remote audit (Google meet video conferencing). Responsibility: Plant Operator/Technician Calibration frequency: Calibration is done as per the equipment's specifications/18/.
Measuring/Reading/Recording frequency	Once per minute. Detection of flare recorded as minute that the flare was on, otherwise recorded as a minute that the flame was off. This is consistent with registered monitoring plan/01/ and hence accepted.

⁵ <https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?end=2017&locations=TH&st=null>

⁶ <https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?end=2017&locations=TH&st=null>

Data collection (from data generation, aggregation, to recording, calculation and reporting)	Not applicable.
Verified value	0 as the equipment implemented at the project could not specify flame detection in minute m. The reported value has been found acceptable by the verification team through remote audit (Google meet video conferencing).
Cross checks	The verification team concludes that the reported value is comparable. Based on the local and sectoral expertise verification team considered it appropriate.
QA/QC procedures applied	Not applicable.

Data/Parameter: $\eta_{\text{Flare-h}}$ Flare efficiency in the minute m

	<i>Discussion and verification assessment</i>
Purpose of data	Project emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/Reading/Recording frequency	Continuous measurement This is consistent with registered monitoring plan/01/ and hence accepted.
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The flare efficiency of 50% in the minute m is applied when the flare is detected in the minute m (Flame_m). If these conditions are not met, 0% default value should be used for this period.
Verified value	0% default factor was used in the calculation. The reported value have been found acceptable by the verification team through remote audit (Google meet video conferencing).
Cross checks	The verification team concludes that the reported value is comparable. Based on the local and sectoral expertise verification team considered it appropriate.
QA/QC procedures applied	Not applicable.

Data/Parameter: EF_{FF,HFO} Emission factor of fossil fuel replaced-residual fuel oil tCO₂/TJ

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/Reading/Recording frequency	Not applicable.
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The value has been taken from IPCC 2006 default value for residual fuel oil, Volume 2, Chapter 1, 1.23/30/ and is found to be consistent by the verification team.
Verified value	77.4 tCO ₂ /TJ
Cross checks	The verification team concludes that the reported value is comparable.
QA/QC procedures applied	Not applicable.

Data/Parameter: NCV_{HFO} Weighted average net calorific value of fuel type i (HFO) in year y TJ/tonne

	<i>Discussion and verification assessment</i>
Purpose of data	Baseline emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/Reading/Recording frequency	Not applicable.
Data collection (from data generation, aggregation, to recording, calculation and reporting)	The value has been taken from IPCC 2006, Volume 2: Energy, Table 1.2/30/ and is found to be consistent by the verification team.

Verified value	0.0404 TJ/tonne
Cross checks	The verification team concludes that the reported value is comparable.
QA/QC procedures applied	Not applicable.

Findings: CL 02, CAR 03 and CAR 06 was raised and successfully closed. Refer to appendix 2 for further details.

4.5 Quality of Evidence to Determine GHG Emission Reductions and Removals

The applied monitoring methodology AMS.I.C and AMS-III.H does not specify exact requirements for calibration of the measuring equipment but recommends following the relevant industry standards or the manufacture specifications/18/. The calibration frequency defined in the registered monitoring plan/01/ is followed by the project participant and described in the above section corresponding to each monitoring parameter.

(a) Methane destruction component (AMS.III.H)

According to the paragraph 27 of the AMS III.H/06/ and as per the validated VCS PD/01/, the baseline emissions for the systems affected by the project activity are calculated as follows:

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

Where,

BE_y	Baseline emissions in year y (tCO ₂ e)
$BE_{power, y}$	Baseline emissions from electricity or fuel consumption in year y (tCO ₂ e)
$BE_{ww, treatment, y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO ₂ e)
$BE_{s, treatment, y}$	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO ₂ e)
$BE_{ww, discharge, y}$	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO ₂ e).
$BE_{s, final, y}$	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO ₂ e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.

The baseline emissions of the wastewater treatment systems affected by the project activity ($BE_{ww, treatment, y}$) is calculated using the below equation as per the validated VCS PD/01/:

$$BE_{ww, treatment, y} = \sum Q_{ww, i, y} * COD_{inflow, i, y} * \eta_{COD, BL, i} * MCF_{ww, treatment, BL, i} * B_{0, ww} * UF_{BL} * GWP_{CH4}$$

Where,

$BE_{ww, treatment, y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO ₂ e)
$Q_{ww, i, y}$	Volume of wastewater treated in baseline wastewater treatment system i in year y (m ³)
$COD_{inflow, i, y}$	Chemical oxygen demand of the wastewater inflow to the baseline treatment system I in year y. Average value may be used through sampling with the confidence/precision level 90/10 (t/m ³).
$\eta_{COD, BL, i}$	COD removal efficiency of the baseline treatment system i
$MCF_{ww, treatment, BL, i}$	Methane correction factor for the baseline anaerobic wastewater treatment i (MCF values as per table III.H.2)
i	Index for baseline wastewater treatment system
$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.25 kg CH ₄ /kg COD) ⁷
UF_{BL}	Model correction factor to account for model uncertainties (0.89) ⁸
GWP_{CH_4}	Global Warming Potential for methane (value of 25)

The parameter $\eta_{COD, BL, i}$ is calculated based on the historical COD measurement of the baseline system prior implementation of project activity as verified by the verification team through remote audit (Google meet video conferencing). The measurement campaign of 11 days has been conducted in order to determine the COD removal efficiency which is in line with paragraph 39 (b) of AMS. III-H/06/.

Using the above mentioned parameters, the total baseline emissions of the wastewater treatment systems affected by the project activity in 2017, 2018 and 2019 were found to be **66,985 tCO₂e**, **40,724 tCO₂e** and **41,674 tCO₂e** respectively.

Baseline emission from electricity and fuel consumptions ($BE_{power, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the only electricity consumption in the baseline wastewater treatment system is for pumping the wastewater from the starch factory into the open anaerobic lagoons.

There has been no consumption of fossil fuels during the operation of the baseline system as verified by the verification team through remote audit (Google meet video conferencing). Therefore, the baseline emissions from electricity and fuel consumptions ($BE_{power, y}$) is assumed to be zero which is found to be acceptable.

$$BE_{power, y} = 0$$

⁷ The IPCC default value of 0.25 kg CH₄/kg COD was corrected to take into account the uncertainties. Project activities may use the default value of 0.6 kg CH₄/kg BOD, in case the parameter BOD_{5,20} is used to determine the organic content of the wastewater. In this case, baseline and project emissions calculations shall use BOD instead of COD in the formulas, and the monitoring of the project activity shall be based in direct measurements of BOD_{5,20}, i.e., the estimation of BOD values based on COD measurements is not allowed.

⁸ Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

Baseline emission from wastewater discharge ($BE_{ww, discharge, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the treated wastewater is not discharged into the sea/lake/river in the baseline scenario, therefore the methane emissions from degradable organic carbon in treated wastewater discharged ($BE_{ww, discharge, y}$) into a river, sea or lake in the baseline situation is assumed to be zero which is found to be acceptable.

$$BE_{ww, discharge, y} = 0$$

Baseline emissions of the sludge treatment systems affected by the project ($BE_{s, treatment, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), there has been no sludge treatment system used in the baseline scenario, hence the baseline emissions from sludge treatment are not taken into consideration which is found to be acceptable.

Baseline emissions from final sludge disposal ($BE_{s, final, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the sludge has been used for soil application in the baseline scenario. Therefore, baseline methane emissions from anaerobic decay of the final sludge ($BE_{s, final, y}$) produced is assumed to be zero which is found to be acceptable.

$$BE_{s, final, y} = 0$$

(b) Thermal energy production component AMS.I.C:

According to the applied methodology AMS I.HC/06/ and as per the validated VCS PD/01/, the baseline emissions due to thermal energy production is calculated using the below equation:

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

Where:

$BE_{\text{thermal, CO2,y}}$ The baseline emission from steam displaced by the project activity during the year y in tCO₂e.

$EG_{\text{thermal,y}}$ The net quantity of heat supplied by the project activity during the year y TJ.

$EF_{\text{FF,CO2}}$ The CO₂ emission factor per unit of the energy of the fuel that would had been use in the base line plant in (tCO₂/ TJ), obtained from reliable local or national data if available, otherwise, IPCC Default emission factor should be used.

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

Using the above mentioned parameters, the total baseline emissions from the steam displaced by the project activity in 2017, 2018 and 2019 were found to be **6446 tCO₂e**, **4096 tCO₂e** and **3640 tCO₂e** respectively.

Therefore, the total baseline emissions ($BE_{\text{AMS-III.H COD approach}} + BE_{\text{AMS-I.C}}$) = **163,565 tCO₂e**.

Following are the ex-ante parameters (Data and Parameters available at validation and fixed during the entire crediting period) for the project activity:

Parameter	Value	Unit	Verification Remark
GWP _{CH4} Global Warming Potential for Methane	25	tCO ₂ e/tCH ₄	Verification team has checked the value from the IPCC database/30/ and found it to be consistent. The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/ as well.
B _{0,ww} Methane producing capacity of the wastewater	0.25	kg CH ₄ /kg COD	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.
UF _{BL} Model correction factor to account for model uncertainties	0.89	Factor	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.

UF_{PJ} Model correction factor to account for model uncertainties	1.12	Factor	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.
$MCF_{ww,treatment,BL,i}$ Methane correction factor for baseline wastewater treatment systems i	0.8	Factor	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.
$MCF_{ww,treatment,PJ,k}$ Methane correction factor for project wastewater treatment systems k	0.8	Factor	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.
COD removal efficiency-baseline	87.62%	%	The value is based on the historical data of the baseline lagoons based on colorimetric analysis. The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB.
CFE_{ww} Capture efficiency of the biogas recovery equipment in the wastewater treatment systems.	0.9	-	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.
EF_y CO ₂ emission factor for grid power	0.5637	tCO ₂ /MWh	The value has been calculated by the Thai DNA and was found consistent from the DNA supportive/26/. The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB.
D_{CH_4} Density of methane at normal condition (T=273.15 K,	0.716	kg/m ³	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06 and the

p=101.325 kPa) of the biogas in the year y			tool to determine project emissions from flaring gases, version 3 /29/.
$\eta_{BL,thermal}$ Efficiency of the boiler using fossil fuel that would have been used in the absence of the project activity.	100	%	The value is fixed during the current monitoring period and was found consistent with the registered VCS-PD/01/, which has been justified and validated by the validation VVB to follow the applied methodology/06/.

Calibration details of monitoring equipment:

The calibration of all the monitoring equipment's was carried out by the project participant as per the registered monitoring plan/01/. However, few calibration gaps were observed during the monitoring period as detailed in section 4.4 of this report. As a result of which, the calibration delay error factor has been applied within the permissible level and the conservative value has been applied for calculating the emission reduction in the ER sheet/03/ as verified by the verification team.

Flow Meter	Date of calibration	Next Calibration Due
Serial No. 6B00F220000 Accuracy class 0.50% Calibration Frequency: Annual	17/05/2018 and 07/06/2019	06/06/2020
COD Colorimeter	Date of calibration	Next Calibration Due
Serial No. 041090C53333 Accuracy: 0.24% Calibration Frequency: Annual	16/09/2016, 01/11/2017 and 11/01/2019	11/01/2020
Weigh bridge - 1	Date of calibration	Next Calibration Due
Serial no. 2015024 Accuracy: 0.01% Calibration Frequency: Once in three years	16/05/2019	15/05/2022
Weigh bridge - 2	Date of calibration	Next Calibration Due
Serial no. 2015003 Accuracy: 0.01% Calibration Frequency: Once in three years	06/08/2015, 25/12/2015, 03/04/2017 and 05/12/2019	04/12/2022
Biogas flow meter (GM 1)	Date of calibration	Next Calibration Due

Serial No. 9A070602000 Accuracy-1.50% Calibration frequency: Once in two years	03/12/2014, 18/07/2016, 17/05/2018, 07/06/2019	06/06/2021
Biogas flow meter (GM 2)	Date of calibration	Next Calibration Due
Serial No. EA033D02000 Accuracy-1.50% Calibration frequency: Once in two years	03/12/2014, 18/07/2016, 17/05/2018, 07/06/2019	06/06/2021
Biogas flow meter (GM 3)	Date of calibration	Next Calibration Due
Serial No: N413E702000 Accuracy-1.50% Calibration frequency: Once in two years	24/04/2018, 07/06/2019	06/06/2021
Gas analyzer	Date of calibration	Next Calibration Due
Serial No: ARAM-0090 Accuracy-0.90% Calibration frequency: Annual	04/08/2015, 16/09/2016, 28/04/2017, 21/02/2018, 08/11/2018, 20/09/2018, 12/04/2019	11/04/2020
Oil meter (OM 1)	Date of calibration	Next Calibration Due
Serial No: 92093 Accuracy-1.0% Calibration frequency: Once in two years	02/12/2014, 19/07/2016, 22/05/2018, 10/06/2019	09/06/2021
Oil meter (OM 2)	Date of calibration	Next Calibration Due
Serial No: 4164890 Accuracy-1.0% Calibration frequency: Once in two years	02/12/2014, 19/07/2016, 22/05/2018, 10/06/2019	09/06/2021

Calculation of Project Emissions:

(a) Methane destruction component: (AMS III.H)

According to the paragraph 41 of AMS III.H/06/ and as per the validated VCS PD/01/, the project activity emissions from the systems affected by the project activity are calculated as follows:

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

Where,

PE_y	Project emissions in year y (tCO ₂ e)
$PE_{power, y}$	Emissions from electricity or fuel consumption in the year y (tCO ₂ e)
$PE_{ww, treatment, y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation (tCO ₂ e)
$PE_{s, treatment, y}$	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation (tCO ₂ e)
$PE_{ww, discharge, y}$	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO ₂ e)
$PE_{s, final, y}$	Methane emissions from anaerobic decay of the final sludge produced in year y (tCO ₂ e)
$PE_{fugitive, y}$	Methane emissions from biogas release in capture systems in year y (tCO ₂ e)
$PE_{biomass, y}$	Methane emissions from biomass stored under anaerobic conditions (tCO ₂ e)
$PE_{flaring, y}$	Methane emissions due to incomplete flaring in year y (tCO ₂ e)

Emissions from electricity consumption ($PE_{v, power} = PE_{EC,y}$)

The emissions from electricity consumption is calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 03”. The below equation is used as per the validated VCS PD/01/:

$$PE_{Power, y} = EC_{PJ, j, y} * EF_{EF, j, y} * (1 + TDL_{j, y})$$

Where,

$PE_{Power, y}$	Emissions from electricity consumption in the year y (tCO _{2e})
$EC_{PJ, j, y}$	Electricity from the grid consumed by the project activity (wastewater treatment, biogas recovery and biogas utilisation/flaring systems) (MWh)
$TDL_{j, y}$	Average technical transmission and distribution losses for providing electricity to source j in year y
$EF_{EF, j, y}$	Thailand National Grid emission factor (tCO _{2e} /MWh)

In this monitoring period under the second crediting period, the emission factor of the project is referred to the published value announced by Thai DNA/26/ as verified by the verification team. This is in line with paragraph 17 of Tool 7 version 05, EB87 Annex 9.

Using the above mentioned parameters, the total project emissions from electricity consumption for 2017, 2018 and 2019 were found to be **517 tCO_{2e}**, **421 tCO_{2e}** and **528 tCO_{2e}** respectively.

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

As verified by the verification team, the methane emissions from wastewater treatment systems affected by the project activity is calculated as per equation 2 of paragraph 29 in AMS.III.H/06/ and as per the validated VCS PD/01/. The below equation is used:

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

Where,

$PE_{ww, treatment, y}$	Emissions from degradable organic carbon in treated wastewater in year y (tCO _{2e})
$Q_{ww, y}$	Volume of wastewater treated in project activity (m ³)
$\eta_{COD, PJ, k, y}$	COD removal efficiency of the project wastewater treatment system k in year y (t/m ³) measured based on inflow COD and outflow COD in system k
$MCF_{ww, treatment, PJ, k}$	Methane correction factor for the project wastewater treatment system k (MCF values as per table 2 in AMS III.H. version 18)

$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.25 kg CH ₄ /kg COD) ⁹
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
GWP_{CH_4}	Global warming potential for methane (value of 25)

Using the above mentioned parameters, the methane emissions from wastewater treatment systems affected by the project activity for 2017, 2018 and 2019 were found to be **2910 tCO₂e**, **2046 tCO₂e** and **1652 tCO₂e** respectively.

Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery ($PE_{s, treatment, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the project activity does not include sludge treatment system, therefore the emissions from the sludge treatment system is considered negligible.

$$PE_{s, treatment, y} = 0$$

Methane emissions from degradable organic carbon in treated wastewater ($PE_{ww discharge y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the project activity discharges the treated wastewater in existing open lagoons and not into the river, sea or lake. Therefore, the emissions from this component is considered negligible.

$$PE_{ww discharge y} = 0$$

Methane emissions from the decay of the final sludge produced ($PE_{s, final, y}$)

As verified by the verification team through remote audit (Google meet video conferencing), the project proponent has applied the final sludge for field application as fertilizer and as suggested by the AMS III.H/06/, the emission from anaerobic decay from the final sludge produced can be omitted. Therefore, the emissions from this component is considered negligible.

$$PE_{s, final, y} = 0$$

Methane emissions from biogas release in capture systems ($PE_{fugitive y}$)

According to the paragraph 42 of AMS III.H/06/, the project activity emissions from methane release in capture systems are determined as given below:

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

Where,

⁵ The IPCC default value of 0.25 kg CH₄/kg COD was corrected to take into account the uncertainties. Project activities may use the default value of 0.6 kg CH₄/kg BOD, in case the parameter BOD_{5,20} is used to determine the organic content of the wastewater. In this case, baseline and project emissions calculations shall use BOD instead of COD in the formulas, and the monitoring of the project activity shall be based in direct measurements of BOD_{5,20}, i.e., the estimation of BOD values based on COD measurements is not allowed.

$PE_{fugitive, y}$	Methane emissions from methane release in capture and utilization/combustion/flare systems in year y (tCO ₂ e)
$PE_{fugitive, ww, y}$	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO ₂ e)
$PE_{fugitive, s, y}$	Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (tCO ₂ e)

Using the above mentioned parameters, the project activity emissions from methane release in capture systems were found to be **21,974 tCO₂e**.

(a) Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment ($PE_{fugitive, ww, y}$)

These emissions are calculated as follows:

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

Where,

CEF_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)
$MEP_{ww, treatment, y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (tonne)

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

Where,

$Q_{ww, y}$	Volume of wastewater treated in project wastewater treatment system k in year y (m ³ /year)
$B_{o, ww}$	Methane producing capacity of the wastewater
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
$COD_{removed, PJ, k, y}$	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)
$MCF_{ww, treatment, PJ, k}$	Methane correction factor for the project wastewater treatment system k equipped with biogas recovery equipment (MCF values as per table III.H.2)

Using the above mentioned parameters, the fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment were found to be **21,974 tCO₂e**.

(b) Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y ($PE_{y, fugitive, s}$) :

As verified by the verification team through remote audit (Google meet video conferencing), sludge is used only for land application, therefore there is no sludge treatment envisaged in the project activity. Hence, emission from sludge treatment is considered negligible.

$$PE_{y, \text{ fugitive, s}} = 0$$

Methane emissions due to incomplete flaring ($PE_{\text{flaring, y}}$)

As per the registered VCS PD/01/, the methane emissions due to incomplete flaring in year y are calculated as per the methodological tool “Project emissions from flaring”, version 3. These emissions are calculated as follows:

$$PE_{\text{flare, y}} = GWP_{CH_4} * \sum F_{CH_4, RG, m} * (1 - \eta_{\text{flare, m}}) * 10^{-3}$$

Where:

$PE_{\text{flare, y}}$	Project emissions from flaring of the residual gas in year y (tCO ₂ e)
GWP_{CH_4}	Global warming potential of methane valid for the commitment period (tCO ₂ e/tCH ₄)
$F_{CH_4, RG, m}$	Mass flow of methane in the residue gas in the minute m (kg)
$\eta_{\text{flare, m}}$	Flare efficiency in minute m

Using the above mentioned parameters, the methane emissions due to incomplete flaring for 2017, 2018 and 2019 were found to be **0** tCO₂e, **38** tCO₂e and **6** tCO₂e respectively.

Methane emissions from biomass stored under anaerobic conditions which does not take place in the baseline situation ($PE_{\text{biomass, y}}$)

As verified by the verification team through remote audit (Google meet video conferencing), the biomass storage is not required in the project activity. Therefore, methane emissions from biomass stored under anaerobic conditions are considered negligible.

$$PE_{\text{biomass, y}} = 0$$

(b) Thermal energy production (AMS.I.C):

According to paragraph 66 of AMS-I.C/06/ and as per the validated VCS PD/01/, CO₂ emissions from on-site consumption of fossil fuels due to the project activity is calculated using the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, Version 03. As per paragraph 6 of the tool, the equation is as follows:

$$PE_{FC, j, y} = \sum F_{CHFO, y} * COEF_{i, y}$$

$PE_{FC, j, y}$	Project emissions due to combustion of fossil fuel in year y (tCO ₂ e)
$F_{CHFO, y}$	Amount of fossil used in the boiler in ton/yr
$COEF_{i, y}$	CO ₂ emission coefficient of fuel type i in year y (tCO ₂ /mass or volume unit)

As per paragraph 7 of the applied tool, the option B is selected for determination of $COEF_{i,y}$ as per the registered VCS PD/01/. The equation is as follows;

$$COEF_{i,y} = NCV_{HFO} * EF_{HFO,CO2}$$

NCV_{HFO} NCV of fossil fuel used in the process (TJ/tonne)

$EF_{HFO,CO2}$ Emission factor of Heavy fuel oil as per IPCC (tCO₂/TJ)

By considering both the above equations, the parameter $PE_{FC,j,y}$ is determined as follows:

$$PE_{FC,j,y} = \sum F_{CHFO,y} * NCV_{HFO} * EF_{HFO,CO2}$$

Using the above mentioned parameters, the CO₂ emissions from on-site consumption of fossil fuels due to the project activity were found to be **0 tCO₂**.

Therefore, the total project emissions ($PE_{AMS-III.H \text{ COD approach}} + PE_{AMS-I.C}$) = **30,092 tCO₂**.

According to the paragraph 29 of AMS III.H and paragraph 28 of AMS I.C/06/ and as per the validated VCS PD/01/, emission reduction is estimated as follows;

$$ER_{y, \text{ ex-post}} = BE_{y, \text{ ex-post}} - (PE_{y, \text{ ex-post}} + LE_{y, \text{ ex-post}})$$

Therefore, the total emission reduction (using the COD approach) is found to be **133,473 tCO₂**.

According to the paragraph 31 AMS III.H/06/, emission reduction achieved by the project activity is limited to the ex-post calculated baseline emissions minus project emissions using the actual monitored data for the project activity (There was no leakage as per the applied methodology). Emission reductions achieved on any year are the lowest value of the following;

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

As per paragraph 32 in AMS III.H./06/, in case of flaring/combustion MD_y is measured using the conditions of the flaring process:

$$MD_y = BG_{\text{burnt},y} * W_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$$

Where:

MD_y	Methane captured and destroyed/gainfully used by the project activity in the year y
$BG_{\text{burnt}, y}$	Biogas flared/combusted in year y (m ³)
W_{CH4}	Methane content in the biogas in the year y (mass fraction)
D_{CH4}	Density of methane at the temperature and pressure of the biogas in the year y (tonnes/m ³)
FE	Flare efficiency in year y (fraction)

Using the above parameters, the total baseline emissions using the MD_y approach were found to be **142,634 tCO₂e**. Since, the baseline emissions for the COD approach (i.e. **163,565 tCO₂e**) is more

conservative, therefore it has been chosen in the emission reduction calculation of the project activity. Therefore, the total emission reduction is found to be **133,473** tCO₂.

Findings: CL 01, CAR 04 and CAR 05 was raised and successfully closed. Refer to appendix 2 for further details.

4.6 Non-Permanence Risk Analysis

Not applicable since the project involves installation of an anaerobic wastewater treatment facility and is not an AFOLU project.

5 VERIFICATION CONCLUSION

KBS Certification Services Pvt. Ltd. has been contracted by 'SD Biosupply Co., Ltd.' to undertake independent first verification and certification for the greenhouse gas (GHG) emission reductions reported from the "SD Biosupply Wastewater Treatment and Biogas Utilization Project" for the monitoring period 01/01/2017 to 31/12/2019.

The verification is based on the validated VCS PD and the monitoring report for this project. Our verification approach was based on the requirements as defined under the VCS Standard Version 4.0. The management of the "South Pole Carbon Asset Management Ltd." is responsible for the preparation of the GHG emissions data and the reported GHG emissions reductions on the basis set out within the project Final Monitoring Report, Version 03.1 dated 23/06/2020. The development and maintenance of records and reporting procedures are in accordance with the Final Monitoring Report, Version 03.1 dated 23/06/2020.

It is our responsibility to express an independent GHG verification opinion on the GHG emissions and on the calculation of GHG emission reductions from the project for the period 01/01/2017 to 31/12/2019 based on the reported emission reductions in the Final Monitoring Report Version 03.1 dated 23/06/2020/02/ for the same period.

Based on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these, KBS planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that this reported amount of GHG emission reductions for the period is fairly state.

Verification period: From 01/01/2017 to 31/12/2019

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)
2017	73,431	13,282	0	60,149
2018	44,820	8,528	0	36,292
2019	45,314	8,282	0	37,032
Total	163,565	30,092	0	133,473

Location: Faridabad, Haryana, India

Date: 03/07/2020



Kaushal Goyal (Managing Director, KBS Certification Services Pvt. Ltd.)

APPENDIX 1: REFERENCES

S. No	Document Name
/1/	/1.1/ Registered VCS PD, version 02 dated 23/11/2017 /1.2/ Validation report, Version 01Aa dated 05/02/2018
/2/	/2.1/ VCS MR Version 01 dated 07/04/2020 /2.2/ VCS MR Version 03.1 dated 23/06/2020
/3/	/3.1/ ER spread-sheet dated corresponding to MR Version 01 /3.2/ ER spread-sheet dated corresponding to MR Version 03.1
/4/	VCS Program Guide Version 04
/5/	VCS Standard Version 4.0
/6/	Small-Scale CDM methodologies AMS-III.H.: Methane Recovery in Wastewater Treatment, version 18.0; AMS-I.C.: Thermal energy for user with or without electricity, version 20.0 Tools: TOOL 06: "Project emissions from flaring", Version 03
/7/	PEA (Provincial Electricity Authority of Thailand) Bills/Invoices for the current monitoring period (01/01/2017 to 31/12/2019).
/8/	COD Measurement from External Laboratory- Water analysis report for the current monitoring period (01/01/2017 to 31/12/2019).
/9/	Operation License for Biogas production dated 10 th June 2005 Operation License for Starch Production dated 1 st march 1994
/10/	COD sampling method adopted by PP
/11/	SD Flare manual by SD Biosupply Co., Ltd.
/12/	Commissioning report and SD Log sheet for project start date (18/08/2005)
/13/	Snap shots of the following: 1. Major Equipments with corresponding nameplates under project 2. All the meters, measuring & testing equipment (including their nameplates)
/14/	Records of outage
/15/	Log books maintained at plant site for the entire monitoring period (01/01/2017 to 31/12/2019).
/16/	Operation and maintenance record
/17/	Competency certificates of operators
/18/	Technical details for the project activity equipments /meters
/19/	Confirmation regarding double counting
/20/	Calibration certificates of monitoring equipments (weigh bridge, flow meters, oil meters etc.)
/21/	Flare specification
/22/	Sludge removal and its application - "Monthly performance reporting to Department of Pollution Control" for the monitoring period (01/01/2017 to 31/12/2019)
/23/	Organization structure/chart of the project activity

/24/	Internal audit reports corresponding to this monitoring period (01/01/2017 to 31/12/2019)
/25/	Training/safety plan for 2018
/26/	Thailand Grid-EF-2017 http://ghgreduction.tgo.or.th/download-tver/68-2017-11-28-06-43-22/353-2559.html
/27/	Fuel Purchase receipts/records for the monitoring period (01/01/2017 to 31/12/2019)
/28/	Starch Production details along with the sales record for the monitoring period (01/01/2017 to 31/12/2019)
/29/	Tool to determine project emissions from flaring gases, Version 03
/30/	IPCC Default values https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
/31/	Miracle International Technology Co., Ltd. MIT: https://www.mit.in.th/ https://appdb.tisi.go.th/tis_devs/tislab/calibrate/clb52_e.html https://www.mit.in.th/htmlthai/file/ISO17025_0052_Thai.pdf

APPENDIX 2: FINDINGS

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

FAR ID	xx	Section no.	Date: DD/MM/YYYY
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.	4.5	Date: 27/05/2020
Description of CL				
Under section 4.1 of the submitted MR, the parameters “EF _{FF,HFO} ” and “NCV _{HFO} ” have been added. However, they have been included in the ex-post “Data and parameters monitored” section of the registered PDD. Please clarify.				

Project participant response		Date: 12/06/2020
The parameters of “EF_{FF,HFO}” and “NCV_{HFO}” have been moved to section “Data and parameters monitored” which is now consistent with the registered PD. Please see revised MR.		
Documentation provided by project participant		
300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020		
DOE assessment		Date: 13/06/2020
The parameters “EF_{FF,HFO}” and “NCV_{HFO}” have been included in section “Data and parameters monitored” of the revised MR. However the format of the table needs to be changed as per the other monitoring parameters referred in the MR. Hence, the finding is still open.		
Project participant response		Date: 16/06/2016
The table format for monitoring parameters of “EF_{FF,HFO}” and “NCV_{HFO}” have been updated and is now consistent with the VCS template.		
Documentation provided by project participant		
300136_MR_MP01012017-31122019_SD_WWT_TH_V3_16062020		
DOE assessment		Date: 17/06/2016
The table for the parameters “EF_{FF,HFO}” and “NCV_{HFO}” has been revised in the submitted MR and it is as per the format of the monitoring parameters. Hence, CL 01 is closed		

CL ID	02	Section no.	4.4	Date: 27/05/2020
Description of CL				
- Under section 4.2 of the submitted MR, for the monitoring parameter “V_{RG,h}”, PP needs to clarify which gas is it relating to since the flare values have been mentioned. - Under section 4.2 of the submitted MR, for the monitoring parameter “FC_{HFO,y}”, the serial number of monitoring equipment (OM 1) for the calibration date (10/06/2019) mentioned in the calibration certificate is different. Also, the serial number of monitoring equipment (OM 2) for the calibration dates (22/05/2018, 10/06/2019) mentioned in the calibration certificate is different. Please clarify.				
Project participant response				Date: 12/06/2020

1. Under section 4.2 of the revised MR, the monitoring parameter has been updated as “V_{RG,CH4}”. The methane is the gas relating to the flare value.
2. The serial number of both meters has been updated.
 - Serial number of OM1 has been corrected to “92093” with an ID of TM-4-1-0068-44, which is now consistent with the latest calibration certificate. The record of fuel oil meter sending for maintenance can be used as supportive evidence as the same serial number (92093) has also been mentioned.
 - Serial number of OM2 has been corrected to “4164890” with an ID of TMC-0157-43. The mentioned serial number is now consistent with the latest calibration certificate. The record of fuel oil meter sending for maintenance can be used as supportive evidence as the same serial number (4164890) has also been mentioned.

The totalized number under the gas meter log sheet can be used for proving that the meter has not been changed.

Documentation provided by project participant

300136_MR_MP01012017-31122019_SD_WWT_TH_v.2_12062020

Att01 Log sheet

Att02 Meter maintenance record

Att03 Calibration report - update

DOE assessment

Date: 13/06/2020

1. The nomenclature of the parameter has been updated to “V_{RG,CH4}” referring to methane gas in the revised MR. Hence, it is found to be acceptable.
2. The serial numbers of both OM1 and OM 2 meters have been updated and is found consistent with the maintenance sheet provided by PP. Hence, it is found to be acceptable.

Hence, CL 02 is closed.

Table 3. CAR from this verification

CAR ID	01	Section no.	4.1	Date:	27/05/2020
Description of CAR					
In cover page of the submitted MR, the start date of the monitoring period mentioned is inconsistent with other sections of the MR.					
Project participant response					Date:
The monitoring period of the report has been updated. Please see the revised MR.					11/06/2020
Documentation provided by project participant					
300136_MR_MP01012017-31122019_SD_WWT_TH_v.2_12062020					
DOE assessment					Date:
					13/06/2020

The start date of the monitoring period is now consistent with other sections of the revised MR. Hence, CAR 01 is closed.

CAR ID	02	Section no.	4.1	Date: 27/05/2020
Description of CAR				
Under section 2.3.1 of the submitted MR, the reference link (footnote 1) is not functional.				
Project participant response				Date: 12/06/2020
The reference link (footnote 1) has been updated. Please see the revised MR.				
Documentation provided by project participant				
300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020				
DOE assessment				Date: 13/06/2020
The reference link (footnote 1) is now functional in the revised MR. Hence, CAR 02 is closed.				

CAR ID	03	Section no.	4.4	Date: 27/05/2020
Description of CAR				

Under section 4.2 of the submitted MR, PP needs to do the following corrections/revisions:

1. PP has mentioned futuristic language for all the monitoring parameters which needs to be revised accordingly.
2. For the parameter " $Q_{ww,y}$ ",
 - a. The values monitored for the year 2017 and 2019 is inconsistent with the ER sheet.
 - b. The serial number of the old flow meter is inconsistent with the calibration certificate.
 - c. The meter was replaced during this monitoring period, PP need to provide supportive for the change of the meter.
3. For the parameter " $COD_{ww,untreated,y}$ ",
 - a. The values monitored for the year 2017 is inconsistent with the ER sheet.
 - b. The serial number of the monitoring equipment meter is inconsistent with the calibration certificate and as verified during remote auditing.
 - c. Also, the calibration dates are inconsistent with the calibration certificate and ER sheet. The calibration gap mentioned is inconsistent as well.
4. For the parameter " $COD_{ww,treated,y}$ ", the values monitored for all the three years are inconsistent with the ER sheet
5. For the parameter " W_{CH_4} ", the values monitored for all the three years are inconsistent with the ER sheet. Also the calibration date for the year 2019 mentioned as 18/04/2019 is inconsistent with the calibration certificate. It should be 12/04/2019 and the validity should be changed accordingly.
6. For the parameter " $V_{RG,h}$ ", the value monitored for the year 2019 is inconsistent with the ER sheet. Also the monitoring equipment was changed during this monitoring period, PP need submit the supportive document for the same.
7. For the parameter " EC_y ", the meter calibration details are missing.
8. For the parameter " $S_{final,PJ,y}$ ", the calibration validity date for both the weigh bridges (15/05/2022) is inconsistent with the ER sheet. Also as the weigh bridge was changed during this monitoring period, PP need to provide the supportive document for the same.
9. For the monitoring parameters " $BG_{burnt,y}$ ", " W_{CH_4} ", " $BG_{combusted,y}$ " and " $V_{RG,h}$ ", PP needs to provide the basis of the calibration frequency as mentioned in the registered PDD. Also, provide supportive for the same.

Project participant response

Date: 11/06/2020

1. The language used in the monitoring report has been revised. There is no futuristic language been mentioned. Please see the updated MR.
2. For the parameter " $Q_{ww,y}$ ",
 - a. The values monitored for the year 2017 and 2019 has been updated and is now consistent with the ER sheet.
 - b. The serial number of the old flow meter has been corrected and is now consistent with the calibration certificate.
 - c. The log sheet with remark on the replacement of the meter has been provided in this regard. The meter was replaced on 20/04/2017 with the new meter with same model.
3. For the parameter " $COD_{ww,untreated,y}$ ",
 - a. The values monitored for the year 2017 has been updated and is now consistent with the ER sheet.
 - b. The serial number of the meter has been updated. It is now consistent with the calibration certificate and as verified during remote auditing.
 - c. The calibration date has been updated and is now consistent with the calibration certificate as well as ER sheet. The calibration gap mentioned has also been updated respectively.
4. For the parameter " $COD_{ww,treated,y}$ ", the values monitored for all the three years have been updated and are now consistent with the ER sheet.
5. For the parameter " W_{CH4} ", the values monitored for all the three years have been revised and updated. The calibration date for the year 2019 has also been updated to "12/04/2019" consistent with the calibration certificate. The validity of the calibration has been changed accordingly.
6. The $V_{RG,h}$ value monitored for the year 2019 has been updated and now consistent with the ER sheet. The log sheet with remark on the change of meter has been submitted as supportive document for this regard.
7. Since the electricity consumption is under PEA, the meter maintenance is not under the jurisdiction of project proponent. The comment has been added. Please see updated MR.
8. For the parameter " $S_{final,PJ,y}$ ", the calibration validity dates for both the weigh bridges have been revised to "15/05/2021" and are now consistent with the ER sheet. The weigh bridge was changed in February 2017. The remark on the log sheet has been submitted as supportive document for this regard.
9. For the monitoring parameters " $BG_{burnt,y}$ ", " W_{CH4} ", " $BG_{combusted,y}$ " and " $V_{RG,h}$ ", PP needs to provide the basis of the calibration frequency as mentioned in the registered PDD

Documentation provided by project participant

300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020

300136_ER_MP01012017-31122019_SD_WWT_TH_V2_10062020

Att01 Log sheet

Att02 Meter maintenance record

Att03 Calibration report - update

DOE assessment

Date: 13/06/2020

1. It is still in futuristic language. It needs to be updated to “Has been” instead of “shall be/should be” in the entire monitoring report. Open
2. For the parameter “ $Q_{ww,y}$ ”,
 - a. The values monitored for the year 2017 and 2019 is now consistent in the revised MR with the ER sheet.
 - b. The serial number of the old flow meter is now consistent in the revised MR with the calibration certificate.
 - c. The old meter was replaced by the new meter due to malfunctioning of the old meter as mentioned in the log sheet provided by PP which is found to be acceptable.
3. For the parameter “ $COD_{ww,untreated,y}$ ”,
 - a. The values monitored for the year 2017 is still not consistent with the ER sheet.
 - b. The serial number of the monitoring equipment meter is now consistent in the revised MR with the calibration certificate and from the remote auditing evidence.
 - c. The calibration dates are now consistent in the revised MR with the calibration certificate and ER sheet. However, the start date for calibration gap for 2017 mentioned in “comments” section is inconsistent. It should be 15/09/2017 to 1/11/2017. Open
4. For the parameter “ $COD_{ww,treated,y}$ ”, the values monitored for all the years is now consistent in the revised MR with the ER sheet.
5. For the parameter “ W_{CH4} ”, the values monitored for all the years are now consistent in the revised MR with the ER sheet. Also the calibration dates for the year 2019 is now consistent with the calibration certificate.
6. For the parameter “ $V_{RG,h}$ ”, the value monitored for the year 2019 is now consistent in the revised MR with the ER sheet. Also, the old meter was replaced by the new meter due to malfunctioning of the old meter as mentioned in the log sheet provided by PP which is found to be acceptable.
7. For the parameter “ EC_y ”, the meter details can be provided along with the calibration schedule as per PEA. Open
8. For the parameter “ $S_{final,PJ,y}$ ”, the calibration validity date for both the weigh bridges in the revised MR is now consistent with the ER sheet. Also, the old weighbridge (S no. 2006068) was replaced by the new weighbridge (S no. 2015024) due to malfunctioning of the old one as mentioned in the log sheet provided by PP which is found to be acceptable. But the calibration dates for both the weighbridges (S no. 2015003 and S no. 2015024) *is not covering the monitoring period*. Open
9. For the monitoring parameters “ $BG_{burnt,y}$ ”, “ W_{CH4} ”, “ $BG_{combusted,y}$ ” and “ $V_{RG,h}$ ”, the basis of the calibration frequency has been provided in the revised MR.

Project participant response
Date: 16/06/2020

1. The monitoring report has been revised and does not show any futuristic language.
3. For the parameter “ $COD_{ww,untreated,y}$ ”,
 - a) The values monitored for the year 2017 is consistent with the ER sheet
 - c) The calibration dates under comments section in the monitoring report is consistent with the calibration certificate and ER sheet. As the monitoring period of the project activity starts from 01/01/2017 to 31/12/2019.
7. The meter details has been provided. Though the calibration schedule could not be envisaged as the maintenance schedule is not under project proponent jurisdiction.
8. The calibration dates for both the weighbridges (S no. 2015003 and S no. 2015024) has been updated and are now covering the monitoring period.

Documentation provided by project participant

300136_MR_MP01012017-31122019_SD_WWT_TH_V3_16062020

Att02 Calibration

DOE assessment

Date: 17/06/2020

1. The language has been updated in the revised MR as per the verification approach.
 3. For the parameter “COD_{ww,untreated,y}”,
 - a) The values monitored for the year 2017 is now consistent in the revised MR with the ER sheet.
 - c) The justification for the start date of the calibration gap for 2017 is acceptable by the verification team since it is the start date of the monitoring period.
 7. For the parameter “EC_y”, the meter details have been provided in the revised MR.
 8. The calibration dates for both the weighbridges are now covering the monitoring period and found to be consistent in the revised MR.
- Hence, CAR 03 is closed.

CAR ID	04	Section no.	4.5	Date: 27/05/2020
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Description of CAR

Under section 5.2 of the submitted MR, the value of the parameter “MEP_{ww, treatment,y}” for the year 2018 is inconsistent with the ER sheet.

Project participant response

Date: 12/06/2020

The “MEP_{ww, treatment,y}” 2018 value has been updated and is now consistent with the ER sheet. Please see revised MR

Documentation provided by project participant

300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020

DOE assessment

Date: 13/06/2020

The value of the parameter “MEP_{ww, treatment,y}” for the year 2018 is now consistent in the revised MR with the ER sheet. Hence, CAR 04 is closed.

CAR ID	05	Section no.	4.5	Date: 27/05/2020
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Description of CAR

Under section 5.4 of the submitted MR, the value of overall baseline emissions for the year 2017 is inconsistent with the ER sheet.

Project participant response	Date: 12/06/2020
The value of overall baseline emissions for the year 2017 has been updated and is now consistent with the ER sheet.	
Documentation provided by project participant	
300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020	
300136_ER_MP01012017-31122019_SD_WWT_TH_V2_10062020	
DOE assessment	Date: 13/06/2020
1. The value of the parameters “BE_{y, ex-post}” and “MD_y” for the year 2016 in the revised MR is now consistent with the ER sheet. 2. The value of overall baseline emissions for the year 2017 in the revised MR is now consistent with the ER sheet. Hence, CAR 05 is closed.	

CAR ID	06	Section no.	4.4	Date: 27/05/2020
Description of CAR				
1. Under “data 2017”, “data 2018” and “data 2019” of the submitted ER sheet, the nomenclature of the parameter “BG_{flare,y}” is inconsistent with the MR and registered PDD. 2. Under “PEA BILL” of the submitted ER sheet, the value of electricity consumption for the March, 2016 is inconsistent with the PEA bill supportives. 3. Under “Calibration” of the submitted ER sheet, the serial number of the old WW flow meter (FM 1) is inconsistent with the calibration certificate. 4. Under “Calibration” of the submitted ER sheet, serial number of the monitoring equipment COD colorimeter is inconsistent with the calibration certificate. 5. Under “Calibration” of the submitted ER sheet, the calibration date of the gas analyser for the year 2019 mentioned as 18/04/2019 is inconsistent with the calibration certificate. It should be 12/04/2019 and the validity should be changed accordingly.				
Project participant response				Date: 12/06/2020
1. Under “data 2017”, “data 2018” and “data 2019” of the ER sheet have been updated. The parameter of “V_{RG,CH4}” has been added to the cell; now showing as “V_{RG,CH4}/ BG_{flare,y}”. The parameter is now inlined with MR and the registered PD. Comment under the parameter “V_{RG,CH4}” has also been updated. Please see revise MR and ER 2. The chosen value for March 2016 is inline with the monthly report by PEA. Though the shown value has been adjusted with 4/31, in order to reflect the actual monitoring period in March 2016. Further justification has also been prepared under CAR03 – 8. 3. The serial number of the old WW flow meter (FM 1) has been updated and is now consistent with the calibration certificate. 4. The serial number of COD colorimeter has been updated and is now consistent with the calibration certificate. 5. The calibration date of the gas analyzer in 2019 has been updated to 12/04/2019. It is now inlined with the calibration certificate.				
Documentation provided by project participant				

300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020	
300136_ER_MP01012017-31122019_SD_WWT_TH_V2_10062020	
DOE assessment	Date: 13/06/2020
- Under “data 2017”, “data 2018” and “data 2019” of the revised ER sheet, the nomenclature for $V_{RG,CH4}$ has been updated. - The justification provided for the chosen value for March 2016 is found to be appropriate and hence been accepted by the verification team. - The serial number of the old WW flow meter (FM 1) in the revised ER sheet is now consistent with the calibration certificate. - The serial number of the monitoring equipment COD colorimeter in the revised ER sheet is now consistent with the calibration certificate. - The calibration date of the gas analyser for the year 2019 in the revised ER sheet is now consistent with the calibration certificate. Hence, CAR 06 is closed.	

CAR ID	07	Section no.	4.1	Date: 27/05/2020
Description of CAR				
Under section 3.1 of the submitted MR, PP needs to provide line diagram representing the monitoring points of the various monitoring equipments installed.				
Project participant response				Date: 12/06/2020
The line diagram has been updated under section 3.1. Please see the revised MR				
Documentation provided by project participant				
300136_MR_MP01012017-31122019_SD_WWT_TH_V2_12062020				
DOE assessment				Date: 13/06/2020
The line diagram shows the project boundary and not the meter installed points. Hence, the finding is open.				
Project participant response				Date: 16/06/2020
The line diagram with the monitoring point has been updated. Please see the revised MR				
Documentation provided by project participant				
300136_MR_MP01012017-31122019_SD_WWT_TH_V3_16062020				
DOE assessment				Date: 17/06/2020
The line diagram now provides the meter installed points in the revised MR. Hence, CAR 06 is closed.				

Table 4. FAR from this verification

FAR ID	xx	Section No.		Date: DD/MM/YYYY
Description of FAR				
Project participant response				Date: DD/MM/YYYY
Documentation provided by project participant				
DOE assessment				Date: DD/MM/YYYY

APPENDIX 3: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Personnel Name:		Madhuri Nanda	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☐
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope	Technical Area		
Energy industries (renewable/non-renewable sources)	TA 1.1		
	TA 1.2		
Waste handling and disposal	TA 13.1.		
	TA 13.2.		
Agriculture	TA 15.1		
Approved by (Manager C & T)	Sanjay Kandari		
Approval date:	07/05/2020		

Personnel Name:		Ms. Deboshmita Dey	
Qualified to work as:			
Team Leader	☐	Technical Expert	☐
Validator/Verifier	☒	Financial Expert	☐
Technical Reviewer	☐	Local Expert	☐
Area(s) of Technical Expertise			

Sectoral Scope	Technical Area
-	-
Approved by (Manager C & T)	Sanjay Kandari
Approval date:	26/11/2019

Personnel Name:		Rohit Badaya	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope	Technical Area		
Energy industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar		
	TA 1.2: Energy generation from renewable energy sources		
Energy distribution	TA 2.1: Energy distribution		
Energy demand	TA 3.1. Energy Demand		
Waste Handling and Disposal	TA 13.1 Solid waste and wastewater		
	TA 13.2 Manure		
Approved By	Manager Competency & Training		
Approval date:	29/12/2018		