



P.S.C. STARCH WASTEWATER TREATMENT AND BIOGAS UTILIZATION PROJECT



South Asia

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Summary:

TÜV SÜD, commissioned by Swiss Carbon Value Ltd., has verified the greenhouse gas emission reductions reported for the project activity “P.S.C Starch Wastewater Treatment and Biogas Utilization Project” in Thailand, VCS Registration Reference N° 417, for the period 01/01/2019 to 30/11/2019 with regard to the relevant requirements for VCS activities.

The project activity involves biogas recovery and its utilization as a fuel in hot oil boiler and steam boilers. The project involves wastewater generation from two different manufacturing units out three products (i.e. starch, sweetener and ethanol). In the baseline, wastewater generated was treated in cascading open anaerobic lagoons. The project activity involves an intertwined network of anaerobic treatment system which consist of UASB system and covered lagoons. The biogas generated by the overall system is used at sweetener plant (steam boilers), starch plant (hot oil boiler) and sweetener plant (electricity generation).

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

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

The project was validated by TUV Nord Cert (validation report N° 53219108-08/509 dated 18/11/2009) and it was registered under the VCS registration reference N° 417.

The GHG emission reductions were calculated on the basis of the approved methodology “AMS-III.H Methane Recovery in Wastewater Treatment’ version 13 and the monitoring plan included in

the registered Project Design Document, version 03.1 of 18/11/2009. During this verification, 00 Corrective Action Request (CAR) and 2 Clarification Requests (CRs) were identified related to operation, GHG emission reduction estimation, monitoring and baseline scenario of the VCS project activity in relation to all relevant VCS requirements for the project activity and the applied baseline and monitoring methodology, and these CARs and CRs are successfully closed after necessary corrections/clarifications by the client. The same has been discussed in Appendix B of this verification report.

In conclusion, it is TÜV SÜD's opinion that the project activity "P.S.C Starch Wastewater Treatment and Biogas Utilization Project" in Thailand, VCS project ID 417, meets all relevant requirements for VCS standard and guidelines and correctly applies the baseline and monitoring methodology AMS-III.H Methane Recovery in Wastewater Treatment' version 13. The monitoring system is in place and the emission reductions are calculated without material misstatement. Hence, TÜV SÜD is able to certify that the emission reductions from the project during the monitoring period 01/01/2019 to 30/11/2019 amount to 59,738 tCO₂e.

CONTENTS

1	Introduction.....	5
1.1	Objective.....	5
1.2	Scope and Criteria	5
1.3	Level of Assurance.....	5
1.4	Summary Description of the Project	6
2	Verification Process	6
2.1	Method and Criteria.....	7
2.2	Document Review	7
2.3	Interviews.....	10
2.4	Site Inspections.....	10
2.5	Resolution of Findings	11
2.6	Eligibility for Validation Activities	11
3	Validation Findings.....	12
3.1	Participation under Other GHG Programs.....	12
3.2	Methodology Deviations	12
3.3	Project Description Deviations.....	12
3.4	Grouped Project	13
4	Verification Findings.....	13
4.1	Project Implementation Status	13
4.2	Safeguards	30
4.3	AFOLU-Specific Safeguards.....	30
4.4	Accuracy of GHG Emission Reduction and Removal Calculations	30
4.5	Quality of Evidence to Determine GHG Emission Reductions and Removals.....	37
4.6	Non-Permanence Risk Analysis.....	38
5	Verification conclusion.....	38
APPENDIX B: <Clarification Requests, Corrective Action Request and Forward Action Request>		40

1 INTRODUCTION

1.1 Objective

TÜV SÜD commissioned by "Swiss Carbon Value Ltd " has performed an independent verification of its VCS project, "P.S.C Starch Wastewater Treatment and Biogas Utilization Project", in Thailand, already registered under VCS with Project ID.417 for the reported GHG emission reductions for the given monitoring period 01/01/2019 to 30/11/2019. The VCS projects must undergo independent third-party verification and certification of emission reductions as the basis for issuance of Voluntary Emission Reductions (VERs/VCUs).

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

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

1.2 Scope and Criteria

The verification scope is:

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

The project is assessed against the of VCS program guide v 4.0, VCS standard v4.0. TÜV SÜD has, based on the recommendations in the latest version of CDM Validation and Verification Manual v 3.2, and employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

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

1.3 Level of Assurance

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

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

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

Role	Last Name	First Name	Country
Team Leader, Technical Expert	Menon	Rekha	India
Host Country Expert	Phoolcharoen	Siam	Thailand
Technical Reviewer	Murty	Eswar	India

1.4 Summary Description of the Project

The project activity involves biogas recovery and its utilization as a fuel in hot oil boiler and Steam boilers. The project involves wastewater generation from two different manufacturing units out three products (i.e. starch, sweetener and ethanol). The project is implemented at P.S.C Starch Products Public Company Limited in 28/04/2005 (project start date). In the baseline, wastewater generated was treated in cascading open anaerobic lagoons. The project activity involves an intertwined network of anaerobic treatment system which consist of UASB system and covered lagoons. The newly constructed covered lagoon 1 (CL1) pre-treats the wastewater before feeding to UASB. By June 2006, a covered sheet at the existing first open anaerobic lagoon was installed to collect biogas generated. The covered lagoon (CL 2) was designed to receive wastewater from sweetener plant together with the effluent from the UASB reactors. In October 2009, a new ethanol plant started operation in line with these existing facilities. Wastewater from ethanol plant is taken into a covered lagoon (CL 3) and then diverted to CL1. Thus, the biogas generated by the overall system (UASB+CL1+CL2+CL3) is used at sweetener plant (steam boilers), starch plant (hot oil boiler) and sweetener plant (electricity generation). The components of electricity production and fuel replacement are not claimed for emission reductions. Verification team has checked the project activity equipment's installed at the project site and found in compliance with the registered VCS PD version 3.1 /02/.

The project site is located in the compound of the P.S.C. Starch factory located at 999 Nongya Bothong road, Nongyai District, Chonburi Province, Thailand, about 150km away

from Bangkok. Geographical coordinates: Latitude 13°18'6.50"N and Longitude 101°21'49.47"E.

As per the registered VCS PD (VCS Ref. No: 417) of the VCS project, baseline emissions are calculated as the sum of fugitive methane emissions from lagoons in the baseline case in the absence of the project activity. Project emissions are calculated as the fugitive methane emissions from the project activity, the electricity consumption to run the project activity in present scenario. The emission reduction is calculated as the difference of baseline emissions and the project emissions as the leakage emissions are considered to be negligible for the project activity as per the applied methodologies.

Project Participant(s)	P.S.C Starch Products Public Company Limited Swiss Carbon Value Ltd.		
Project Title	P.S.C Starch Wastewater Treatment and Biogas Utilization Project		
Location of the project	The project site is located in the compound of the P.S.C. Starch factory located at 999 Nongya Bothong road, Nongyai District, Chonburi Province, Thailand, about 150km away from Bangkok.		
Methodology(ies)	AMS-III.H: "Methane Recovery in Wastewater Treatment", version 13 /06 /		
Sectoral Scope(s)	13	Technical Area(s)	13.1.
Registered PDD	Registered VCS-PD, version 3.1 of 18/11/2009.		
Starting date of the crediting period	01/12/2009		
Project's crediting period	01/12/2009 to 30/11/2019		
Project documentation link	VCS database: https://www.vcsprojectdatabase.org/#/project_details/417		

2 VERIFICATION PROCESS

2.1 Method and Criteria

Verification was conducted using TUV SUD procedures in line with the requirements specified in the VCS Requirements and VVB guidance, i.e. VCS Program Guide, VCS Version 4.0 of 19/09/2019, VCS Standard, VCS Version 4.0 of 19/09/2019 and Validation and Verification Manual, VCS Version 3.2 of 19/10/2016. The GHG emission reductions are on the basis of the approved Baseline and monitoring methodology "AMS-III.H", "Methane Recovery in Wastewater Treatment version 13" and applicable tools.

Tool referenced in the applied methodologies:

AMS-III.H

- “Project emissions from flaring”, version 3.0 (Tool06) /15/
- “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, version 3.0 (Tool03) /16/
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” version 3.0 (Tool05) /17/
- “Tool to calculate the emission factor for an electricity system” version 7.0 (Tool07) /18/

The verification consisted of the following three phases

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

The following sections outline each step in more detail.

2.2 Document Review

The monitoring report (MR), version 01 of 22/04/2020, MR version 02 of 09/06/2020 /01/, the emission reduction calculations spreadsheet (VCS417PSC_ER cal_5thMR(PAF)_ver1.0_22042020.xlsx) version 01 of 22/04/2020 and (VCS417PSC_ER cal_5thMR(PAF)_v2.0_09062020.xlsx) version 02 of 09/06/2020 /03/, were assessed as part of the verification. In addition, the registered VCS-PD /02/ in particular the baseline estimations and the monitoring plan for the project were reviewed.

The following table lists the documentation that was reviewed during the verification.

/01/	Swiss Carbon Value Ltd: VCS monitoring report for the project activity “P.S.C Starch Wastewater Treatment and Biogas Utilization Project”, version 01 of 22/04/2020 and version 02 of 09/06/2020
/02/	Swiss Carbon Value Ltd: VCS project description for project activity “P.S.C Starch Wastewater Treatment and Biogas Utilization Project” in Thailand, version 3.1 of 18/11/2009
/03/	Swiss Carbon Value Ltd: Emission Reduction spread sheet VCS417PSC_ER cal_5thMR(PAF)_ver1.0_22042020.xlsx) version 01 of 22/04/2020 and (VCS417PSC_ER cal_5thMR(PAF)_v2.0_09062020.xlsx) version 02 of 09/06/2020
/04/	VCS: VCS Program Guide, VCS Version 4.0 of 19/09/2019
/05/	VCS: VCS Standard, VCS Version 4.0 of 19/09/2019
/06/	CDM Executive Board: Approved consolidated baseline and monitoring methodology “AMS”-III.H, Methane Recovery in Wastewater Treatment, version 13 of 17/07/2009.
/07/	VCS: P.S.C Starch Wastewater Treatment and Biogas Utilization Project (ID: 417) https://www.vcsprojectdatabase.org/#/project_details/417
/08/	VCS: Monitoring report form, version 04.0 dated 19/09/2019

/09/	TUV Nord: Validation report (validation report N°53219108-08/509 of 18/11/2009) for the project activity "P.S.C Starch Wastewater Treatment and Biogas Utilization Project"
/10/	RINA Services: Verification report for the project activity 'P.S.C Starch Wastewater Treatment and Biogas Utilization Project' covering the monitoring period 01/01/2018 to 31/12/2018
/11/	Daily log sheets of P.S.C. Starch Company: (a) Wastewater flow meter readings for the period 01/01/2019 to 30/11/2019 (b) Methane content (% CH ₄) in biogas for the period 01/01/2019 to 30/11/2019 (c) COD measurement of wastewater for the period 01/01/2019 to 30/11/2019 (d) Biogas consumption for boilers and turbine (GM 1 & GM 2) for the period 01/01/201 to 30/11/2019 (e) Biogas consumption for flare for the period 01/01/2019 to 30/11/2019
/12/	Calibration Reports: a. Wastewater Flow meter (FM1): Serial Number: 3K672016320307 Calibrated by Miracle International Technology Co. Ltd. On 05/03/2018 b. Wastewater Flow meter (FM2): Serial Number: 6201472 Calibrated by Miracle International Technology Co. Ltd. On 26/12/2017 c. FM2 : Serial Number: 3K672017130820 Calibrated by ABB on 14/05/2020 d. Wastewater Flow meter (FM3): Calibrated by Miracle International Technology Co. Ltd. On 26/12/2017 and serial number 3K672018091156 by ABB on 08/03/2018 e. Continuous gas analyser: Serial Number: 96159; By AWJ Innovation Co. Ltd.: Test Certificate with Calibration date 14/03/2017 f. Biogas flow meter to boiler (GM1): Serial Number: 503208; By Miracle International Technology Co. Ltd, calibrated on 21/12/2017 g. Biogas flow meter to boiler (GM2): Serial Number: 630165; By Miracle International Technology Co. Ltd, calibrated on 12/11/2018
/13/	List of Accredited Laboratories; webpage https://www.tisi.go.th/home/en in English language retrieved on 25/05/2020
/14/	By AWJ Innovation Co. Ltd: https://www.awj.co.th/service%20%20calibration.html in English language retrieved on 25/05/2020
/15/	CDM Executive Board: "Project emissions from flaring", version 3.0 (Tool06)
/16/	CDM Executive Board: "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion", version 3.0 (Tool03)
/17/	CDM Executive Board: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" version 3.0 (Tool05)
/18/	CDM Executive Board: "Tool to calculate the emission factor for an electricity system" version 7.0 (Tool07)
/19/	ERPA between PSC Products Public Company Limited and Swiss Carbon Value Ltd, dated 21/02/2017
/20/	VERRA: https://verra.org/covid-19-travel-guidance/ last accessed on 15/04/2020

2.3 Interviews

	Date	Name and Role	Organization	Topic
/a/	15/05/2020	Ladaporn Khunikakorn, SEA Regional Director	Swiss Carbon Value Ltd	project description Project
/b/		Sirinut Raya, Project Manager	Swiss Carbon Value Ltd	Implementation status, Operation and Maintenance, Data storage and Archiving procedures, Trainings
/c/		Ms.Piyanuch Lalun – (Environmental officer)	P.S.C Starch Products Public Company Limited	Technology involved, UASB and flare specification, Monitoring parameters, data collection and QA/QC procedures. Health and safety related topics
/d/		Ms. Pongsupa Pantaree (Environmental officer)		
/e/		Mr. Manus Boonprakob (Environmental Manager)		
/f/		Miss Thoungsuke Plontem	Stakeholder living in the community	Stakeholder consultation

2.4 Site Inspections

The verification team could not visit the site due to COVID-19 pandemic and subsequent travel restrictions. As per the Emission Reduction Purchase Agreement (ERPA) dated 21/02/2017 /18/, the client is committed to deliver the VERs until 30/11/2020.

Based on the above mentioned justification, the DOE could not postpone the site visit. The same is as per the VCS- COVID travel guidance (<https://verra.org/covid-19-travel-guidance/>) /20/.

All information provided in the revised MR /02/ was verified during the desk-review phase against credible sources and interviews with concerned stakeholders. It is to be also noted that more than three years have not elapsed since the last onsite inspection was conducted. Since an onsite inspection is avoided, the verification team decided to carry out the audit by other means of standard auditing techniques, which included video conference calls, videos of the site, videos of the equipment's installed and measuring devices in place, pictures of the meters , emails, raw data and telephonic interviews.

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

2.5 Resolution of Findings

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

- The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions.*
- The VCS Version 4.0 standard have not been met.*
- There is a risk that the emission reductions cannot be monitored or calculated.*

A clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable VCS Version 4.0 standard have been met.

The No. of CARs/CLs raised by TUV SUD are the following

CAR:0, CL: 02 and FAR: 0

2.5.1 Forward Action Requests

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

No FARs raised during this verification.

2.6 Eligibility for Validation Activities

TUV SUD is accredited for validating and verifying GHG emission reduction project activities falling under sectoral scope 13, waste handling and disposal .

3 VALIDATION FINDINGS

3.1 Participation under Other GHG Programs

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

3.2 Methodology Deviations

There is no methodology deviation proposed in this monitoring period.

3.3 Project Description Deviations

Two deviations were applied during last monitoring period , which was accepted by VCS and continued in this monitoring period too.

Description of Deviation

1. During registration of the project it was envisaged that treated COD measurement shall be taken at after CL 2 and after CL 3 (Registration project boundary diagram). However, during implementation, the treated wastewater from CL3 is sent to CL1. Then the last unit for closed anaerobic system is CL2 before discharge to pond system. The COD_{ww,discharge.PJ.y} is changed to be the COD of treated wastewater from CL2.

Assessment

The deviation is in compliance to the methodology. In line with the methodology the final emission reduction is the minimum of COD approach and MDy approach. Therefore, the change will not affect the conservative estimation of emission reductions. Further, the same approach has been applied since previous verifications. Therefore, the deviation is accepted by the verification team.

2. COD_{y,ww.untreated,starch}, COD_{y,ww.untreated,sweetener}, COD_{y,ww.untreated,ethanol}, COD_{y,ww.treated,CL2}, COD_{y,ww.treated,CL3} and COD_{y,ww,treated.lagoon} are not measured on daily basis as per the monitoring plan for COD parameters in the registered VCS PD. The wastewater analysis of the samples were carried out by internal laboratory, but not on every operational days. As per AMS-III.H, average value may be used through sampling with the confidence/precision level 90/10. The example of calculating step from Annex 13 of EB 48 is followed applying standard statistical calculation.

Assessment

The revised approach is in line with the methodology provisions. The deviation is transparently described in the monitoring report and calculation is presented in the emission reduction worksheet. Further, the deviation has been applied since previous verifications. Therefore, the deviation is accepted by the verification team.

3.4 Grouped Project

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

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

On the basis of the online interviews and the reviewed project documentation, the verification team confirms that the project was implemented as described in the registered VCS PD version 3.1 except the deviations described above. All the physical components and project boundary are in conformity with the description in registered VCS PD version 3.1. The project activity was implemented in December 2009 and in operation since then. Based on the VCS PD and the available information at VCS database it is confirmed that the project's first crediting period is from 01/12/2009 – 30/11/2019.

The project activity involves capturing of methane generated from the wastewater treatment through UASB technology and covered lagoons. The captured methane (biogas) is utilized as fuel in thermal oil boilers replacing heavy fuel oil. However, PP has decided not to claim any emission reductions from fossil fuel replacement.

As per the applied methodologies; AMS-III.H, version 13, the project boundary is defined as below:

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

There are no methodology deviations. The project description deviations have been explained section 3.3 above.

TUV SUD confirms that the project is not part of any emissions trading program or any other mechanism that includes GHG allowance trading. Further, the project has not received or sought any other form of environmental credit or has become eligible to do so since validation or previous verification. It is also checked that the project has not participated or been rejected under any other GHG programs since validation or previous verification.

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

DATA/PARAM ETER Unit	Source of data	Reported value for the project period	Assessment/Observation
Global Warming Potential for Methane (GWP _{CH4}) in tCO _{2e} /tCH ₄	Data based on renewed PD /02/ and validation report /09/	25	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which was initially 21 as per the registered VCS-PD. However, as per the deviation applied in the previous verifications the value was updated to 25 as per IPCC fourth assessment report. Hence the value considered is appropriate.
Methane producing capacity of the wastewater (B _{0,ww}); kg CH ₄ /kg COD	Data based on registered PD /02/ and validation report /09/	0.21	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Model correction factor to account for model uncertainties (UF _{BL})	Data based on registered PD /02/ and validation report /09/	0.94	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Model correction factor to account for model uncertainties (UF _{PJ})	Data based on registered PD /02/ and validation report /09/	1.06	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.

Methane correction factor for baseline wastewater treatment systems i ($MCF_{ww,treatment, BLi}$)	Data based on registered PD and renewed /02/ and validation report /09/	0.8	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Methane correction factor for project wastewater treatment systems k equipped with biogas recovery equipment ($MCF_{ww,treatment, PJ,k}$)	Data based on registered PD /02/ and validation report /09/	0.8	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Methane correction factor for project wastewater treatment systems not equipped with biogas recovery ($MCF_{ww,treatment, PJ,lagoon}$)	Data based on registered PD /02/ and validation report /09/	0.8	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Methane correction factor based on discharge pathways in the project situation ($MCF_{ww,PJ,discharge}$)	Data based on registered PD /02/ and validation report /09/	0.8	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
Capture efficiency of the biogas recovery	Data based on registered PD /02/ and	0.9	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and

equipment in the wastewater treatment systems (CFE_{ww})	validation report /09/		validated by validation DOE to follow the applied methodology and tool /02/, /09/.
COD removal efficiency-baseline treatment for the starch and sweetener plants in ($\eta_{BL, starch}$); %	Data based on registered PD, /02/ and validation report /09/	98.61	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
COD removal efficiency-baseline treatment system for the ethanol plants ($\eta_{BL, ethanol}$); %	Data based on registered PD, /02/ and validation report /08/	87.76	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
η flare, m (FE)	Data based on registered PD, renewed PD /02/ and validation report /09/	50%	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.
CO ₂ emission factor for grid power (EF_v); tCO ₂ /MWh	Data based on registered PD, /02/ and validation report /09/	0.5057	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE.
Total electrical capacity of the equipment installed in the project activity (P_{el} ; kW)	Data based on registered PD /02/ and validation report /09/	245.1	The value is ex-ante fixed for 10 years crediting period as per the registered PD, which has been justified and validated by validation DOE to follow the applied methodology and tool /02/, /09/.

TUV SUD is able to confirm that the Data and Parameters fixed ex-ante have been implemented in full compliance with registered monitoring plan.

Data and Parameters monitored:

Data/Parameter	Assessment																			
Data Unit	$Q_{y,ww,starch}; m^3$																			
Description	Volume of wastewater treated in the year y from the starch plant																			
Source of data to be used	Measured – Volumetric flow meters-FM1																			
Value of monitored parameter for the monitoring period	Period		Value (m³)																	
	01/01/2019 to 30/11/2019		634,265																	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily logbook reports /11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.																			
Monitoring equipment	<table><tr><td colspan="5">Magnetic flow meter. The meter with tag FM1 measures the wastewater treated in the year y from the starch plant, entering to biogas system of the project.</td></tr><tr><td colspan="2">Serial number</td><td colspan="3">3K672016320307</td></tr><tr><td colspan="2">Model</td><td colspan="3">ABB. FEV11</td></tr></table>					Magnetic flow meter. The meter with tag FM1 measures the wastewater treated in the year y from the starch plant, entering to biogas system of the project.					Serial number		3K672016320307			Model		ABB. FEV11		
Magnetic flow meter. The meter with tag FM1 measures the wastewater treated in the year y from the starch plant, entering to biogas system of the project.																				
Serial number		3K672016320307																		
Model		ABB. FEV11																		
Accuracy of the monitoring equipment	PP has installed electromagnetic flow meter with an accuracy class of 0.4% respectively. The accuracy of the meters represents good monitoring practice.																			
Measuring/Reading/Recording frequency	Continuous monitoring, record on the daily basis. The practice found to be followed in the log records during the online interviews and consistent with registered monitoring plan.																			
Calculation method (if applicable)	N/A																			
Calibration																				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years, this is also consistent with registered monitoring plan and the previous verifications. Hence accepted.																			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	Se.no	Accuracy	Calibration dates	Calibration entity	Does it cover															

					<i>the MP</i>
	3K672016320 307	0.4%	05/03/20 18	MIT	yes
Calibration certificates	Please refer above				
Does the calibration of meters have be done by an accredited person or institution?	(MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI) /13/				

Data/Parameter	Assessment		
Data Unit	$Q_{y,ww,sweetner}; m^3$		
Description	Volume of wastewater treated in the year y from the sweetener plant		
Source of data to be used	Measured – Volumetric flow meters-FM2		
Value of monitored parameter for the monitoring period	Period	Value (m³)	
		Lower	Higher
	01/01/2019 to 30/11/2019	384,607	392,861
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	Magnetic flow meter. The meter with tag FM2 measures the wastewater treated in the year y from the sweetener plant, entering to biogas system of the project.		
	Serial number	6201472	
	Model	M4Q4	
	New meter		
	Serial number	3K672017130820	
	Model	FEP31150A1D1D2B1A1-AOA1A1C1AYH1JNM5	
Accuracy of the monitoring equipment	PP has installed electromagnetic flow meter with an accuracy class of 0.4% respectively. The accuracy of the meters represents good monitoring practice.		
Measuring/Reading/Recording frequency	Continuous monitoring, record on the daily basis. The practice found to be followed in the log records during online interviews and consistent with registered monitoring plan.		

Calculation method (if applicable)	N/A																			
Calibration																				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years, this is also consistent with registered monitoring plan and the previous verifications. Hence accepted.																			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	During the desk review and interactions with the PP, It was noted that old meter was replaced and a new meter was in place from 01/05/2019. The same was also checked from the log records /11/ and confirmed. However, the new meter was calibrated only on 14/05/2020 /12/ and thus PP has applied the maximum error in the ER calculations for the calibration gap period i.e. from 01/05/2019 until 30/11/2019. <table><tr><td>Se.no</td><td>Accur acy</td><td>Calibrati on dates</td><td>Calibra tion entity</td><td>Do es it cov er the MP</td></tr><tr><td>62014720</td><td>0.35 %</td><td>26/12/ 2017</td><td>MIT</td><td>NO</td></tr><tr><td>3K672017130820720 16320307</td><td>0.4%</td><td>14/05/ 2020</td><td>MIT</td><td>NO</td></tr></table>					Se.no	Accur acy	Calibrati on dates	Calibra tion entity	Do es it cov er the MP	62014720	0.35 %	26/12/ 2017	MIT	NO	3K672017130820720 16320307	0.4%	14/05/ 2020	MIT	NO
Se.no	Accur acy	Calibrati on dates	Calibra tion entity	Do es it cov er the MP																
62014720	0.35 %	26/12/ 2017	MIT	NO																
3K672017130820720 16320307	0.4%	14/05/ 2020	MIT	NO																
Calibration certificates	Please refer above																			
Does the calibration of meters have be done by an accredited person or institution?	(MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI) /13/.																			

Data/Parameter	Assessment
Data Unit	$Q_{y,ww,ethanol}; m^3$

Description	Volume of wastewater treated in the year y from the ethanol plant																			
Source of data to be used	Measured – Volumetric flow meters-FM2																			
Value of monitored parameter for the monitoring period	Period		Value (m³)																	
	01/01/2019 to 30/11/2019		337,361																	
	The values mentioned in the monitoring report and ER sheet have been verified with the daily log book reports /11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.																			
Monitoring equipment	<table><tr><td colspan="5">Magnetic flow meter. The meter with tag FM3 measures the wastewater treated in the year y from the sweetener plant, entering to biogas system of the project.</td></tr><tr><td colspan="2">Serial number</td><td colspan="3">3K672018091156</td></tr><tr><td colspan="2">Model</td><td colspan="3">FEP31150A1D1D2B1A-1A1C1AYH1M5</td></tr></table>					Magnetic flow meter. The meter with tag FM3 measures the wastewater treated in the year y from the sweetener plant, entering to biogas system of the project.					Serial number		3K672018091156			Model		FEP31150A1D1D2B1A-1A1C1AYH1M5		
Magnetic flow meter. The meter with tag FM3 measures the wastewater treated in the year y from the sweetener plant, entering to biogas system of the project.																				
Serial number		3K672018091156																		
Model		FEP31150A1D1D2B1A-1A1C1AYH1M5																		
Accuracy of the monitoring equipment	PP has installed electromagnetic flow meter with an accuracy class of 0.40% respectively. The accuracy of the meters represents good monitoring practice.																			
Measuring/Reading/Recording frequency	Continuous monitoring, record on the daily basis. The practice found to be followed in the log records during the online interviews and consistent with registered monitoring plan.																			
Calculation method (if applicable)	N/A																			
Calibration																				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	The flow meter is calibrated at least once every 3 years, this is also consistent with registered monitoring plan and the previous verifications. Hence accepted.																			
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	The calibration covers the current MP /12/.																			
	Se.no	Accuracy	Calibration dates	Calibration entity	Does it cover the MP															

	3K672018091 156	0.40%	08/03/20 18	ABB	yes
Calibration certificates	Please refer above				
Does the calibration of meters have be done by an accredited person or institution?	ABB is the manufacturer of the flow meter and a credible entity to calibrate the meter.				

Data/Parameter	Assessment		
Data Unit	COD _{y,ww,untreated,starch} ; mg/l		
Description	COD of wastewater from starch plant before entering CL1 : CS1		
Source of data to be used	Measured-Close Reflux Titrimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	01/01/2019 to 30/11/2019	13,227	16,594
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports checked by biogas plant supervisor and approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	It is checked that the COD content was analyzed using the Close Reflux Titrimetric method.		
Accuracy of the monitoring equipment	N/A		
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis and reported to Biogas plant in charge. The Biogas Supervisor checks the values and enters the data in excel sheet. Hard copies of the log books are stored and excel sheets along with the log records are sent to Swiss Carbon Value for ER calculations.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval	N/A		
Is the calibration interval in line with the monitoring plan of the PD?			

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A
Calibration certificates	N/A
Does the calibration of meters have to be done by an accredited person or institution?	N/A

Data/Parameter	Assessment		
Data Unit	COD _{y,ww,untreated,sweetner} ; mg/l		
Description	COD of wastewater from starch plant before entering CL2 : CS2		
Source of data to be used	Measured-Close Reflux Titrimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	01/01/2019 to 30/11/2019	5,972	9,112
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports checked by biogas plant supervisor and approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	It is checked that the COD content was analyzed using the Close Reflux Titrimetric method.		
Accuracy of the monitoring equipment	N/A		
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis and reported to Biogas plant in charge. The Biogas Supervisor checks the values and enters the data in excel sheet. Hard copies of the log books are stored and excel sheets along with the log records are sent to Swiss Carbon Value for ER calculations.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A		

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A
Calibration certificates	N/A
Does the calibration of meters have to be done by an accredited person or institution?	N/A

Data/Parameter	Assessment		
Data Unit	COD _{y,ww,untreated,Ethanol} ; mg/l		
Description	COD of wastewater from starch plant before entering CL3 : CS3		
Source of data to be used	Measured-Close Reflux Titrimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	01/01/2019 to 30/11/2019	48,327	56,170
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports checked by biogas plant supervisor and approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	It is checked that the COD content was analyzed using the Close Reflux Titrimetric method.		
Accuracy of the monitoring equipment	N/A		
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis and reported to Biogas plant in charge. The Biogas Supervisor checks the values and enters the data in excel sheet. Hard copies of the log books are stored and excel sheets along with the log records are sent to Swiss Carbon Value for ER calculations.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A		

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A
Calibration certificates	N/A
Does the calibration of meters have to be done by an accredited person or institution?	N/A

Data/Parameter	Assessment		
Data Unit	COD _{y,ww,treated,CL2} ; mg/l		
Description	COD of wastewater exiting the covered lagoon 2 treatment process : CS4		
Source of data to be used	Measured-Close Reflux Titrimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	01/01/2019 to 30/11/2019	2,659	4,365
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports checked by biogas plant supervisor and approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	It is checked that the COD content was analyzed using the Close Reflux Titrimetric method.		
Accuracy of the monitoring equipment	N/A		
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis and reported to Biogas plant in charge. The Biogas Supervisor checks the values and enters the data in excel sheet. Hard copies of the log books are stored and excel sheets along with the log records are sent to Swiss Carbon Value for ER calculations.		
Calculation method (if applicable)	N/A.		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A		
Does the calibration cover the monitoring period?	N/A		

Has the calibration frequency been respected?	
Calibration certificates	N/A
Does the calibration of meters have been done by an accredited person or institution?	N/A

Data/Parameter	Assessment		
Data Unit	COD _{y,ww,treated,CL3} ; mg/l		
Description	COD of wastewater exiting the covered lagoon 3 treatment process: CS5		
Source of data to be used	Measured-Close Reflux Titrimetric method		
Value of monitored parameter for the monitoring period	Period	Value	
		Lower	Higher
	01/01/2019 to 30/11/2019	944	1,964
	The values mentioned in the monitoring report and ER sheet have been verified with the daily reports checked by biogas plant supervisor and approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.		
Monitoring equipment	It is checked that the COD content was analyzed using the Close Reflux Titrimetric method.		
Accuracy of the monitoring equipment	N/A		
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis and reported to Biogas plant in charge. The Biogas Supervisor checks the values and enters the data in excel sheet. Hard copies of the logbooks are stored and excel sheets along with the log records are sent to Swiss Carbon Value for ER calculations.		
Calculation method (if applicable)	N/A		
Calibration			
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A		

Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A
Calibration certificates	N/A
Does the calibration of meters have to be done by an accredited person or institution?	N/A

Data/Parameter	Assessment										
Data Unit	W _{CH4} ; %										
Description	Methane content in the biogas in the year y										
Source of data to be used	Measured – Online Gas analyzer system to monitor % of methane in biogas										
Value of monitored parameter for the monitoring period	<table border="1"> <tr> <th>Period</th><th>Value (%)</th></tr> <tr> <td>01/01/2019 to 30/11/2019</td><td>59.17%</td></tr> </table> The values mentioned in the monitoring report and ER sheet have been verified with the daily reports approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.	Period	Value (%)	01/01/2019 to 30/11/2019	59.17%						
Period	Value (%)										
01/01/2019 to 30/11/2019	59.17%										
Monitoring equipment	<table border="1"> <tr> <td colspan="2">The infrared gas analyzer</td></tr> <tr> <td>Serial number</td><td>96159</td></tr> <tr> <td>Model</td><td>INCA 4002 T099-01</td></tr> <tr> <td>Manufacturer</td><td>ABB</td></tr> <tr> <td>Accuracy</td><td>1%</td></tr> </table>	The infrared gas analyzer		Serial number	96159	Model	INCA 4002 T099-01	Manufacturer	ABB	Accuracy	1%
The infrared gas analyzer											
Serial number	96159										
Model	INCA 4002 T099-01										
Manufacturer	ABB										
Accuracy	1%										
Accuracy of the monitoring equipment	Please refer above. The same was confirmed during the online interviews										
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis 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 found to be followed during the online interviews and consistent with registered monitoring plan.										
Calculation method (if applicable)	N/A.										
Calibration											

Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Once in every three years, which is as per the registered monitoring plan.	
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	The monitoring period is from 01/01/2019 to 30/11/2019. The calibration frequency is once in 3 years. The calibration covers the entire MP, which is valid until 13/03/2020.	
Calibration certificates	Se. no.	Calibration details
	96159	By AWJ Innovation Co. Ltd.: Calibration date on 14/03/2017 /12/
Does the calibration of meters have to be done by an accredited person or institution?	AWJ Innovation Co. Ltd. is credible to calibrate gas analysers (https://www.awj.co.th/service%20%20calibration.html) /14/	

Data/Parameter	Assessment				
Data Unit	BG combusted,y				
Description	Amount of biogas combusted for gainful use in the year y				
Source of data to be used	Measured – Biogas flow meters- GM1, GM2				
Value of monitored parameter for the monitoring period	Biogas sent to the boilers and gensets are continuously measured using flow meters GM1 and GM2. <table border="1"> <tr> <th>Period</th><th>Value (Nm³)</th></tr> <tr> <td>01/01/2019 to 30/11/2019</td><td>10,400,242</td></tr> </table> The above mentioned values are total of biogas sent to boilers and gensets. The values mentioned in the monitoring report and ER sheet have been verified with the daily reports approved by the Plant Manager/11/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.	Period	Value (Nm ³)	01/01/2019 to 30/11/2019	10,400,242
Period	Value (Nm ³)				
01/01/2019 to 30/11/2019	10,400,242				

Monitoring equipment	<table border="1"> <tr> <th colspan="2">Flow meter to boilers (GM1)</th></tr> <tr> <td>Serial number</td><td>503208</td></tr> <tr> <td>Model</td><td>ST51</td></tr> <tr> <td>Manufacturer</td><td>FCI</td></tr> <tr> <td>Accuracy</td><td>2%</td></tr> </table> <table border="1"> <tr> <th colspan="2">Flow meter to boilers (GM 2)</th></tr> <tr> <td>Serial number</td><td>630165</td></tr> <tr> <td>Model</td><td>ST51</td></tr> <tr> <td>Manufacturer</td><td>FCI</td></tr> <tr> <td>Accuracy</td><td>2%</td></tr> </table>	Flow meter to boilers (GM1)		Serial number	503208	Model	ST51	Manufacturer	FCI	Accuracy	2%	Flow meter to boilers (GM 2)		Serial number	630165	Model	ST51	Manufacturer	FCI	Accuracy	2%
Flow meter to boilers (GM1)																					
Serial number	503208																				
Model	ST51																				
Manufacturer	FCI																				
Accuracy	2%																				
Flow meter to boilers (GM 2)																					
Serial number	630165																				
Model	ST51																				
Manufacturer	FCI																				
Accuracy	2%																				
Accuracy of the monitoring equipment	Please refer above. The same was confirmed during the desk review.																				
Measuring/Reading/Recording frequency	Daily. The measured data is logged in daily basis 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 found to be followed during the online interviews and consistent with registered monitoring plan.																				
Calculation method (if applicable)	N/A.																				
Calibration																					
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	Once in every 3 years, which is as per the registered monitoring plan.																				
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	The monitoring period is from 01/01/2019 to 30/11/2019. The calibration frequency is once in three years. No calibration gap found, and the calibration covers the entire monitoring period.																				
Calibration certificates	<table border="1"> <tr> <th>Se. no.</th><th>Calibration details</th></tr> <tr> <td>503208</td><td>By Miracle International Technology Co. Ltd. dated 20/12/2017 /12/.</td></tr> <tr> <td>630165</td><td>By Miracle International Technology Co. Ltd. dated 12/11/2018 /12/.</td></tr> </table>	Se. no.	Calibration details	503208	By Miracle International Technology Co. Ltd. dated 20/12/2017 /12/.	630165	By Miracle International Technology Co. Ltd. dated 12/11/2018 /12/.														
Se. no.	Calibration details																				
503208	By Miracle International Technology Co. Ltd. dated 20/12/2017 /12/.																				
630165	By Miracle International Technology Co. Ltd. dated 12/11/2018 /12/.																				
Does the calibration of meters have to be done by an accredited person or institution?	Miracle International Technology Co. Ltd. is accredited to calibrate the flow meter /13/																				

Data/Parameter	Assessment				
Data Unit	EC _y ; Mwh/y				
Description	Quantity of electricity consumed by the wastewater treatment system and biogas plant in year y				
Source of data to be used	The electricity consumed by the project is calculated based on the maximum rated consumption (multiplying total electrical capacity with 8760 hours and 10% additional factor to be conservative).				
Value of monitored parameter for the monitoring period	<table border="1"> <tr> <th>Period</th><th>Value in Mwh</th></tr> <tr> <td>01/01/2019 to 30/11/2019</td><td>2,167</td></tr> </table>	Period	Value in Mwh	01/01/2019 to 30/11/2019	2,167
Period	Value in Mwh				
01/01/2019 to 30/11/2019	2,167				
Monitoring equipment	N/A				
Accuracy of the monitoring equipment	N/A				
Measuring/Reading/Recording frequency	N/A				
Calculation method (if applicable)	Since there was no electric meter for the electricity consumption of project activity, maximum rated consumption was used to calculate the emissions from PE _{power, y} . This approach has taken into account the distribution losses of 10% and the calculation is based on an assumption that the electrical appliances are running at full capacity for 8,760 hours per year, the QA/QC aspect has already been assured.				
Calibration					
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PD?	N/A				
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A				
Calibration certificates	N/A				
Does the calibration of meters have to be done by an accredited person or institution?	N/A				

4.2 Safeguards

4.2.1 No Net Harm

The project involves wastewater treatment from starch, sweetener and ethanol plant. The biogas captured from the treatment system is used replacing the HFO from boilers. Thus, the project avoids methane and CO₂ emissions. Thus, the project will not result in negative environmental impacts. Moreover, the project has positive socio- economic impacts by creating jobs to the villagers and supporting the locals by many several CSR activities. The same was confirmed by interviewing the project owner and local villagers.

4.2.2 Local Stakeholder Consultation

Noted that no stakeholder comments were received. It is checked that the plant maintains a grievance register to records the comments received from locals. However, no such comments were recorded. The same was checked against the grievance register and cross checked with stakeholders interviewed. Summarize any stakeholder input received during ongoing communication with local stakeholders.

4.3 AFOLU-Specific Safeguards

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

4.4 Accuracy of GHG Emission Reduction and Removal Calculations

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

The emission reduction due to methane capturing and utilization in onsite boilers was estimated by measuring the required parameters using appropriate monitoring equipment and using the formulae described in the methodologies; AMS III.H., version 18 and the VCS PD. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 4.1 of this report. It is confirmed that all the ex-ante parameters have been correctly used in the emission reduction calculation. According to the applied methodologies, the conservativeness of the achieved emission reduction was checked, and the calculation has been transparently provided in the ER sheet.

Baseline Emissions:

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

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

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

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

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

Parameter	Details	Quantification
$BE_{ww,treatment,y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO ₂ e)	01/01/2019 to 30/11/2019 = 98,090
$Q_{ww,i,y}$	Volume of wastewater treated in baseline wastewater treatment system i in year y (m ³)	01/01/2019 to 30/11/2019 = 1,353,673
$COD_{inflow,i,y}$	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)	01/01/2019 to 30/11/2019 = 0.027
$\eta_{COD,BL,i}$	COD removal efficiency of the baseline treatment system i	$\eta_{BL,starch}$ 01/01/2019 to 30/11/2019 = 98.61% $\eta_{BL,ethanol}$ 01/01/2019 to 30/11/2019 = 87.76%
$MCF_{ww,treatment,BL,i}$	Methane correction factor for the baseline treatment system i	0.8
i	Index for baseline wastewater treatment system	-
$B_{o,ww}$	Methane producing capacity of the wastewater	0.21

Parameter	Details	Quantification
UF_{BL}	Model correction factor to account for model uncertainties	0.94
GWP_{CH4}	Global Warming Potential for methane	25

According to the paragraph 31 of AMS-III.H, version 13, emission reduction achieved by the project activity is limited to the ex-post calculated baseline emissions minus project emission using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

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

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

$$MD_y = BG_{bunt,y} * W_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$$

As per the registered VCS PD, the alternative MD_y value is deviated from the approved methodology and can be calculated as follows:

$$MD_y = W_{CH4,y} * D_{CH4} * GWP_{CH4} * [(BG_{to\ flare,y} * FE) + (BG_{combusted,y} * DE)]$$

Parameter	Details	Quantification
MD_y	Methane captured and destroyed/gainfully used by the project activity in the year y (tCO ₂ e)	01/01/2019 to 30/11/2019 = 110,159
$W_{CH4,y}$	Methane content in the biogas in the year y (mass fraction)	01/01/2019 to 30/11/2019 = 59.17%
D_{CH4}	Density of methane at the temperature and pressure of the biogas in the year y (tonnes/m ³)	0.0007
GWP_{CH4}	Methane producing capacity of the wastewater	25
$BG_{to\ flare,y}$	Biogas sent to flared in year y (Nm ³)	0
$BG_{combusted,y}$	Biogas volume in year (consumption between	01/01/2019 to 30/11/2019 = 10,400,242

	<i>biogas flared and utilized for gainful use) (Nm³)</i>	
$\eta_{\text{flare},m}/FE$	Flare efficiency in year y	0%

Project Emissions:

Project emissions related to methane avoidance component as per AMS-III.H, version 13 is calculated as below:

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

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

$$PE_{\text{power},y} = EC_{PJ,j,y} * EF_y$$

Parameter	Details	Quantification
PE_y	Project activity emissions in year y (tCO ₂ e)	01/01/2019 to 30/11/2019 = 38,352
$PE_{\text{power},y}$	Emissions from electricity or fuel consumption in the year y (tCO ₂ e)	01/01/2019 to 30/11/2019 = 1,097
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr).	01/01/2019 to 30/11/2019 = 2,167
EF_y	Thailand National Grid Emission Factor (tCO ₂ e/MWh)	0.5057

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

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

$$PE_{\text{ww,treatment},y} = \sum (Q_{\text{ww},y} * COD_{\text{removed},PJ,\text{lagoon},y} * MCF_{\text{ww,treatment},PJ,k} * B_{o,\text{ww}} * UF_{PJ} * GWP_{\text{CH}_4})$$

Parameter	Details	Quantification
$PE_{ww, treatment, y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation (tCO ₂ e)	01/01/2019 to 30/11/2019 = 24,141
$Q_{ww, k, y}$	Volume of wastewater treated in project wastewater treatment system k in year y (m ³)	01/01/2019 to 30/11/2019 = 1,361,927
$COD_{removed, PJ, lagoon, y}$	Chemical oxygen demand removed by project secondary wastewater treatment system in year y (tonnes/m ³), calculated as $COD_{inflow, lagoon}(CS4)$ minus $COD_{outflow, lagoon}(CS5)$	01/01/2019 to 30/11/2019 = 0.0041
$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.21 kg CH ₄ /kg COD)	0.21
$MCF_{ww, treatment, PJ, k}$	Methane correction factor for the project wastewater treatment system k	0.80
UF_{PJ}	Model correction factor to account for model uncertainties	1.06
GWP_{CH_4}	Global Warming Potential for methane	25

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

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

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

$$PE_{fugitive,ww,y} = (1 - CEF_{ww,y}) * MEP_{ww,treatment,y} * GWP_{CH_4}$$

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

Where:

Parameter	Details	Quantification
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year y (tCO _{2e})	01/01/2019 to 30/11/2019 = 13,114
$PE_{fugitive,ww,y}$	Fugitive emission through capture inefficiencies in the anaerobic wastewater treatment in the year y (tCO _{2e})	01/01/2019 to 30/11/2019 = 13,114
$PE_{fugitive,s,y}$	Fugitive emission through capture inefficiencies in the anaerobic sludge treatment in the year y (tCO _{2e})	There is no sludge treatment in the project activity.

$CFE_{ww,y}$	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	0.9 (default value)
$COD_{removed, PJ, k, y}$	The chemical oxygen demand removed by the treatment system k of the project activity equipped with biogas recovery in the year y (tonnes/ m^3) calculated as; $K = CL2$: $COD_{removed, PJ, CL2, y} = COD_{ww, untreated, y, starch / sweetener / ethanol} - COD_{loadout, PJ, CL2, y}$	01/01/2019 to 30/11/2019 = 0.025
$MEP_{ww, treatment, y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (t)	01/01/2019 to 30/11/2019 = 5,245

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

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

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

Leakage Emissions

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

Emission Reductions:

$$\begin{aligned}
 ER_{y,ex\ post} &= \min((BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{power,y} - LE_{y,ex\ post})) \\
 &= \min(59,738), (109,062) \\
 &= 59,738 \text{ tCO}_2\text{e}
 \end{aligned}$$

4.5 Quality of Evidence to Determine GHG Emission Reductions and Removals

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

All records needed for monitoring are archived in line with the requirements of the registered monitoring plan. No significant, lack of evidence and missing data were detected during onsite verification. Hence, the verification team confirms that the monitoring system ensures required quality of the monitoring system to ensure the quality of the monitored data. All internal data are subjected to QA/QC measures. All the roles and responsibilities for monitoring and reporting have been clearly defined. Based on document review /01/ to /14/ and interview, it was found that the management and operational structure is in line with that stated in the registered monitoring plan.

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

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

TUV SUD's is of the opinion that this method of estimation is accurate and results in conservative estimation of emission reduction and is line with the applicable VCS requirements.

4.6 Non-Permanence Risk Analysis

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

5 VERIFICATION CONCLUSION

TÜV SÜD South Asia Pvt. Ltd has performed verification of the emission reductions reported for the project activity “P.S.C Starch Wastewater Treatment and Biogas Utilization Project” in Thailand, VCS Registry Project ID 417, for the period 01/01/2019 to 30/11/2019, with regard to the relevant requirements for VCS activities. The project participants of the “P.S.C Starch Wastewater Treatment and Biogas Utilization Project ” project are responsible for:

- the preparation of greenhouses gas emissions data and the reported greenhouse gas emission reductions from the project on the basis set out in the monitoring plan contained in the registered VCS PD, version 03.1 of 18/11/2009.*
- the development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of greenhouse gas emission reductions of the project.*

It is the responsibility of TÜV SÜD to express an independent verification opinion about the project’s conformity with the requirements of VCS Standard version 4.0 and GHG program applied, on the reported greenhouse gas emission reductions from the project.

Based on documented evidence and corroborated by an online interviews with stakeholders, TUV SUD can confirm that:

- the project has been implemented and operated as per the registered VCS-PD;*
- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable VCS Standard version 4.0 and program guide v4.0;*
- the monitoring is in place as per the applied baseline and monitoring methodology;*
- the monitoring plan in the registered VCS-PD is as per the applied baseline and monitoring methodology.*

It is TÜV SÜD’s opinion that the GHG emission reduction stated in the monitoring report version 02 of 09/06/2020 for the “P.S.C Starch Wastewater Treatment and Biogas Utilization Project” in Thailand for the period 01/01/2019 to 30/11/2019 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology CDM Executive Board: AMS-III.H ‘Methane Recovery in Wastewater

Treatment' version 13 of 17/07/2009 and the monitoring plan contained in the registered VCS-PD.

Hence TUV SUD is able to certify that the emission reduction from the project during the verification period: From 01/01/2019 to 30/11/2019

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)
01/01/2019 to 30/11/2019	98,090	38,352	0	59,738
Total	98,090	38,352	0	59,738

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

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

FAR ID	N/A	Section no.	2.5.1	Date: 16/05/2020
Description of FAR				
<i>No FARs raised in the previous verification, which needs to be addressed.</i>				
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.	4.1	Date: 16/05/2020
Description of CL				
1. It is checked that the FM2 was changed on 01/05/2019. PP is requested to provide the meter and calibration details of FM2 in the MR and provide supporting evidences for the same. 2. The FM3 meter details provided in the MR is not consistent with the meter details provided in the previous verification report. PP is requested to clarify the meters involved in the current MP and supporting evidences for the same. 3. It is noted that the COD measurements (higher and lower) for wastewater exiting the outlet of CL2 provided in the MR is not consistent with the ER sheets and COD log sheets provided.				
Project participant response				Date: 09/06/2020

1. The pictures of the meters have been submitted for the reference. The specification of the meter can be access through this [link](#) and the calibration certificate has been provided as attachment; Att01.
2. The meter which has been mentioned in the MR version 1 was the meter which has been implemented in the beginning of 2018. It was replaced by another flow meter which has been verified during previous version; ABB with s/n 3K672018091156. The information of the meter has now been updated and it is now consistent with the meter implemented at the project site. Please see the updated MR along with submitted .pptx file of meter pictures.
3. The values of COD measurements exiting the outlet of CL2 (higher and lower) have been updated with the correct information. Please see the update MR version 2.0.

Documentation provided by project participant

VCS417P.SC_MR_MP01012019-30112019_WWT_TH_v.2.0_09062020

Att01 Calibration Certificates

DOE assessment

Date: 10/06/2020

1. Meter calibration certificate of FM2 , dated 14/05/2020 by MIT has been provided. The same has been crosschecked with the meter details at the site and confirmed to be appropriate.
2. The FM3 meter details has been corrected in the revised MR and the same is consistent with the previous verification report, calibration certificate and the meter details available at the site.
3. The values of COD measurements exiting the outlet of CL2 has been corrected in the revised MR.

Based on the above justifications CL 1 is closed.

CL ID	02	Section no.	4.4	Date:	16/05/2020
Description of CL					
1. It is checked that the format for the log sheets provided by from 01/01/2019 until 31/03/2019 is different from the log sheets from April 2019. The first three months log sheets from Jan until March 2019 doesn't have few parameters like COD, WCH4. 2. PP is also requested to provide log sheets for the day 01/12/2019 for all the monitored parameters. 3. It is checked that the for the month of August 2019, the ER spread sheets states data package incomplete and ignore the value. However, during the discussions with PP, it is understood that there was no wastewater generated during this period since the starch plant was shut for maintenance. PP is requested to provide the records for plant shutdown and maintenance to cross check the same. 4. PP is requested correct the operation days in the ER sheet and provide evidence for the same.					

Project participant response		Date: 09/06/2020
1. The log sheet of COD and WCH4 covering monitoring period from 01/01/2019 to 31/03/2019 have been prepared. Please see Att02. 2. The log sheet of December 2019 has also been provided within folder Att02. 3. PP has updated the comment in ER calculation sheet. The data has been ignored due to the maintenance of the starch plant in August 2019. 4. The operation days of the starch plant has been updated. This information is in lined with the monitoring days which has been counted for emission reduction calculation. Please refer to the log sheet for the operation days of the plant.		
Documentation provided by project participant		
<i>Att02 Log sheet – additional</i>		
DOE assessment		Date: 10/06/2020
1. Log sheets of COD and WCH4 from January 2019 until March 2019 has been provided and the same is found to be consistent with the ER sheets. 2. Log sheets for 01/12/2019 has been provided and the same is confirmed to be inconsistent with the ER sheets. 3. The ER sheets have been updated. Noted that there was no waste flow from FM1 for the months of August, September and partly in October. The same has been confirmed from the log sheets. 4. Operational days in the ER spread sheets has been corrected as per the days considered in ER sheets. The same is accepted since it is conservative. Based on the above justifications, CL2 is closed.		

Table 3. CAR from this verification

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

DOE assessment	Date: dd/mm/yyyy

Table 4. FAR from this verification

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