PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Wastewater Treatment and Biogas Recovery Project, SDDPL, Baramati, Maharashtra, India.

Version 1.0

Date of PCN: 02/03/2024

First CoU Issuance Period: 10 years, 00 months

Date: 01/01/2014 to 31/12/2023

Project Concept Note (PCN)
CARBON OFFSET UNIT (CoU) PROJECT

BASIC INFORMATION	
Title of the project activity	Wastewater Treatment and Biogas Recovery Project, SDDPL,Baramati, Maharashtra, India.
Scale of the project activity	Small Scale
Completion date of the PCN	02/03/2024
Project participants	Project Proponent: Schreiber Dynamix Dairies Private Ltd. (SDDPL),Baramati, Maharashtra, India.
Host Party	India
Applied methodologies and standardized baselines	Type I (Renewable Energy Projects) UNFCCC Methodology Category AMS III. H: Methodology for methane recovery in wastewater treatment. version 19 AMS-I.C: Methodology for Thermal energy production with or without electricity version 22 UCR Protocol Standard Baseline Emission Factor
Sectoral scopes	01 Energy industries (Renewable / Non-renewable Sources)
Estimated amount of total GHG emission reductions per year	14,775 CoUs/yr (14,775 tCO_{2eq}/yr)

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The project activity **Wastewater Treatment and Biogas Recovery Project, SDDPL, Baramati, Maharashtra, India**, is located in E-94, MIDC, Bhigwan Road, Baramati, District. Pune, State Maharashtra, Country India - 413133.

The details of the registered project are as follows:

Schreiber Dynamix Dairies Pvt. Ltd., (SDDPL) a fully integrated dairy industry is located at Baramati in the state of Maharashtra, India. The daily processing capacity of plant is 800,000 - 1,600,000 liters of milk/day which is sourced from surrounding districts. It produces various dairy products through superior technology and process. The products include cheese, butter, ghee, casein, skimmed milk powder, dairy whitener, lactose, whey protein concentrate, whey powder and juices (milk and fruit) in aseptic packing.

The PP has the full ownership of the project activity. This project is an operational activity with continuous reduction of GHGs, currently being applied under "Universal Carbon Registry" (UCR).

In June 2015, under Section 18 of the Companies Act 2013, Schreiber Dynamix Dairy Limited was changed into Schreiber Dynamix Dairy Private Limited (SDDPL).

Purpose of the project activity:
While manufacturing of above products the wastewater is generated in two streams:
1. Wastewater generated through processing of milk, yogurt, and other dairy products
2. Wastewater generated from production of dairy products such as cheese and casein.

Pre-project activity scenario:

(i) Wastewater generated through processing of milk, yogurt, and other dairy products: This wastewater is having the organic load, COD in the range of 3,500 mg/liter to 6,000 mg/liter and treated in the existing 4,500 m3/day Wastewater Treatment Plant (WWTP). The wastewater is treated with anaerobic as well as aerobic treatment. The biogas generated from anaerobic treatment through 5 nos. of anaerobic digesters is captured and flared in the atmosphere in the baseline scenario.

(ii) Wastewater generated from production of dairy products such as cheese and casein: This wastewater is having the organic load, COD in the range of 250,000 mg/liter to 390,000 mg/liter and is treated in the existing anaerobic deep lagoons without methane recovery.

Project Activity scenario:

(i) Wastewater generated through processing of milk, yogurt and other dairy products will continue to be treated in the existing 4,500 m3/day Wastewater Treatment Plant (WWTP). The biogas generated from anaerobic treatment is captured and will be used to fire in the retrofitted boilers with dual fuel burner.

(ii) The wastewater generated from production of dairy products such as cheese and casein. A by product called 'whey' is generated during manufacturing of these products. During Lactose recovery from whey, Mother Liquor (De-Lactose Permeate (DLP)) is generated. Mother liquor has a typical characteristic of 95.62% organic matter having organic load, COD in the range of 250,000 mg/liter to 390,000 mg/liter. This mother liquor is treated in a specially designed RCC constructed anaerobic treatment plant - Mother Liquor Treatment Plant (MLTP) with methane recovery.

(iii) Post recovery of methane, additional treatment on mother liquor is needed due to its high organic load. Therefore, it is further treated in the existing 4,500 m3/day WWTP. Outlets from MLTP get mixed with other stream of wastewater at equalization tank and treated in 4,500 m3/day WWTP.

(iv) The biogas generated from four anaerobic digesters of 4,500 m3/day WWTP, two anaerobic digesters of 45 m3/day MLTP will be captured and fired in the existing retrofitted boiler RFB 60, SM140.1 & SM140.2 (SM140.1 and SM140.2 which are stand-by boilers for RFB 60. The generated biogas is used exclusively in RFB-60 boiler.)

The purpose of the project activity is to install anaerobic digesters for primary treatment of this wastewater (namely Mother Liquor) and subsequently recovering methane rich biogas generated during the process at Schreiber Dynamix Dairies Pvt. Ltd. And the recovered biogas will be used in retrofitted boilers replacing equivalent quantity of FO (Furnace Oil).

Green House Gas Reduction:

The reduction in greenhouse gas emissions took in two ways,

1. The flow of Mother Liquor is fed to closed anaerobic digesters. Thus, it prevents methane (CH_4) emissions into the atmosphere.
2. Generated biogas from 45 m3/day MLTP as well as existing 4,500 m3/day WWTP is being used in retrofitted boilers replacing equivalent quantity of FO (Furnace Oil)/LSHS (Low Sulphur Heavy Stock). This will reduce carbon dioxide (CO_2) emissions to the atmosphere by reducing the amount of FO burning in the respective boiler.

Description of project activity:

Proposed project activity involves treatment of mother liquor through following major stages:
1) Mother Liquor Treatment with anaerobic digesters. Waste Water Treatment Plant SDDPL Plant Waste Water Treatment Plant.
2) Biogas Generation, Capture and Transfer to Boilers.
3) Utilization of biogas in boilers as a fuel for partial displacement of furnace oil.
4) Treatment on waste water generated from mother liquor treatment plant

Each of the above stages of the project activity is briefly explained below:

1. **Mother Liquor Treatment with Anaerobic Digesters**:

   Mother Liquor (ML) undergoes several stages in its treatment process:

   1. **Reception and Storage**: Initially, ML is received in a storage tank.
   2. **Intermediate Storage**: It is then transferred to an intermediate storage tank.
   3. **Buffer Tank**: In the buffer tank, ML is mixed with hydrated lime or soda ash to adjust the pH from the initial range of 3-4 to a neutral level.
   4. **Overflow to Digester Feed Sump**: The overflow from the buffer tank enters the digester feed sump.
   5. **Anaerobic Digesters**: Neutralized ML is subsequently pumped into two anaerobic digesters. These digesters are specially designed with reinforced cement concrete (RCC) to handle the low pH of the Mother Liquor.
   6. **Biogas Recovery**: The digesters are equipped with special media to enhance the recovery of biogas from the Mother Liquor.

   This process ensures efficient degradation of organic matter while managing the unique characteristics of the Mother Liquor.

2. **Biogas Generation, Capture and Transfer**

   Biogas Production and Utilization Process:

   1. **Generation by Methanogenic Bacteria**: Biogas is produced through the decomposition of organic matter by methanogenic bacteria. This process results in approximately 80% reduction in Chemical Oxygen Demand (COD).
   2. **Collection and Storage**:
      - The biogas generated is first collected in the top dome of anaerobic digesters.
      - From there, it is conveyed to a Gasholder (GH) via a knock-out drum.

3. **Retention Time in Gasholder**:
    - The GH provides a one-hour retention time. This ensures that any fluctuations in gas generation do not adversely affect downstream gas utilization.
4. **Pressurization and Transfer**:
    - The collected biogas is then pressurized using blowers.
    - It is transferred to boilers for consumption.

These boilers are located approximately 800 meters away from the GH.

5. **Moisture Removal**:
    - To ensure clean and efficient utilization, moisture traps are installed on the biogas line.
    - This process removes moisture, resulting in dry and clean biogas suitable for use as a fuel.

3. Utilization of biogas in boilers for partial displacement of coal or furnace oil, in steam generation

1. **Dual Fuel Burner System**:
    - The pressurized biogas is received at a knock-out drum installed at the boiler house.
    - It is then fed to the boilers through a dual fuel burner system.
    - This system allows both fuels biogas and furnace oil (FO) to be fired simultaneously.
    - The quantities of each fuel are controlled during combustion.
2. **Burner Replacement**:
    - The old furnace oil-fired boiler burners have been replaced with advanced imported dual fuel burners.
    - These new burners are designed for combustion of both furnace oil and biogas in all the boilers.
    - The dual fuel burners feature a fully automated mechanism for precise monitoring and control of combustion parameters.

3. **Boiler Operation**:
    - RFB60 operates exclusively on biogas.
    - The steam generated from this biogas-fired boiler is fed to the plant.
    - RFB60 meets approximately 6-8% of the daily steam consumption required for plant operation.
    - SM140.1 and SM140.2 which are stand-by boilers for RFB 60.
4. **Reducing CO2 Emissions**:
    - The steam generated through the biogas-fired boilers significantly reduces equivalent CO2 emissions.
    - Without biogas utilization, this CO2 would have been generated from the FO-fired boilers.
    - By using biogas, the total FO consumption is reduced by average 99%, resulting in substantial environmental benefits.

4. Treatment on wastewater generated from Mother Liquor Treatment Plant

1. **Mother Liquor Composition**:
    - The treated Mother Liquor (wastewater) from the digesters contains Chemical Oxygen Demand (COD) levels ranging from 5,000 to 8,000 mg/liter.
    - This Mother Liquor is then directed to an equalization tank within the existing Wastewater Treatment Plant (WWTP).
2. **Anaerobic Digestion**:
    - The Mother Liquor generated during the process undergoes treatment in a specially designed anaerobic digester.
    - This step ensures efficient breakdown of organic matter and stabilization of the wastewater.
3. **Integration with Existing Wastewater Flow**:
    - The treated Mother Liquor is then mixed with the existing wastewater flow.
    - This combined stream undergoes further treatment.
4. **Ozonization and Discharge**:
    - The final treated water, which includes the Mother Liquor, is subjected to ozonization.
    - After this treatment, the water is discharged from the system.

5. **Modified Boilers for Energy Recovery**:
   - The existing boilers have been modified to accommodate the firing of biogas generated from wastewater treatment and MLTP.
   - These boilers can now operate using a combination of biogas and Furnace Oil (FO) or Low Sulfur Heavy Stock (LSHS).
   - The steam produced by these boilers serves various plant needs.

By integrating these processes, the facility achieves efficient wastewater treatment, energy recovery, and environmental benefits.

The anticipated annual average emission reductions resulting from the project activity are estimated to be **14,775 tCO_2e/yr**. The actual emission reduction achieved during the initial CoU (crediting period) will be submitted as part of the first monitoring and verification process.

a) RFB 60 Boiler.

b) Gas Holder.

Project's Contribution to Sustainable Development

Social Well-Being: The project activity will create employment opportunities for both skilled and unskilled laborers involved in the operation and maintenance of the plant.

Economic Well-Being: The project activity aims to enhance the economic well-being of the local population by providing direct and indirect employment opportunities during the erection, commissioning, and subsequent operation and maintenance of the plant.

Environmental Well-Being: The project activity contributes to improving the local environment by effectively managing bad odors and proper disposal of wastewater. By avoiding direct release of mother liquor into the environment, it helps prevent public nuisance caused by flies and insects. Additionally, the project has both local and global environmental benefits. It reduces greenhouse gas emissions by avoiding methane release from wastewater and also decreases emissions of flue gases equivalent to the replaced fuel oil consumption in the boiler for steam generation. Overall, the project ensures environmental cleanliness through the treatment of COD-rich mother liquor.

Technological Well-Being: The project involves treating Mother Liquor and recovering biogas, which will be utilized in boilers for steam generation, displacing an equivalent amount of fuel oil consumption. By promoting such advanced technologies, the project facilitates their adoption in the region and the country. Furthermore, it provides an opportunity for SDDL employees to learn about and work with cutting-edge mother liquor treatment systems.

A.2 Do no harm or Impact test of the project activity>>

- **Project Objective:** The primary objective of this project is to treat wastewater, specifically the Mother Liquor, and recover methane-rich biogas during the treatment process.

- **Process Overview:**

  1. **Wastewater Treatment:** The project involves treating the Mother Liquor, which is a type of wastewater.
  2. **Biogas Recovery:** During the treatment process, methane-rich biogas is generated.
  3. **Boiler Utilization:** The recovered biogas will be utilized in retrofitted boilers.
  4. **Fuel Oil Replacement:** The biogas will replace an equivalent quantity of Furnace Oil (FO) in the boilers for steam generation.

By implementing this project, Schreiber Dynamix Dairies Pvt Ltd aims to achieve environmental benefits, improve energy efficiency, and contribute to sustainable practices. The utilization of biogas as an alternative fuel source reduces greenhouse gas emissions and promotes cleaner energy production. Additionally, it facilitates the adoption of advanced technologies within the organization and the broader community.

United Nations Sustainable Development Goals:

The project activity is for primary treatment of waste water (namely Mother Liquor) and subsequently recovering methane rich biogas generated during the process at Schreiber Dynamix Dairies Pvt. Ltd. And the recovered biogas will be used in retrofitted boilers replacing equivalent quantity of FO (Furnace Oil).

Thus, the renewable energy generation from project activity will result in reduction of the greenhouse gas emissions. Positive contribution of the project to the following Sustainable Development Goals:

- SDG 7: Affordable and Clean Energy
- SDG 9: Industry, Innovation, and Infrastructure
- SDG12: Responsible Consumption and Production
- SDG13: Climate Action
- SDG15: Life on Land

SDG 7: Affordable and Clean Energy	Explanation: By utilizing biogas as a feed for boilers instead of furnace oil, the project contributes to ensuring access to affordable, reliable, sustainable, and modern energy for all, while also reducing greenhouse gas emissions and promoting cleaner energy sources.	SDG 7: Affordable and Clean Energy 7.1: Ensure universal access to affordable, reliable, and modern energy services: By utilizing biogas from dairy processing, the project helps ensure affordable and sustainable energy access. 7.2: Increase the share of renewable energy in the global energy mix: The project contributes to increasing the proportion of renewable energy sources in industrial energy consumption.
SDG 9: Industry, Innovation, and Infrastructure	Explanation: The project represents an innovative approach to industrial energy usage by integrating renewable energy sources, promoting sustainable practices within the dairy processing industry, and enhancing infrastructure for cleaner energy production and consumption	SDG 9: Industry, Innovation, and Infrastructure 9.4: Upgrade infrastructure and retrofit industries to make them sustainable: By integrating biogas technology, the project upgrades infrastructure and promotes sustainable practices within the dairy industry. 9.5: Enhance scientific research and upgrade the technological capabilities of industrial sectors: The project demonstrates technological innovation by converting biogas into a viable alternative energy source for industrial boilers.

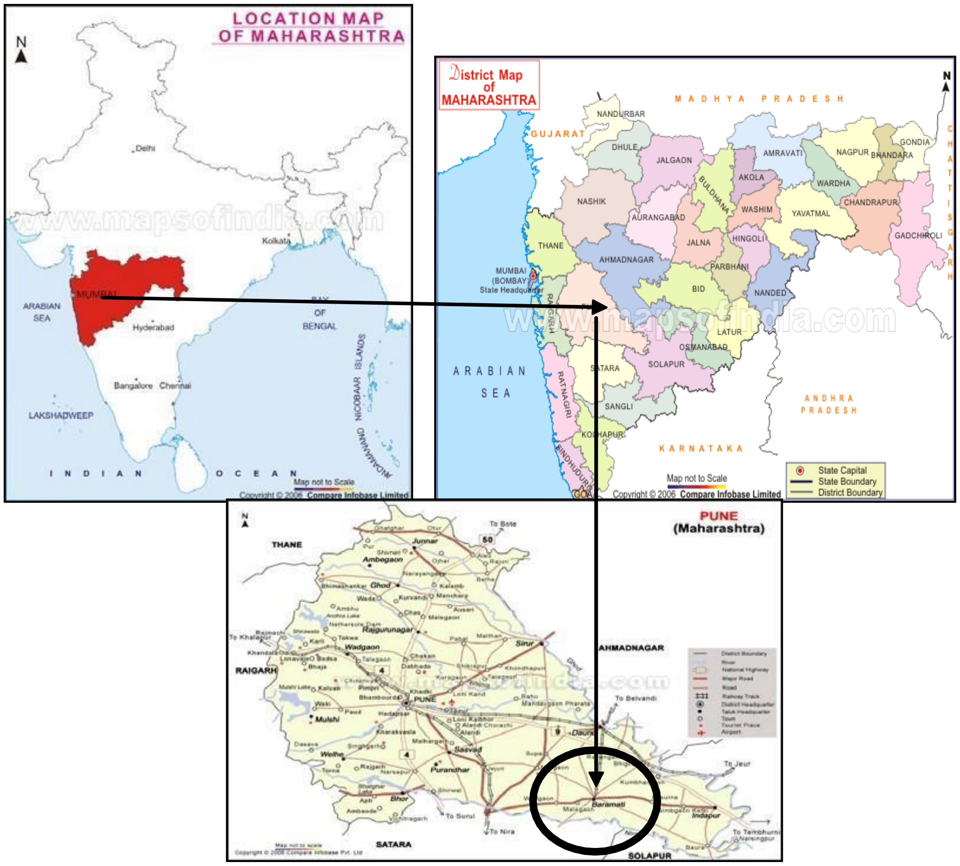
SDG 12: Responsible Consumption and Production	Explanation: Converting biogas from dairy processing into a feed for boilers aligns with the goal of promoting sustainable consumption and production patterns by reducing reliance on fossil fuels, minimizing waste, and optimizing resource efficiency in the dairy industry.	SDG 12: Responsible Consumption and Production 12.2: Achieve sustainable management and efficient use of natural resources: By converting biogas into energy, the project promotes efficient resource management and reduces reliance on finite fossil fuel resources. 12.5: Substantially reduce waste generation through prevention, reduction, recycling, and reuse: The project minimizes waste by utilizing dairy byproducts to produce renewable energy instead of disposing of them as waste.
SDG 13: Climate Action	Explanation: Utilizing biogas as a substitute for furnace oil in boilers helps mitigate climate change by reducing greenhouse gas emissions, particularly methane emissions from dairy waste, and promoting the transition towards low-carbon and resilient energy systems.	SDG 13: Climate Action 13.1: Strengthen resilience and adaptive capacity to climate-related disasters: By reducing greenhouse gas emissions, particularly methane from dairy waste, the project enhances resilience to climate change impacts. 13.2: Integrate climate change measures into national policies, strategies, and planning: The project aligns with national and global efforts to mitigate climate change by promoting the use of renewable energy sources.

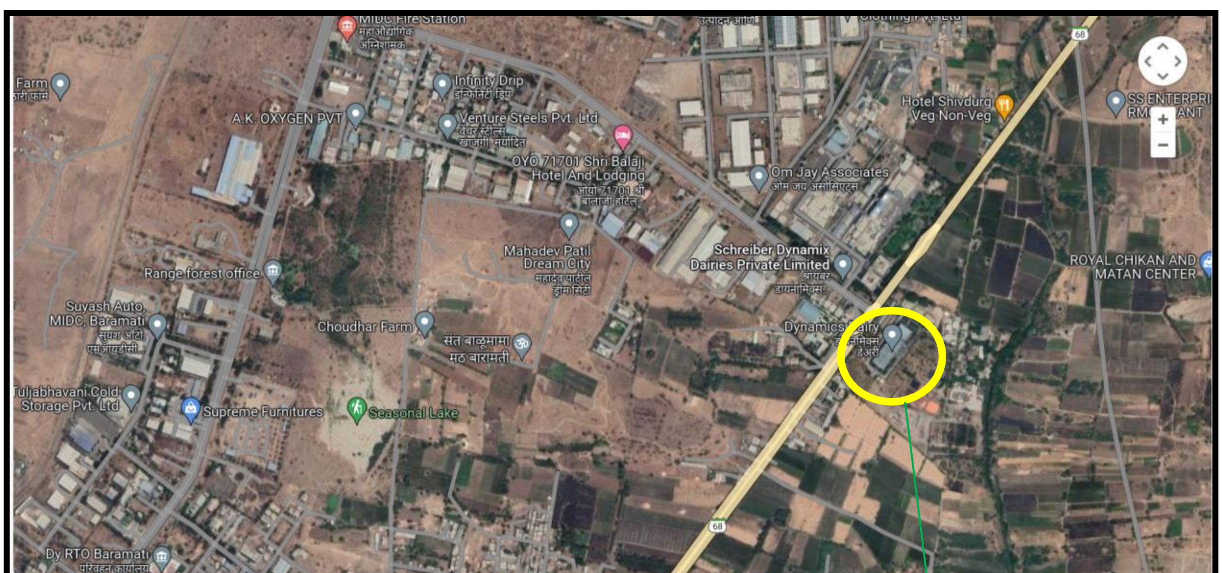
SDG 15: Life on Land	Explanation: By Implementing biogas technology in dairy processing, the project supports sustainable land use practices, reduces pollution from agricultural activities, and contributes to biodiversity conservation by mitigating the environmental impacts associated with traditional fossil fuel usage.	SDG 15: Life on Land 15.1: Ensure the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems: The project contributes to sustainable land use practices and reduces pollution from dairy processing activities. 15.3: Combat desertification, restore degraded land, and soil: By reducing methane emissions from dairy waste, the project helps mitigate land degradation and soil pollution associated with traditional waste disposal methods.

A.3. Location of project activity >>

Country	: India.
District	: Pune
Taluka	: Baramati
State	: Maharashtra
Pincode	413133
Latitude	: 18^{0}11’24.16″ N
Longitude	: 74^{0}37’ 06.04″ E

The source of waste water for the proposed project activity is process units for manufacturing of dairy products and other products at Schreiber Dynamix Dairies pvt Ltd.





Source: Google map.

Biogas generation site.

A.4. Technologies/measures

Type and Category:
According to the simplified modalities and procedures described in Appendix B for small-scale CDM project activities, the proposed project activity falls under the following:

Type	*Category/Version*	*Sectoral Scope*
III – Other project activities	III.H. Methane Recovery in WastewaterTreatment, version 19.	13
I – Renewable energy projects	I.C. Thermal energy production with orwithout electricity, version 22.	01

The waste water treatment system consists of the following equipment:

Characteristics of the equipment installed:

Design basis for 45m^3/day mother liquor:
The design basis considered to size the various units for Mother Liquor treatment is as follows:

Characteristics	**Mother Liquor**
Total flow	45 m^3/day
COD	390,000 mg/liter
BOD	220,000 mg/liter
TSS	5 % (w/v)
pH	3 – 5.5

Technical specification of Stand-by boilers: (MR13343, MR13450)

Appliance	: Steam boiler
Type	: 3 pass, conventional, smoke tube type
Make	: Thermax Ltd.
Model	: SM 140 B
Sr. No.	: MR13343, MR13450
Steam generation capacity	: 13200 kg/hr (F&A 100^{0}C)
Designed pressure	: 23.5 kg/cm^{2}g
Design temperature	: 250.0^{0}C
Combustion air temperature	: Ambient
Present thermal efficiency considered	: 89% [6]@ NCV with economizer

Technical specification of boilers: (MR12342)

Appliance	: Steam boiler
Type	: 1 pass, conventional, smoke tube type
Make	: Thermax Ltd.
Model	: RFB60
Sr. No.	: MR 12342
Steam generation capacity	: 6000 kg/hr (F&A 100^{0}C)
Designed pressure	: 17.5 kg/cm^{2}g

Design temperature	: 207.0^{0}C
Combustion air temperature	: Ambient
Present thermal efficiency considered	: 89% [6]@ NCV with economizer

A.5. Parties and project participants >>

Party (Host)	Participants
India	**Project Proponent:** Schreiber Dynamix Dairies Private Ltd. E-94, MIDC, Bhigwan Road, Baramati, District. Pune, State Maharashtra, Country India – 413133 **Aggregator:** Climekare Sustainability Pvt Ltd. **UCR ID:** 336812961

A.6. Baseline Emissions>>

Project Activity Overview: The project involves treating mother liquor in anaerobic digesters, which would otherwise continue to be treated in anaerobic deep lagoons without any biogas recovery. The biogas generated during the project activity will be utilized in the boiler, effectively replacing an equivalent quantity of Furnace Oil (FO).

Baseline Scenario: In the absence of this project, the baseline scenario would consist of the continued treatment of Mother Liquor in anaerobic deep lagoons without biogas recovery. Additionally, the corresponding quantity of FO would be consumed in the boiler to generate the required steam.

By implementing this project, we aim to enhance environmental sustainability, energy efficiency, and reduce greenhouse gas emissions. The utilization of biogas as an alternative fuel source contributes to a cleaner and more efficient process.

A.7. Debundling>>

The project proponent confirms that there is no registered small-scale project activity registered within the previous two years with them in the same project category and technology, whose project boundary is within 1 km of the project boundary of the proposed small scale activity. Thus the proposed project activity is not a debundled component of any other large-scale project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines >>

<u>SECTORAL SCOPE</u> - 13

TYPE I - III – Other project activities

CATEGORY - III.H. Methane Recovery in Wastewater Treatment, version 19.

SECTORAL SCOPE - 01

TYPE I - Renewable Energy Projects

CATEGORY - I.C. Thermal energy production with / without electricity, version 22.

The project activity involves mother liquor treatment in anaerobic digesters that otherwise would continue to be treated in anaerobic deep lagoons without any biogas recovery. Generated biogas in the project activity shall be used in the boiler thereby replacing corresponding quantity of FO.

Hence, simplified baseline for the project activity is, continued treatment of Mother Liquor in anaerobic deep lagoons without biogas recovery and consumption of equivalent quantity of FO that otherwise would have been consumed in the boiler to generate corresponding quantity of steam.

B.2. Applicability of methodologies and standardized baselines >>

For AMS III.H. Version 19

Applicability Clause	Applicability Criteria	Project activity
2.1 - 2	This methodology comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options:	The methodology comprises measures that recover biogas from biogenic organic matter in the waste water (Mother Liquor composing of Carbohydrates, proteins & fat) by means of applicability criteria option (f).
2.1 –2 a)	Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion.	This criterion is not applicable since the project activity involves replacement of existing anaerobic system.
2.1 – 2 b)	Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment.	This criterion is not applicable since the project activity does not involve installation of anaerobic sludge treatment system.
2.1 – 2 c)	Introduction of biogas recovery and combustion to a sludge treatment system.	This criterion is not applicable since the project activity does not involve introduction of biogas recovery and combustion to an existing sludge treatment system.

2.1 – 2 d)	Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant.	This criterion is not applicable since the project activity does not involve introduction of biogas recovery to an existing treatment system i. e. anaerobic lagoon.
2.1 – 2 e)	Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment,to an untreated wastewater stream.	This criterion is not applicable since the project activity involves installation of Up flow Anaerobic Sludge Blanket digesters with methane recovery and combustion to a waste water stream which was previously treated in an existing anaerobic wastewater treatment system i.e., anaerobic lagoon.
2.1 – 2 f)	Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	This criterion is applicable since the project activity involves installation of Up flow Anaerobic Sludge Blanket digesters with methane recovery and combustion followed by further treatment in aerobic as well as anaerobic process.
2.2 – 3	In cases where baseline system is anaerobic lagoon the methodology is applicable if;	
2.2 – 3 a)	(a) The lagoons are ponds with a depth greater than two meters, without aeration. The value for depth is obtained from engineering design documents, or through direct measurement, or by dividing the surface area by the total volume. If the lagoon filling level varies seasonally, the average of the highest and lowest levels may be taken	The anaerobic lagoons are ponds with a depth greater than two meters, without aeration[7]
2.2 – 3 b)	(b) Ambient temperature above 15°C, at least during part of the year, on a monthly average basis	Ambient temperature of the Project site is above 15^0Con a monthly average basis[8]
2.2 – 3 c)	(c) The minimum interval between two consecutive sludge removal events shall be 30 days	The minimum interval between two consecutive sludge removal events is 30 days[9]

2.2 – 4	The recovered biogas from the above measures may also be utilized for the following applications instead of combustion/flaring.	
2.2 – 4 a)	Thermal or mechanical, electrical energy generation directly;	This criterion is applicable since the project activity involves utilization of recovered biogas for thermal energy generation directly in boilers for steam generation.
2.2 – 4 b)	Thermal or mechanical, electrical energy generation after bottling of upgraded biogas, in this case additional guidance provided in the appendix shall be followed;	This criterion is not applicable since the recovered biogas is utilized for thermal energy generation directly without bottling
2.2 – 4 c)	Thermal or mechanical, electrical energy generation after upgrading and distribution, in this case additional guidance provided in the appendix shall be followed: (i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (iii) Upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users;	This criterion is not applicable since the recovered biogas is utilized for thermal energy generation directly without upgrading and distribution. This criterion is not applicable since there is no upgrading and injection of biogas into a natural gas distribution grid. This criterion is not applicable since there is no up gradation and transportation of biogas via a dedicated piped network to a group of end users. This criterion is not applicable since there is no upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users.
2.2 – 4 d)	Hydrogen production	This criterion is not applicable since there is no hydrogen production from the recovered biogas.
2.2 – 4 e)	Use as fuel in transportation applications after upgrading	This criterion is not applicable since biogas is not used as fuel in transportation applications after upgrading
2.2 – 5)	If the recovered biogas is used for project activities covered under paragraph 4(a), that component of the project activity can use a corresponding methodology under Type I.	The recovered biogas is used for thermal (steam) energy generation in project activities covered under paragraph 4 (a) and hence the project activity can use a corresponding methodology under Type I and the methodology AMS I.C. is used

2.2 – 6)	For project activities covered under paragraph 4 (b), if bottles with upgraded biogas are sold outside the project boundary, the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If however the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO2 emissions avoided by the displacement of fossil fuel can be claimed under the corresponding Type I methodology, e.g. AMS-I.C "Thermal energy production with or without electricity".	This criterion is not applicable since project activity is not covered under paragraph 4 (b).
2.2 – 7)	For project activities covered under paragraph 4 (c) (i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	This criterion is not applicable since project activity is not covered under paragraph 4 (c) (i).
2.2 – 8)	For project activities covered under paragraph 4(c)(ii), emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology, e.g. AMS-I.C.	This criterion is not applicable since project activity is not covered under paragraph 4 (c) (ii).
2.2 – 9)	In particular, for the case of paragraph 4(b) and (c)(iii), the physical leakage during storage and transportation of upgraded biogas, as well as the emissions from fossil fuel consumed by vehicles for transporting biogas shall be considered. Relevant procedures in paragraph 18 of the appendix of "AMS-III.H.: Methane recovery in wastewater treatment" shall be followed in this regard	This criterion is not applicable since project activity is not covered under paragraph 4 (b) and (c) (iii).
2.2 – 10)	For project activities covered under paragraph 4(b) and (c), this methodology is applicable if the upgraded methane content of the biogas is in accordance with relevant national regulations (where these exist) or, in the absence of national regulations, a minimum of 96 per cent (by volume)	This criterion is not applicable since project activity is not covered under paragraph 4 (b)and (c).

2.2 – 11)	If the recovered is utilized for the production of hydrogen (project activities covered under paragraph 3(d)), that component of the project activity shall use the corresponding methodology "AMS-III.O.: Hydrogen production using methane extracted from biogas".	This criterion is not applicable since the recovered biogas is not utilized for production of hydrogen.
2.2 – 12)	If the recovered biogas is used for project activities covered under paragraph 4(e), that component of the project activity shall use corresponding methodology "AMS-III.AQ.: Introduction of Bio-CNG in transportation applications".	This criterion is not applicable since the recovered biogas is not used for project activities covered under paragraph 4 (e).
2.2 – 13)	New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the relevant requirements in the "General guidelines for SSC CDM methodologies". In addition, the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines shall be followed.	The project activity is not a green field project and it does not involve any change of equipment resulting in a capacity addition of the wastewater treatment system compared to the designed capacity of the baseline treatment system.
2.2 – 14)	The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater shall be uniquely defined and described in the PDD.	The location of the wastewater treatment plant is defined in section A.2. The source generating the wastewater is process units formanufacturing of dairy products and other products at SDDPL as described in section A.2 of the PDD.
2.2 – 15)	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO2 equivalent annually from all Type III components of the project activity.	The project activity will result in emission reduction of 9.530 kt CO2 annually which is less than 60 kt CO2 equivalent annually

For AMS I.C. Version 22

Applicability Clause	Applicability Criteria	Project activity
2.2 – 3)	Biomass-based cogeneration and tri-generation systems are included in this category.	The project activity does not involve biomass based cogeneration system and hence this criterion is not applicable.
2.2 – 4)	Emission reductions from a biomass cogeneration or tri-generation system can accrue from one of the following activities: (a) Electricity supply to a grid; (b)Electricity and/or thermal energy production for on-site consumption or for consumption by other facilities; (c) Combination of (a) and (b).	The project activity does not involve biomass cogeneration and hence none of the activities is applicable.
2.2 – 5)	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	The project activity involves retrofitting the existing facilities (Furnace Oil fired boilers) for renewable energy generation though firing biogas.
2.2 – 6)	In the case of new facilities (Greenfield projects) and project activities involving capacity additions the relevant requirements related to determination of baseline scenario provided in the "General guidelines for SSC CDM methodologies" for Type-II and Type-III Greenfield/capacity expansion project activities also apply.	The project activity does not involve capacity addition.
2.2 – 7)	The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal	The total installed/rated thermal energy generation capacity of the project equipment is 6.5 MW
2.2 – 8)	For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 9 for the applicable limits for cogeneration project activities).	The Proposed Project activity is a co-fired system and the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel is 16.56 MW thermal and does not exceed 45 MW thermal.

2.2 – 9)	The following capacity limits apply for biomass cogeneration and tri-generation units: (a) If the emission reductions of the project activity are on account of thermal and electrical energy production, the total installed thermal and electrical energy generation capacity of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating the capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the installed capacity of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant); (b) If the emission reductions of the project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment shall not exceed 45 MW thermal; (c) If the emission reductions of the project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment shall not exceed 15 MW.	The project activity does not involve biomass co-generation and hence none ofthe activities is applicable.
2.2 – 10)	The capacity limits specified in paragraphs 7 to 9 above apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project shall comply with capacity limits specified in the paragraphs 7 to 9, and shall be physically distinct from the existing units	The project activity does not involve addition of renewable energy units at existing renewable energy facility.

2.2 – 11)	If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	The project activity does not involve solid biomass fuel (e.g. briquette).
2.2 – 12)	Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	The project activity does not involve solid biomass fuel.
2.2 – 13)	If electricity and/or thermal energy produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	The steam produced by the project activity is not delivered to a third party i.e. another facility or facilities within the project boundary.
2.2 – 14)	If the project activity recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions as per relevant procedures in the tool "Emissions from solid waste	The project activity recovers and utilizes biogas for heat production and type III component of a SSC methodology is considered i. e. AMS III.H.

	disposal sites” and/or “Project emissions from flaring”. In the event that the biomass fuel (solid/liquid/gas) is sourced from an existing CDM project, then the emissions associated with the production of the fuel shall be accounted with that project.	
2.2 – 15)	If project equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP).	The project activity does not involve refrigerants and hence not applicable.
2.2 – 16)	Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources, provided: (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology “AMS-III.K.: Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process”. Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.	The project activity does not involve charcoal based biomass energy generation.

2.2 – 17)	In the case the project activities utilizes biomass, the “TOOL16: Project and leakage emissions from biomass” shall be applied to determine the relevant project emissions from the cultivation of biomass and the utilization of biomass or biomass residues.	The project activity does not utilize biomass.

B.3. Applicability of double counting emission reductions >>

The project activity has been registered as a CDM project activity (registration date of the project activity under CDM mechanism is 04/09/2012) in the past as follows:

UNFCCC CDM Title	Waste water treatment and biogas recovery project	
CDM ID	2503	
Host Parties	Schreiber Dynamix Dairies Ltd.	
Sectoral Scopes	1: Energy industries (renewable - / non-renewable sources) 13: Waste handling and disposal	
Methodology	AMS-III.H. ver. 19 - Methane recovery in wastewater treatment AMS-I.C. ver. 22 - Thermal energy production with or without electricity	
Other Details	CDM Registration Date	04 Sep 12 (Date of registration action 15 Nov 12)
	Crediting Period	04 Sep 12 - 03 Sep 22 (Fixed)
Prior Issuance of CDM credits	Nil	

The project activity was registered under CDM under ID 2503 on 04 Sep 12 for the 04 Sep 12 - 03 Sep 22, however no CER’s have been issued for the same. The project activity is now seeking CoUs under the UCR CoU Standard/Program for the period 01/01/2014 to 31/12/2023 and hence there is no double counting issue of carbon credits for the said vintage period. Additionally, the same has been stated in the undertaking provided in the Double Counting Avoidance Assurance Document (DAA) by the PP.

B.4. Project boundary, sources and greenhouse gases (GHGs)>>

As per AMS III. H -

- 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.
- Implementation of the project activity at a wastewater and/or sludge treatment system will affect certain sections of the treatment systems while others mayremain unaffected. The treatment systems not affected by the project activity, i.e. sections operating in the project scenario under the same operational conditions as in the baseline scenario (e. g. wastewater inflow and COD content, temperature, retention time, etc.), shall be described in the PDD, but emissions from those sections do not have to be accounted for in the baseline and project emission calculations (since the same emissions would occur in both baseline and project scenarios). The assessment and identification of the systems affected by the project activity will be undertaken *ex ante*, and the PDD shall justify the exclusion of sections or components of the system. The treatment systems (lagoons, reactors, digesters, etc.) that will be covered and/or equipped with biogas recovery by the project activity, but continue to operate with the same qty. of feed inflow, volume (retention time), and temperature (heating) as in the baseline scenario, may be considered as not affected i.e., the methane generation potential remains unaltered.

As per the above statement, the systems affected / unaffected by this project activity is as follows:

Sr. No	Systems	Affected / Unaffected	Emissions (Excluded/ Included)	Reason for inclusion /exclusion
1.	Anaerobic lagoons	Affected	Included in baseline emissions	Anaerobic lagoon has been replaced by mother liquor treatment plant
2.	Boiler- RFB 60,	Affected	Included in baseline and project emissions	Part of the Furnace consumption in the boiler has been replaced by Biogas
3.	Flaring system	Affected	Excluded from baseline emissions and included in project emissions	Flaring system has been affected by diverting the Biogas to the boiler for steam generation

4.	4,500 m^3/day WWTP	Affected	Excluded from baseline emissions and included in project emissions	Operational conditions of baseline systems are affected in project scenario
5	45 m^3/day Mother Liquor treatment plant	Affected	Excluded from baseline emissions and included in project emissions	Part of project scenario, not present in baseline scenario
6	Sludge removal system	Unaffected	Excluded from baseline emissions and project emissions	The Project activity does not affect sludge removal system hence, the parameter is excluded
7	Discharge pathway of treated waste water	Unaffected	Excluded from baseline emissions and project emissions	Treated wastewater in baseline as well as project scenario is discharged and used for irrigation and gardening purpose. Hence, the parameter is excluded.
8	Disposal of final sludge generated	Unaffected	Excluded from baseline emissions and project emissions	Final generated sludge issued for land application in both, baseline and project scenario. Hence, the parameter is excluded.

As per AMS I.C –

The special extent of the project boundary encompasses:

(a) All plants generating power and/or heat located at the project site, whether fired with biomass, fossil fuels or a combination of both;

(b) All power plants connected physically to the electricity system (grid) that the Project plant is connected to;

(c) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;

(d) The processing plant of biomass residues, for project activities using solid biomass fuel (e.g. briquette), unless all associated emissions are accounted for as leakage emissions;

(e) The transportation itineraries, if the biomass is transported over distances greater than 200 kilometers, unless all associated emissions are accounted for as leakage emissions;

(f) The site of the anaerobic digester in the case of project activity that recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology.

For the purpose of determining GHG emissions in the project activity, the following sources are included:

i. Baseline emissions due to Mother Liquor treatment in anaerobic deep lagoons.

ii. Baseline emissions due to combustion of furnace oil in the boiler which otherwise would have been utilized in the boilers.

iii. Project emissions due to electricity consumption by project activity from grid as well as captive source for 4,500 m^3/day WWTP, 45 m^3/day MLTP and retrofitted boiler RFB 60, SM140.1 & SM140.2

iv. Project emissions due to on-site fossil fuel consumption due to project activity.

v. Methane emissions due to wastewater treatment systems affected by the project activity for 4,500 m^3/day WWTP.

vi. Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater in the project activity for 4,500 m^3/day WWTP.

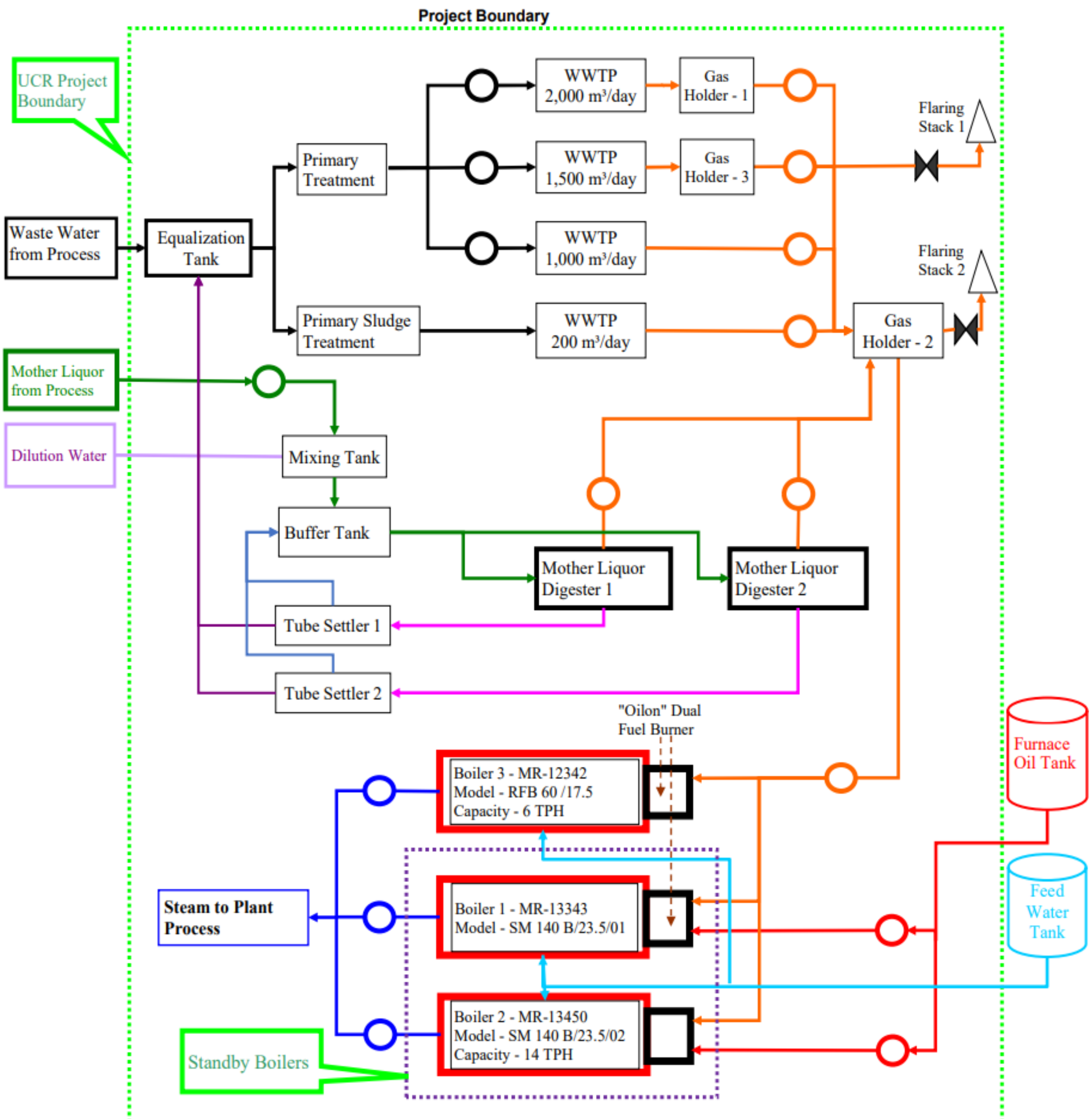
vii. Methane emissions due to inefficiencies in capture systems for 4,500 m^3/day WWTPand 45 m^3/day MLTP.

viii. Project emissions due to biogas flaring system

The following table summarizes the source and type of emissions associated with the project activity:

	Source	Gas	Included	Justification /Explanation
Baseline	**Combustion of Furnace Oil (FO) for steam generation**	CO_2	Included	Emissions due to Furnace oil combustion for the steam generation.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification
	Mother Liquor treatment in Anaerobic Lagoon	CO_2	Excluded	Excluded for simplification
		CH_4	Included	Emissions due to mother liquor treatment in anaerobic lagoons
		N_2O	Excluded	Excluded for simplification
	Existing Waste water treatment System	CO_2	Excluded	Excluded for simplification
		CH_4	Included	Emissions due to Waste water treatment.
		N_2O	Excluded	Excluded for simplification
Project activity	**Combustion of Furnace Oil (FO) for steam generation**	CO_2	Included	Emissions due to Furnace oil combustion for the steam generation.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification
	Electricity consumption	CO_2	Included	Emission due to electricity consumption in the project activity
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification
	45 m^3/day Mother Liquor treatment system	CO_2	Excluded	Excluded for simplification
		CH_4	Included	Emissions due to mother liquor treatment
		N_2O	Excluded	Excluded for simplification
	4,500 m^3/day Waste water treatment systems	CO_2	Excluded	Excluded for simplification
		CH_4	Included	Emissions due to affected part of waste water treatment
		N_2O	Excluded	Excluded for simplification
	Biogas flaring system	CO_2	Excluded	Excluded for simplification
		CH_4	Included	Emissions due to inefficiency in the flaring system
		N_2O	Excluded	Excluded for simplification

Project Boundary:



B.5. Establishment and description of baseline scenario (UCR Protocol) >>

The baseline of the project activity is identified as per paragraph 17, 18, 20, 21, 26 of AMS III.H ver. 19. As per paragraph 24 AMS III. H ver.19, "Wastewater and sludge treatment systems equipped with a biogas recovery facility in the baseline shall be excluded from the baseline emission calculations." the existing WWTP is excluded from the baseline emission calculations.

Mother Liquor was treated in anaerobic lagoons which was not equipped with biogas recovery and hence, baseline emissions for the systems affected by the project activity are considered. The applicable Methane equipped Correction Factor (MCF) will be determined based on the given table III.H.1. As per para 26, while determining baseline emissions using equation 1, historical records of one year prior to the project implementation will be used.
And baseline of the project activity is identified as per paragraph 63 of AMS I.C. Version 22 as, For project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment, the baseline emissions shall be calculated as per equation 3". The equation 2 refers to paragraph 34 of the methodology. Thus, paragraph 34 is identified as baseline scenario.

The project activity involves mother liquor treatment in anaerobic digesters that otherwise would continue to be treated in anaerobic deep lagoons without any biogas recovery. Generated biogas in the project activity shall be used in the boiler thereby replacing corresponding quantity of FO.

Hence, simplified baseline for the project activity is, continued treatment of Mother Liquor in anaerobic deep lagoons without biogas recovery and consumption of equivalent quantity of FO that otherwise would have been consumed in the boiler to generate corresponding quantity of steam.

Estimated Emission Reductions:
Baseline

Wastewater and sludge treatment systems equipped with a biogas recovery facility in the baseline shall be excluded from the baseline emission calculations.

Baseline emissions for the systems affected by the project activity may consist of:

(a) Emissions on account of electricity or fossil fuel used ($BE_{power,y}$);

(b) Methane emissions from baseline wastewater treatment systems ($BE_{ww,treatment,y}$);

(c) Methane emissions from baseline sludge treatment systems ($BE_{s,treatment,y}$);

(d) Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea ($BE_{ww,discharge,y}$);

(e) Methane emissions from the decay of the final sludge generated by the baseline treatment systems ($BE_{s,final,y}$).

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

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
$BE_{power,y}$	=	Baseline emissions from electricity or fuel consumption in year *y* (t CO_2e)
$BE_{ww,treatment,y}$	=	Baseline emissions of the wastewater treatment systems affected by the project activity in year *y* (t CO_2e)
$BE_{s,treatment,y}$	=	Baseline emissions of the sludge treatment systems affected by the project activity in year *y* (t CO_2e)
$BE_{ww,discharge,y}$	=	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (t CO_2e). The value of this term is zero for the case 1(b)
$BE_{s,final,y}$	=	Baseline methane emissions from anaerobic decay of the final sludge produced in year *y* (t CO_2e). 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

Baseline emissions from electricity or fuel consumption: Baseline emission from electricity or fuel consumption has not been considered, since the electricity or fuel consumption in the baseline scenario is very negligible.

In the project activity, baseline treatment system is different from the treatment system in the project scenario; hence the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post.

Baseline emissions of the sludge treatment systems affected by the project activity:

As a conservative approach, baseline emissions from the sludge treatment systems have not been considered.

Baseline methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea:

Baseline emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater are not considered as a conservative approach.

Baseline methane emissions from anaerobic decay of the final sludge

As a conservative approach, Methane emissions from anaerobic decay of the final sludge have not been considered in the baseline calculations.

Project emissions consists of:

CO_2 emissions from electricity and fuel used by the project facilities ($PE_{power,y}$);

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

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

Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$);

Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$);

Methane fugitive emissions due to inefficiencies in capture systems ($PE_{fugitive,y}$);

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

Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation ($PE_{biomass,y}$).

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

Where:

PE_y	Project emissions in the year y (t CO2e)
$PE_{power,y}$	Emissions from electricity or fuel consumption in the year y (t CO_2e). These emissions shall be calculated as per paragraph, for the situation of the project scenario, using energy consumption data of all equipment/devices used in the project activity wastewater and sludge treatment systems and systems for biogas recovery and flaring/gainful use
$PE_{ww,treatment,y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (t CO_2e). These emissions shall be calculated as per equation (2) in paragraph using an uncertainty factor of 1.12 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $\eta_{,PJ,k,y}$) and with the following changed

definition of parameters:

$MCF_{ww,treatment,PJ,k}$	Methane correction factor for project wastewater treatment system *k* (*MCF* values as per Table 2 above)
$\eta_{,PJ,k,y}$	Chemical oxygen demand 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*

$PE_{s,treatment,y}$ Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (t CO_2e). These emissions shall be calculated as per equations (3) and (4) in paragraphs, using an uncertainty factor of 1.12 and data applicable to the project situation ($S_{l,PJ,y}$, $MCF_{s,treatment,l}$) and with the following changed definition of parameters:

$S_{l,PJ,y}$	Amount of dry matter in the sludge treated by the sludge treatment system *l* in the project scenario in year *y* (t)
$MCF_{s,treatment,l}$	Methane correction factor for the project sludge treatment system l (*MCF* values as per Table 2 above)

$PE_{ww,discharge,y}$ Methane emissions from degradable organic carbon in treated wastewater in year *y* (tCO_2e). These emissions shall be calculated as per equation (6) in paragraph, using an uncertainty factor of 1.12 and data applicable to the project conditions ($COD_{ww,discharge,PJ,y}$, $MCF_{ww,PJ,discharge}$) and with the following changed definition of parameters:

$COD_{ww,discharge,PJ,y}$	Chemical oxygen demand of the treated wastewater discharged into the sea, river or lake in the project scenario in year *y* (t/m^3)
$MCF_{ww,PJ,discharge}$	Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake) (*MCF* values as per Table 2)

$PE_{s,final,y}$ Methane emissions from anaerobic decay of the final sludge produced in year *y* (t CO_2e). These emissions shall be calculated as per equation (7) in paragraph, using an uncertainty factor of 1.12 and data applicable to the project conditions ($MCF_{s,PJ,final}$, $S_{final,PJ,y}$). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, this term shall be neglected, and the sludge treatment and/or use and/or final disposal shall be monitored during the crediting period with the following revised definition of the parameters:

$MCF_{s,PJ,final}$	Methane correction factor of the disposal site that receives the final sludge in the project situation, estimated as per the procedures described in the methodological tool “Emissions from solid waste disposal sites”

	$S_{final,PJ,y}$ Amount of dry matter in final sludge generated by the project wastewater treatment systems in the year *y* (t)
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year *y*, calculated as per paragraph (t CO_2e)
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year *y* (t CO_2e). For ex ante estimation, baseline emission calculation for wastewater and/or sludge treatment (i.e. equation (2) and/or equation (3)) can be used but without the consideration of GWP for CH_4. However, the ex post emission reduction shall be calculated as per methodological tool "Project emissions from flaring"
$PE_{biomass,y}$	Methane emissions from biomass stored under anaerobic conditions. If storage of biomass under anaerobic conditions takes place in the project and does not occur in the baseline, methane emissions due to anaerobic decay of this biomass shall be considered and be determined as per the procedure in the methodological tool "Emissions from solid waste disposal sites" (t CO_2e)

CO_2 emissions on account of power used by the project activity facilities ($PE_{power,y}$)

These emissions are calculated as per AMS III.H Version 19 and the latest version of "Tool to calculate baseline, project and / or leakage emissions from electricity consumption" (EB39 Annex07, Version 01).

$$PE_{power,y} = \sum_j EC_{PJ,j,y} * EF_{j,y} * (1 + TDL_{j,y})$$

In case of project activity, CO_2 emissions on account of power used by the project activity are from two different sources, regional electricity grid ($PE_{Grid,y}$) and off grid captive power plant i.e. diesel generator sets ($PE_{DG,y}$).

$$PE_{power,y} = PE_{Grid,y} + PE_{DG,y}$$

$$PE_{Grid,y} = EC_{PJ,Grid,y} * EF_{EL,Grid,y} * (1 + TDL_{Grid,y})$$

$$PE_{DG,y} = EC_{PJ,DG,y} * EF_{EL,DG,y} * (1 + TDL_{DG,y})$$

$PE_{power,y}$	CO_2 emissions on account of power used by the project activity facilities (tCO_2e)
$PE_{Grid,y}$	CO_2 emissions on account of power used from regional electricity grid by the project activity facilities (tCO_2e)
$PE_{DG,y}$	CO_2 emissions on account of power used from off grid captive power plant i.e., Diesel Generator (DG) by the project activity facilities (tCO2e)

$EC_{PJ,Grid,y}$	Energy consumption data of all equipment's/devices used in project activity wastewater treatment systems and systems for biogas recovery and gainful use from regional electricity grid for a year y (MWh)
$EC_{PJ,DG,y}$	Energy consumption data of all equipments/devices used in project activity wastewater treatment systems and systems for biogas recovery and gainful use from off grid captive power plant (diesel generator DG) for a year y (MWh)
$EF_{EL,Grid,y}$	CO_2 emission factor of the grid in year y (tCO_2/MWh) For project emissions due to electricity consumption by the project activity using local electricity grid, emission factor is calculated as per scenario A, option A1 of the tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (EB39 Annex07). As per option A1, the combined margin emission factor of the local electricity grid is calculated using the procedures in the latest approved version of the 'Tool to calculate the emission factor for an electricity system. (EB63 Annex19)'. The calculation of Combined Margin (CM) Emission Factor is given in appendix 5. The CM emissions factor ($EF_{grid,.CM,.y}$), calculated is 0.84 tCO_2/MWh and is fixed ex-ante during the entire crediting period and no monitoring of emission factor is required.
$EF_{EL,DG,y}$	CO_2 emission factor of off grid power captive power plant in year y (tCO_2/MWh) For project emissions due to electricity consumption by the project activity using off grid fossil fuel fired captive power plant, emission factor is calculated using Scenario B, option B2 of the tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (EB 39 Annex 07). Default value of emission factor i.e. 1.3 tCO_2/MWh will be used. Hence, the emission factor for captive power plant ($EF_{DG,y}$) will be 1.3 tCO_2/MWh and is fixed ex-ante during the entire crediting period and no monitoring of emission factor is required.
$TDL_{Grid,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
$TDL_{DG,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y* (here, $TDL_{DG,y}$ =0)

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

Project activity will affect existing 4,500 m^3/day waste water treatment plant. These emissions shall be calculated as per AMS III.H. Version 19, using an uncertainty factor of 1.12 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $\eta PJ,k,y$):

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

$Q_{ww,i,y}$	Volume of wastewater treated in project wastewater treatment system *i* in year *y* (m^3)
$COD_{inflow,i,y}$	Chemical oxygen demand of the wastewater inflow to the project treatment system *i* in year *y* (t/m^3).
$\eta_{,PJ,k,}$	Chemical oxygen demand 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 project wastewater treatment system *k* (MCF values as per Table III.H.1)
i	Index for project wastewater treatment system
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

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

These project emissions are not considered as sludge treatment systems are not affected by the project activity.

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

These emissions shall be calculated as per AMS III.H using an uncertainty factor of 1.12 and data applicable to the project situation ($COD_{ww,discharge,PJ,y}$, $MCF_{ww,PJ,discharge}$)

$$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$$

$Q_{ww,y}$	Volume of treated wastewater discharged in year y (m^3)
GWP_{CH4}	Global Warming Potential for methane (value of 21)
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
$COD_{ww,discharge,PJ,y}$	Chemical oxygen demand of the treated wastewater discharged into sea, riveror lake in the project situation in year y (t/m^3)
$MCF_{ww,PJ,discharge}$	Methane correction factor based on discharge pathway in the project situation (e.g. sea, river or lake) of the wastewater (fraction) (MCF values as per table III.H.1)

Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$)

As explained above, if the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, this term shall be neglected. Since the sludge generated in the project activity would be used for soil application, methane emissions from the decay of the sludge are neglected.

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

As per AMS III. H. version 19, project activity emissions form methane release in capture systems are determined as follows,

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

Where,

$PE_{fugitive,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO_2e)

$PE_{fugitive,s,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (tCO_2e)

For this case, $PE_{fugitive,s,y} = 0$

Hence,

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

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

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

CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)
$Q_{ww,y}$	Volume of treated wastewater discharged in year y (m^3)
GWP_{CH4}	Global Warming Potential for methane (value of 21)
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.25 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
$COD_{removed,PJ,k,y}$	Chemical oxygen demand removed[25] by the treatment system k of the project activity equipped with biogas recovery equipment in year y (t/m^3)
$MCF_{ww,treatment,PJ,y}$	Methane correction factor for the project wastewater treatment systems k equipped with biogas recovery equipment (MCF values as per table III.H.1)

Methane emissions due to incomplete flaring in year y ($PE_{flaring,y}$)

In the project activity, generated biogas will be consumed in the heat generating equipment's (boilers). The project activity involves one heat generating equipment's (6TPH (F&A 100^0C) i.e RFB-60 Boiler. When this boiler is forced shut down or is under maintenance, biogas can be supplied to another boilers (SM140.1 & SM140.2). It is very unlikely that both the heat generating equipment's are under maintenance or forced shut down.

However, if such condition occurs, the number of hours of operation of flare shall be monitored as H_{flare} and the quantity of biogas flared shall be obtained by multiplying the flare capacity and number of hours of operation of flare. The project activity involves open flaring system. This system is now not operational in and use of the same is very unlikely because the generated biogas will be used in the boilers. Hence, the default value to be adapted for flare efficiency is 0%.

Methane emissions shall be calculated as per the "Tool to determine project emissions from flaring gases containing methane" (EB 28 Annex 13, version 01)

The tool involves seven steps, out of which, step 3 and step 4 are not applicable since, in project activity enclosed flares are not used.

Step1: Determination of the mass flow rate of the residual gas that is flared

This step calculates the residual gas mass flow rate in each hour *h*, based on the volumetric flow rate and the density of the residual gas. The density of the residual gasis determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} \text{ x } FV_{RG,h}$$

Where,

Variable	**Description**
$FM_{RG,h}$	Mass flow rate of the residual gas in hour *h*
$_{RG,n,h}$	Density of the residual gas at normal conditions in hour *h*
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*

$$_{RG,n,h} = \frac{P}{\frac{R_u}{MM_{RG,h}} x T_n}$$

Where,

Variable	Description
$_{RG, n, h}$	Density of the residual gas at normal conditions in hour *h*
P_n	Atmospheric pressure at normal conditions (101325)
R_u	Universal ideal gas constant (8314)
$MM_{RG,h}$	Molecular mass of the residual gas in hour *h*
T_n	Temperature at normal conditions (273.15)

$$MM_{RG,h} = \sum fv_{i,h} * MM_i$$

Where,

Variable	Description
$MM_{RG,h}$	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	Volumetric fraction of component *i* in the residual gas in the hour *h*
MM_i	Molecular mass of residual gas component *i*
i	The components CH_4, CO, CO_2, O_2, H_2, N_2

As a conservative approach, project proponent will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2)

Step 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, asfollows,

$$FM_{j,h} = \frac{\sum_i fv_{i,h}..AM_j.NA_{j,t}}{MM_{RG,h}}$$

Where,

Variable	Description
$Fm_{j,h}$	Mass fraction of element *j* in the residual gas in hour *h*
$Fv_{i,h}$	Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j	Atomic mass of element *j*
$NA_{j,i}$	Number of atoms of element *j* in component *i*
$MM_{RG,h}$	Molecular mass of the residual gas in hour *h*
j	The elements carbon, hydrogen, oxygen and nitrogen
i	The components CH_4, CO, CO_2, O_2H_2, N_2

Step 3: Determination of methane mass flow rate of the residual gas on a dry basis

The quantity of methane in the residual gas flowing into flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density if methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry basis).

$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$

Where,

Variable	Description
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in hour *h*
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis inhour *h* (NB: this corresponds to $fv_{i,RG,h}$ where *i* refers to methane)
$\rho_{CH4,n}$	Density of methane at normal conditions (0.716)

Step 4: Determination of the hourly flare efficiency

The determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature, the type of flare used (open or enclosed). The project activity involves open flaring. Hence, the flare efficiency in the hour *h* (< $_{flare,h}$) will be any of the following,

1. 0% if the flame is not detected for more than 20 minutes during the hour *h*
2. 50% in the flare is detected for more than 20 minutes during the hour *h*

Step 5: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

Project emissions from flaring are calculated as the sum of emissions from each hour h, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour h (($\eta_{flaure,h}$),as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000}$$

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year *y*
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h*
$\square_{flaure,h}$	Flare efficiency in hour *h*
GWP_{CH4}	Global Warming Potential of methane valid for commitment period

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

Since, generated biogas shall not be stored under anaerobic conditions, methane emissions shall be neglected.

Leakage ($LE_{ww,y}$) **:**

There is no transfer of equipment from another activity nor the existing equipment is transferred to another activity, hence there is no leakage has been considered for this project activity.

Emission Reduction :($ER_{ww\,y}$)

As per paragraph 32 of AMS III.H. version 16, f*or all scenarios in paragraph 1, i.e. 1 (a) to 1 (f) of the methodology, emission reductions shall be estimated ex ante in the PDD using the equations provided in the baseline, project and leakage emissions sections above. The project activity falls under scenario 1 (f). Emission reductions shall be estimated ex ante as follows:*

$$ER_{wwy,ex\ ante} = BE_{ww,y,ex\ ante} - \left(PE_{,ww,y,ex\ ante} + LE_{ww,y,ex\ ante}\right)$$

Where:

$ER_{ww,y,ex\ ante}$	*Ex ante* emission reduction in year *y* (tCO_2e)
$LE_{ww,y,ex\ ante}$	*Ex ante* leakage emissions in year *y* (tCO_2e)
$PE_{ww,y,ex\ ante}$	*Ex ante* project emissions in year *y* (tCO_2e)
$BE_{ww,y,ex\ ante}$	*Ex ante* baseline emissions in year *y* (tCO_2e)

it is possible that the project activity involves wastewater and sludge treatment systems with higher methane conversion factors (MCF) or with higher efficiency than the treatment systems used in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the ex post calculated baseline emissions minus project emissions using the actual monitored data for the projectactivity. The emission reductions achieved in any year are the lowest value of the following:

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

Where:

ER y ,ex post	Emission reductions achieved by the project activity based on monitored values for year y (tCO2e)
BE y ,ex post	Baseline emissions calculated as per AMS III.H. ver.19 using ex post monitored values
PE y ,ex post	Project emissions calculated as per AMS III.H. ver.19 using ex post monitored values
MD y	Methane captured and destroyed/gainfully used by the project activity in the year y (tCO2e)

As per AMS III. H. version 19, *in the case of flaring/combustion MD_y will be measured using the conditions of the flaring process:*

$$MD_{y} = BG_{burnt\ ,y} * w_{CH4\ ,y} * D_{CH4} * FE * GWP_{CH4} \qquad \textbf{(1)}$$

Where:

$BG_{burnt\ ,y}$ Biogas flared/combusted in year y (m^3)

$w_{CH4\ ,y}$ Methane content of the biogas in the year y (volume fraction)

D_{CH4} Density of methane at the temperature and pressure of the biogas in the year y (t/m^3)

FE Flare efficiency in year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied

$BG_{burnt\ ,y}$ will be calculated based on measured values of biogas generated from two nos. of anaerobicdigesters of Mother Liquor Treatment Plant. Biogas generated from existing 4500 m^3/day WWTP will not be considered

In the Project activity, biogas is combusted for gainful purpose hence, flare efficiency of100% will be considered for the calculation purpose.

As per methodology AMS I. C.:

<u>Calculation of baseline emissions:</u>

Baseline of the project activity is identified as per paragraph 42, "*For project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass residues in heat generation equipment, the baseline emissions shall be calculated as per equation 2*." As per AMS I. C. Version 22, the baseline emissions for steam produced using fossil fuels are calculated as follows:

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

Where:

$BE_{thermal,CO_2,y}$	The baseline emissions from steam/heat displaced by the project activity during the year *y* (tCO_2e)
$EG_{thermal,y}$	The net quantity of thermal energy supplied by the project activity during the year *y* (TJ)
EF_{FF,CO_2}	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant; tCO_2/TJ, obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
$\eta_{BL,thermal}$	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

$$EG_{thermal,y} = ((H_{steam} - H_{feedwater}) \times Q_{steam} \times 4.186 \times 10^{-9})$$

Where,

H_{steam}	= Enthalpy of steam, kcal/kg
$H_{feed\ water}$	= Enthalpy of feed water, kcal/kg
Q_{steam}	= Quantity of steam produced, t
4.186	= Conversion factor from kcal to KJ

Efficiency of the baseline boiler will be determined as per AMS I.C. version 22.

"Existing facilities are those that have been in operation for at least three years immediately prior to the start date of the project activity. For project activities implemented in existing facilities, baseline calculations shall be based on historical data on energy use (e.g. electricity, fossil fuel) and plant output (e.g. steam/electricity) in the baseline plant for at least three years prior to project implementation. For existing facilities with less than three years of operational data, all historical data shall be available (a minimum of one year data would be required). For existing facilities having no historical data/information on baseline parameters such as efficiency, energy consumption and output (e.g. the available data is not reliable due to various factors such as the use of imprecise or non-calibrated measuring equipment), the baseline parameters can be determined using a performance test/measurement campaign to be carried out prior to the implementation of the project activity. The project proponent may follow the relevant provisions from the "Tool to determine baseline efficiency of thermal and electricity systems". In the case of project activities that export to other facilities within the project boundary, historical data from the recipient plants is also required". PP will use historical data for use of energy source and plant output as described in the methodology.

Also, "baseline emissions shall be determined based on three years average historical data on the relative share of fossil fuel and biomass in the baseline fuel mix. There lative share is determined based on the energy content of each fuel". In this project activity, in baseline condition, only fossil fuel i. e. Furnace Oil was used and biomass fuel was not used. Hence, baseline emissions shall be calculated as per AMS I.C. version 22.

Calculation of project emissions

The project emissions include,

- CO_2 emission from onsite consumption of fossil fuels due to the project activity will be calculated using the latest version of " Tool to calculate project or leakage CO_2 emissions from fossil fuel consumption"
  - $PE_{FC,boiler,y} = (\sum FC_{FO,bolier,y} \times COEF_{FO,y})$

Where,

$PE_{FC,boiler,y}$	CO_2 emission from the process (boiler) during the year y, tCO_2e/year
$FC_{FO,boiler,y}$	Quantity of fuel type (FO) combusted in the process (boiler) during the year y, kg/year
$COEF_{FO,y}$	CO_2 emission coefficient of the fuel (FO) during the year y , tCO_2e/kg
FO	The fuel type combusted in process j during the year y

The CO_2 emission coefficient $COEF_{FO,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type (FO), as follows using option B in the tool:

$$COEF_{FO,y} = NCV_{FO,y} * EF_{CO2,FO,y}$$

Where:

$COEF_{FO,y}$	The CO_2 emission coefficient of fuel type (FO) in year y (tCO_2e/kg)
$NCV_{FO,y}$	The weighted average net calorific value of the fuel type (FO) in year y(GJ/kg)
$EF_{CO2,FO,y}$	The weighted average CO_2 emission factor of fuel type (FO) in year y(tCO_2/GJ)
FO	The fuel type combusted in process (boiler) during the year y

- CO_2 emission from electricity consumption by the project activity using the latest version of "Tool to calculate baseline, project and / or leakage emissionsfrom electricity consumption".

'CO_2 emissions from electricity consumption by the project activity' will be considered and calculated as per AMS III.H. version 19 and are described aboveunder $PE_{ww,y}$.

Total project emissions:

Therefore, Project emissions due to thermal energy

generation will be,$PE_{thermal,y} = PE_{FC,boiler,y}$

Leakage $(LE_{thermal,y})$ **:**

Leakage emissions are not considered since there is no transfer of equipment from another activity.

Emission Reductions due to thermal energy generation ($\boldsymbol{ER_{thermal,y}}$):

$$\mathbf{ER_{thermal,y} = BE_{thermal,y} - PE_{thermal,y} - LE_{thermal,y}}$$

Where:

$ER_{thermal,\ y}$	Emission reductions in year *y* (tCO_2e)
$BE_{thermal,\ y}$	Baseline emissions in year *y* (tCO_2e)
$PE_{thermal,\ y}$	Project emissions in year y (tCO2e)
$LE_{thermal,y}$	Leakage emissions in year y (tCO2e)

<u>Therefore, total emission reduction because of this project activity is,</u>

$$\mathbf{ER_y = ER_{ww,y} + ER_{thermal,y}}$$

Where,

$ER_{ww,y}$ = $ER_{y,ex\ post}$

$ER_{thermal,y}$ = Emission reductions in year y (tCO_2e)

Estimated Annual baseline emission reductions (BEy) = 14,775 CoUs /year (14,775 tCO_2eq/yr)

B.6. Prior History>>

The project activity has been registered as a CDM project activity (registration date of the project activity under CDM mechanism is 04/09/2012) in the past as follows:

UNFCCC CDM Title	Waste water treatment and biogas recovery project	
CDM ID	2503	
Host Parties	Schreiber Dynamix Dairies Ltd.	
Sectoral Scopes	1: Energy industries (renewable - / non-renewable sources) 13: Waste handling and disposal	
Methodology	AMS-III.H. ver. 19 - Methane recovery in wastewater treatment AMS-I.C. ver. 22 - Thermal energy production with or without electricity	
Other Details	CDM Registration Date	04 Sep 12 (Date of registration action 15 Nov 12)
	Crediting Period	04 Sep 12 - 03 Sep 22 (Fixed)
Prior Issuance of CDM credits	Nil	

The project activity was registered under CDM under ID 2503 on 04 Sep 12 for the 04 Sep 12 - 03 Sep 22, however no CER's have been issued for the same. The project activity is now seeking CoUs under the UCR CoU Standard/Program for the period 01/01/2014 to 31/12/2023 and hence there is no double counting issue of carbon credits for the said vintage period. Additionally, the same has been stated in the undertaking provided in the Double Counting Avoidance Assurance Document (DAA) by the PP.

Hence project will not cause double accounting of carbon offset units or credits (i.e., CoUs).

B.7. Changes to start date of crediting period >>

There are no changes to the start date of the 1st crediting period.

B.8. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

This is PCN version 1.0 and hence there are no changes applicable.

B.9. Monitoring period number and duration>>

Monitored Period 01
1st Monitoring Period Date : 01/01/2014 to 31/12/2023
1st Monitoring Duration : 10 years 00 months

B.10 Monitoring plan>>

1. **Monitoring Plan Objective and Organization**

The project activity will be operated and managed by the SDDPL. The plant will have a manual datarecording system. In order to monitor and control the project performance, the PPwill place a project management team. It will be coordinated by the Plant Manager, SDDL. He is also responsible for checking the information consistency. The PP will have well diversified procedure for collection of data and analysis of data at different levels and for subsequent corrective actions as when required inline with the internal quality systems.

The plant operation team will be entrusted with the responsibility of storing, recording the data related to the project activity. This team will be responsible for calculation of actual emission reduction in the most transparent and relevant manner and submit to the Plant Manager.

Data acquisition for the gas and wastewater flow meters will be executed through the process control unit of the biogas plant. Lab data will be recorded manually by the plant operation team.

Inspection and record of daily checklist of critical parameters of project activity will be maintained by Boiler shift operators / Chemist cum plant operators. The operators will access the condition of all the equipment and measuring equipment and appropriate corrective action will be taken. The meters which will be used in the project activity will beof reputed make with the best accuracy available. All instruments will be calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time. The calibration frequency for each instrument will be determined and documented and will also be a part of the monitoring and verification parameters. All the equipment’s and meters will be calibrated as per the local/national standards or as per manufacturer’s specifications. The equipment’s and meters will be calibrated at appropriate intervals as per manufacturer’s specifications or at least once in three years. The measured data without adequate calibration will be compared with local/national data and commercial data to ensure consistency. Calibration plan and process will be regularly audited during internal and external QMS audits.

All the monitoring data will be stored /will be recorded and scrutinized by Plant Manager and final monitored data kept in soft format as well as hard copies.

Parameters such as generated biogas, biogas fed to the boiler, steam generation from boiler etc. will be monitored continuously through meters. Electricity consumption from local gridas well as captive power plant will be measured and monitored through electronic meters.

The Instrumentation and control system for the project activity will be designed with adequate instruments to control and monitoring the various operating parameters for safe and efficient operations. All the instruments are of reputed make.

Data / Parameter:	$Q_{ww,j,y}$
Data unit:	m^3/month
Description:	Volume of wastewater entering anaerobic digesters in Wastewater Treatment Plant
Source of data to be used:	Volume is measured using the volume flow meter and recorded in the plant log books.
Description of measurement methods and procedures to be applied:	Monitoring: Data is calculated based on cow water and mother liquor flows which are continuously measured with the help of volume flow meter along with the totalizer and the measured value is recorded in the log book hourly which is available for verification.
QA/QC procedures to be applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	Flow meter will be calibrated as per manufacturer's specification

Data / Parameter:	$Q_{ML,j,y}$
Data unit:	m^3/month
Description:	Volume of mother liquor entering anaerobic digesters in Mother Liquor Treatment Plant
Source of data to be used:	Volume is measured using the volume flow meter and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured with the help of volume flow meter along with the totalizer and the measured value is recorded in the log book hourly which is available for verification.
QA/QC procedures to beapplied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	Flow meter will be calibrated as per manufacturer's specification

Data / Parameter:	$COD_{ww,inflow,MLTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand of wastewater inflow at Mother Liquor Treatment Plant
Source of data to be used:	This data is determined by analytical titration method and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is determined by analytical titration method through representative sampling. The samples and measurements shall ensure a 90/10 confidence/precision level. Weighted average value will be used for emission reduction calculations.
QA/QC procedures to beapplied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	-

Data / Parameter:	$COD_{ww,outflow,MLTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand of wastewater outflow at Mother Liquor Treatment Plant
Source of data to be used:	This data is determined by analytical titration method and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is determined by analytical titration method through representative sampling. The samples and measurements shall ensure a 90/10 confidence/precision level. Weighted average value will be used for emission reduction calculations.
QA/QC procedures tobe applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	-

Data / Parameter:	$COD_{ww,removed,PJ,MLTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand removed by the treatment system k (anaerobic digesters in mother liquor treatment plant) in project activity in year y
Source of data to be used:	COD value is calculated and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is calculated as follows, $COD_{ww,\inf lowMLTP,y}$ - $COD_{ww,outflow,MLTP,y}$ Weighted average value will be used for emission reduction calculations.
QA/QC procedures tobe applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	NA

Data / Parameter:	$COD_{ww,\text{inflow},WWTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand of wastewater inflow at anaerobic digesters of 4500 m^3/day Waste Water Treatment Plant in year y
Source of data to be used:	This data is determined by analytical titration method and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is determined by analytical titration method through Representative sampling. The samples and measurements shall ensure a 90/10 Confidence/precision level. Weighted average value will be used for emission reduction calculations.
QA/QC procedures to be applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	$COD_{ww,\inf low,WWTP,y}$ = $COD_{\text{inflow},i,y}$ in project scenario

Data / Parameter:	$COD_{ww,outoflw,WWTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand of wastewater outflow at anaerobic digesters of 4500 m^3/day Waste Water Treatment Plant in year y
Source of data to be used:	This data is determined by analytical titration method and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is determined by analytical titration method through representative sampling. The samples and measurements shall ensure a 90/10 confidence/precision level. Weighted average value will be used for emission reduction calculations.
QA/QC procedures tobe applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	-

Data / Parameter:	$COD_{ww,removed,PJ,WWTP,y}$
Data unit:	$tCOD/m^3$
Description:	The chemical oxygen demand removed by the treatment system k (anaerobic digesters in 4500 m^3/day waste water treatment system) in project activity in year y
Source of data to be used:	COD value is calculated and recorded in the plant log books. Weighted average value will be used for emission reduction calculations.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is calculated as follows, $COD_{ww,\inf low,WWTP,y} - COD_{ww,toutflow,WWTP,y}$
QA/QC procedures tobe applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	NA

Data / Parameter:	$COD_{ww.disch\arg e,PJ,y}$
Data unit:	$tCOD/m^3$
Description:	The Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the project situation in year y
Source of data to be used:	This data is determined by analytical titration method and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is determined by analytical titration method through representative sampling. The samples and measurements shall ensure a 90/10 confidence/precision level. Weighted average value will be used for emission reduction calculations.
QA/QC procedures tobe applied:	As per procedures based on national / international standards. Further values can be cross-checked from the third party laboratory reports.
Any comment:	-

Data / Parameter:	$_{PJ,k}$
Data unit:	%
Description:	The Chemical oxygen demand removal efficiency of the project wastewater treatment system *k* i. e. 4500 m^3/day waste water treatment plants in year *y*
Source of data to be used:	This is determined on based of inflow COD and outflow COD in system k i.e. 4500 m^3/day waste water treatment plants
Brief description of measurement methods and procedures to be applied:	Monitoring: calculated
QA/QC procedures to beapplied:	-
Any comment:	$_{PJ,k} = COD_{ww,\inf low,i,y} - COD_{ww,\inf low,WWTP,y}$ Calculated value based on inflow and outflow COD of wastewater entering 4500 m^3/day wastewater treatment plants

Data / Parameter:	$Q_{FF,FO}$
Data unit:	Tone's/year
Description:	Annual Furnace Oil consumption in the boiler RFB-60
Source of data to be used:	This data is measured using the mass flow meter and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Continuously. Data is measured by means of using mass flow meter and the measured value is totalized and recorded in the log book daily which is available for verification.
QA/QC procedures to beapplied:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. If invoices are available, the metered fuel consumption quantities should be cross-checked with available purchase invoices from the financial records.
Any comment:	Flow meter will be calibrated as per manufacturer's specification. $Q_{FF,FO1} = FC_{Fo,boiler,y}$

Data / Parameter:	$Q_{biogas,WWTP}$
Data unit:	m^3/year
Description:	Quantity of biogas generated from 4,500 m^3/day (From different stream) Waste Water Treatment Plantin year y.
Source of data to be used:	Biogas quantity is measured using the Volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured with the help of volume flow meter with totalizer and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures to beapplied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	Flow meter will be calibrated as per manufacturer's specification

Data / Parameter:	$Q_{biogas,MLTP1}$
Data unit:	m^3/year
Description:	Quantity of biogas generated by Mother liquor digester 1 in year y
Source of data to be used:	Biogas quantity is measured using the volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured with the help of volume flow meter with totalizer and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures to beapplied:	NA
Any comment:	Flow meter will be calibrated as per manufacturer's specification

Data / Parameter:	$Q_{biogas,MLTP2}$
Data unit:	m^3 /year
Description:	Quantity of biogas generated by Mother liquor digester 2 in year y
Source of data to be used:	Biogas quantity is measured using the volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured with the help of volume flow meter with totalizer and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures tobe applied:	NA
Any comment:	Flow meter will be calibrated as per manufacturer's specification

Data / Parameter:	$Q_{biogas,boiler}$
Data unit:	m^3/year
Description:	Quantity of biogas fired in the boiler RFB-60 in year y
Source of data to be used:	Biogas quantity is measured using the Volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: At least hourly measurements will be undertaken, if less, confidence/precision level of 90/10 would be attained. Data will be measured with the help of volume flow meter with totalizer and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures to beapplied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	Flow meter will be calibrated as per manufacturer's specification. Cross check – The emission reductions are calculated based on energy output hence, the consistency of measurements ex post will be checked with annual data on energy generation, fossil fuels and biomass used and the efficiency of energy generation as determined ex ante.

Data / Parameter:	$BG_{burnt,y}$
Data unit:	m^3
Description:	Biogas combusted in year y
Source of data to be used:	Biogas quantity is calculated based on measured values using the Volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Calculated daily at least on hourly basis, based on measured quantity of biogas generated from anaerobic digesters of Mother Liquor Treatment Plant. i. e. $Q_{biogas,MLTP1}$ and $Q_{biogas,MLTP2}$.
QA/QC procedures tobe applied:	---
Any comment:	$BG_{burnt,y} = Q_{biogas,MLTP1} + Q_{biogas,MLTP2}$. Hence, combusted biogas will be calculated based on measured values at anaerobic digesters of MLTP. The methane content measurement shall be carried out on a dry basis at the same point (i. e. gas outlets at anaerobic digesters of MLTP) where the biogas flow measurement is carried out on a dry basis.

Data / Parameter:	$W_{CH4,y}$
Unit:	%
Description:	Methane content in biogas in the year *y*
Source of data:	the data is based on external Lab report as per standard.
Brief description of measurement methods and procedures to be applied:	Monitoring: The fraction of methane in the gas will be measured and monitored based on the biogas sample sent to external Lab for analysis.
QA/QC procedures to be applied (if any):	As per external lab testing SOP.
Any comment:	NA

Data / Parameter:	$T_{Biogas\ process}$
Unit:	°C
Description:	Temperature of the Biogas Process.
Source of data:	Biogas Process temperature is measured using thermometer and the data is recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured with the help of thermometer and the measured value is recorded in the log book which is available for verification.
QA/QC procedures to be applied (if any):	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	NA

Data / Parameter:	NCV_{Biogas}
Data unit:	GJ/m^3
Description:	Heating value of unit quantity of biogas
Source of data to be used:	Laboratory reports
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is analyzed by a NABL accredited laboratory. The NCV shall be measured on dry basis. Analysis will be done quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period. The result of measurement will be compared with measurements from previous years, relevant data sources (e. g. values in literature, national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, additional measurements shall be conducted.
QA/QC procedures tobe applied:	---
Any comment:	---

Data / Parameter:	Moisture
Data unit:	% water
Description:	Moisture content of the biogas
Source of data to be used:	Laboratory reports
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is measured and recorded monthly. This data will be archived by Paper mode. The weighted average value shall be calculated for each monitoring period and used in the calculations.
QA/QC procedures to beapplied:	---
Any comment:	The data will be archived up to 2 years after the completion of crediting period or last issuance whichever is later.

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/hour
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Source of data to be used:	Biogas quantity is measured using the Volume flow meter with totalizer and recorded in the plant log books.
Brief description of measurement methods and procedures to be applied:	Monitoring: It will be ensured that the same basis (dry) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ºC. Frequency: Continuously. Values to be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	QA/QC procedures as per ISO 22000:2018 to be implemented.
Any comment:	In the event of an emergency all the biogas generated will be sent to the flare for combustion. $FV_{RG,h} = Q_{biogas\ flaring}$

Data / Parameter:	T_{flare}
Unit:	^0C
Description:	Temperature in the exhaust gas of the flare
Source of data:	Measurements by project participants recorded in Plant records
Brief description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. Frequency: Continuously
QA/QC procedures to be applied (if any):	Thermocouples should be replaced or calibrated every year
Any comment:	The flare will only be operated during emergencies and therefore this parameter will only be monitored during such times. An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter:	Hrs_{flare}
Data unit:	Hours
Description:	Flare operating hours
Source of data to be used:	Plant records
Value of data:	0 (Not available as no flaring has taken place)
Brief description of measurement methods and procedures to be applied:	The flare will be operated only during emergencies. During such times, the operating hours of the flare will be monitored through the hour meter installed at the flaring stack.
QA/QC procedures to beapplied:	---
Any comment:	The flare will only be operated during emergencies and therefore this parameter will only be monitored during such times.

Data / Parameter:	$_{flare}$
Data unit:	%
Description:	Efficiency of flare
Source of data to be used:	As per the ‘Tool to determine project emissions from flaring gases containing methane’
Brief description of measurement methods and procedures to be applied:	Default value for open flare will be used. The efficiency is 0% if the flame is not detected for more than 20 minutes during the hour h; and 50%, if the flare is detected for more than 20 minutes during the hour h.
QA/QC procedures to beapplied:	---
Any comment:	The flare will only be operated during emergencies and therefore this parameter will only be monitored during such times.

Data / Parameter:	Q_{Steam}
Data unit:	tone’s/hour
Description:	Quantity of steam generated in the boiler RFB 60
Source of data to be used:	Plant records
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is Continuous monitored, integrated hourly and daily totalized recording with the help of calibrated meter which is available for verification. The meter shall be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated once in a three year.
QA/QC procedures to be applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	This will be totalized flow.

Data / Parameter:	Pr_{steam}
Data unit:	kg/cm^2 (g)
Description:	Saturated Steam pressure of boiler RFB 60
Source of data to be used:	Plant records
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured, integrated hourly and daily totalized with the help of Pressure Transmitter and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	NA

Data / Parameter:	T_{steam}
Data unit:	^oC
Description:	Steam temperature of boiler RFB 60
Source of data to be used:	Plant records
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured, integrated hourly and daily totalized recording with the help of temperature Transmitter and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	NA

Data / Parameter:	$T_{feed\ water}$
Data unit:	^oC
Description:	Feed water temperature of boiler RFB 60
Source of data to be used:	Plant records
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is continuously measured, integrated hourly and daily totalized recording with the help of temperature Transmitter and the measured value is recorded in the log book daily which is available for verification.
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	NA

Data / Parameter:	$EC_{PJ,Grid,y}$
Data unit:	MWh/year
Description:	Project activity electricity consumption from 132 KV sub-station electricity system
Source of data to be used:	Plant records
Brief description of measurement methods and procedures to be applied:	Monitoring: Energy meter reading at the boiler end, MLTP/WWTP end will be used to calculate the total project electricity consumption from regional electricity system.
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	NA

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Data unit:</td><td>tCO_2/TJ</td></tr>
<tr><td>Description:</td><td>Weighted average CO_2 emission factor of fuel type i in year y</td></tr>
<tr><td>Source of data to be used:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using</td></tr>
<tr><td>a) Value provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>b) Measurements by the Project participants</td><td>If, a) is not available</td></tr>
<tr><td>c) Regional of national default values</td><td>If, a) is not available
These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If, a) is not available</td></tr>
</table></td></tr>
<tr><td>Value of data:</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards
For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>Brief description of measurement methods and procedures to be applied:</td><td>--</td></tr>
<tr><td>QA/QC procedures to beapplied:</td><td>Applicable where Option B is used.
For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	Hrs_{DG}
Data unit:	Hours
Description:	Annual running hours of the DG sets for power supply during grid failure to MLTP and WWTP
Source of data to be used:	Plant records
Value of data:	
Brief description of measurement methods and procedures to be applied:	Monitoring: Data will be recorded in hrs. manually
QA/QC procedures tobe applied:	---
Any comment:	This data will be archived up to 2 years after the completion of crediting period or last issuance whichever is later.

Data / Parameter:	$Q_{FF,Diesel}$
Data unit:	M^3
Description:	Annual Diesel consumption in the DG sets for power supply during grid failure
Source of data to be used:	This data is measured using volume flow meter and recorded in the plant log books.
Value of data:	
Brief description of measurement methods and procedures to be applied:	Monitoring: Data is measured by means of using volume flow meter in m^3/hr.
QA/QC procedures tobe applied:	NA
Any comment:	Flow meter will be calibrated as per manufacturers specification

Data / Parameter:	Q_{sludge}
Data unit:	tonnes/year
Description:	Quantity of sludge generation in year y
Source of data to be used:	Plant records
Value of data:	0
Brief description of measurement methods and procedures to be applied:	Monitoring: Weighing through weigh bridge.
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	$Q_{sludge} = S_{i,PJ,y}$

Data / Parameter:	$Q_{sludge\ disposal}$
Data unit:	tonnes/year
Description:	Quantity of sludge disposed in year y
Source of data to be used:	Plant records
Value of data:	0
Brief description of measurement methods and procedures to be applied:	The final sludge will be used for land application for bio-Maturing by local farmers. It will be provided free of cost to them. Monitoring: Through plant records
QA/QC procedures tobe applied:	QA/QC procedures as per ISO 22000:2018 to be implemented
Any comment:	Land application activity is carried out by farmers located in the vicinity of the project site. Sludge will be given free of cost to them.

Data / Parameter:	$BE_{y,ex\ post}$
Data unit:	tCO_2e/year
Description:	Baseline emissions calculated using ex post values in year y
Source of data to be used:	Plant records
Value of data:	0
Brief description of measurement methods and procedures to be applied:	Baseline emissions shall be calculated annually based on ex post values of other parameters and recorded in plant log books.
QA/QC procedures tobe applied:	---
Any comment:	

Data / Parameter:	$PE_{y,ex\ post}$
Data unit:	tCO_2e/year
Description:	Project emissions calculated using ex post values in year y
Source of data to be used:	Plant records
Value of data:	0
Brief description of measurement methods and procedures to be applied:	Project emissions shall be calculated annually based on ex post values of other parameters and recorded in plant log books.
QA/QC procedures tobe applied:	---
Any comment:	

Data / Parameter:	MD_y
Data unit:	tCO_2e/year
Description:	Methane captured and gainfully used by the project activity in the year *y*
Source of data to be used:	Plant records
Value of data:	31920
Brief description of measurement methods and procedures to be applied:	Date type: Calculated
QA/QC procedures tobe applied:	---
Any comment:	

Ex-ante calculation of emission reductions:

As per AMS III.H. methodology,

Baseline Emissions (BE):

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

$BE_{power,y}$ = Baseline emissions from electricity or fuel consumption in year *y* (t CO_2e)

= 0

$BE_{ww,treatment,y}$ = Baseline emissions of the wastewater treatment systems affected by the project activity in year *y* (t CO_2e)

$$BE_{ww,treatment,y} = \sum_i (Q_{ww,i,y} * COD_{\inf low,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

Where,

$Qww_{,i,y}$	Volume of waste water treated	m^3/year
$CODinflow_{,i,y}$	COD inlet to Mother Liquor treatment	t/m^3
$\eta_{COD,BL,y}$	COD removal efficiency of the baseline treatment system i	
$MCFww_{,treatment,BL,i}$	Methane correction factor for the existing wastewater treatment system	
$Bo_{,ww}$	Methane generation capacity of the wastewater	kg CH_4/kg COD
UFBL	Model correction factor	
$GWPCH_4$	Global warming potential of methane	tCO2/tCH_4
$BEww_{, treatment,y}$	Baseline emissions from the anaerobic reactor	**tCO_2e/year**
$BEMLTP_{,y}$	Baseline emissions due to mother liquor treatment	

$BE_{ww,treatment,y}$ = 13870 x 0.388 x 0.80 x 0.80 x 0.25 x 0.89 x 21

= 16086 tCO_2e/year

$BE_{s,treatment,y}$ = Baseline emissions of the sludge treatment systems affected by the project activity in year *y* (t CO_2e)

= 0

$BE_{ww,discharge,y}$ = Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (t CO_2e). The value of this term is zero for the case 1(b)

= 0

$BE_{s,final,y}$ = Baseline methane emissions from anaerobic decay of the final sludge produced in year *y* (t CO_2e). 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

= 0

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

= 0+16086 + 0 + 0 + 0

= 16086 tCO2e/year

Methane captured and destroyed/gainfully used by the project activity in the year y (t CO2e)

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times FE \times GWP_{CH4}$$

Where:

$BG_{burnt,y}$ = Biogas[1] flared/combusted in year y (m^3)

$w_{CH4,y}$ = Methane content[13] of the biogas in the year y (volume fraction)

D_{CH4} = Density of methane at the temperature and pressure of the biogas in the year y (t/m^3)

FE = Flare efficiency in year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100 per cent may be applied

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times FE \times GWP_{CH4}$$

= 2083236.68 x 0.67 x 0.001089 x 100% x 21

= 31919.83 tCO2e/year

= 31920 tCO2e/year (round down value)

Project emissions

Project activity emissions from the systems affected by the project activity are

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

$PE_{power,y}$ = $PE_{Grid,y} + PE_{DG,y}$

$PE_{Grid,y}$ = $EC_{PJ,Grid,y}$ x $EF_{EL,Grid,y}$ x $(1 + TDL_{Grid,y})$

= (3663.18618 x 0.84 x (1+20%))

= 3691.01 tCO2e/year

$PE_{DG,y}$ = $EC_{PJ,DG,y}$ x $EF_{EL,DG,y}$ x $(1 + TDL_{DG,y})$

= (7.47 x 1.30) x (1 + 0)

= 9.715 tCO2e/year

$PE_{power,y}$ = $PE_{Grid,y} + PE_{DG,y}$

= 3691.01 + 9.715

= 3700.725 tCO2e/year

= 3701 tCO2e/year (rounded up value)

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

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

Symbol	Parameter
$Q_{ww,y}$	Volume of the waste water treated in the year
$COD_{inf\,ow,i,y}$	Chemical oxygen demand of the wastewater inflow to the project treatment system *i* in year *y* (t/m^3).
$\eta_{PJ,k}$	Chemical oxygen demand 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 project waste water treatment system k
$B_{o,ww}$	Methane producing capacity of the wastewater
UF_{PJ}	Model correction factor to account for model uncertainties
GWP_{CH_4}	Global Warming Potential for methane

Therefore,

$PE_{ww,treatment,y}$ = 1642500*4.438608*0.59*0.0*0.25*1.12*21
= 0.00 tCO_2e/year

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

$$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,dischrge}$$

$Q_{y,ww}$	Volume of waste water treated in the year m^3/day WWTPs
$COD_{,ww,discharge,y}$	Chemical oxygen demand of the treated wastewater inthe year
$B_{o,ww}$	Methane generation capacity of the wastewater
$MCF_{ww,PJ,discharge}$	Methane correction factor based on type of treatment and discharge pathway of the wastewater,

UF_{PJ}	Model Correction factor to account for model uncertainties
GWP_{CH_4}	Global warming potential of methane

Therefore,

$PE_{ww,\ discharge,y}$ = 1642500*0.00015*0.10*(0.25)*1.12*21
= 144.86 tCO_2e/year
= 145 tCO_2e/year (rounded up value)

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

Project activity emissions from methane release in capture systems are determined as follows,

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

Where,

$PE_{fugitive,ww,,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO_2e)

$PE_{fugitive,s,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (tCO_2e)

For this case, $PE_{fugitive,s,y} = 0$

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

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{0,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}$$

For the project activity, $PE_{fugitive,ww,y}$ are calculated separately for anaerobic digesters in Mother Liquor Treatment Plant (MLTP) and Waste Water Treatment Plant (WWTP) as follows

	For Mother Liquor Treatment Plant (MLTP)
CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
$MEP_{ww,treatment,y}$	Methane emission potential of waste water treatment systems equipped with biogas recovery system in year y
$Q_{ww,y}$	Volume of the waste water treated in the year
$B_{o,ww}$	methane generation capacity of the wastewater
UF_{PJ}	Model Correction factor to account for model uncertainties
GWP_{CH4}	Global Warming Potential for methane
$COD_{removed,PJ,k,y}$	Chemical oxygen demand removed by the treatment system k (45 m^3 Mother Liquor Treatment Plant) of the project activity equipped with biogas recovery equipment in year y
$MCF_{ww,treatment,PJ,y}$	Methane correction factor for the project wastewater treatment systems k equipped with biogas recovery equipment

$PE_{fugitive,ww,y}$	**Methane fugitive emissions on account of inefficiencies in capture systems in MLTP**
For Waste Water Treatment Plant (WWTP)	
CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
$MEP_{ww,treatment,y}$	Methane emission potential of waste watertreatment systems equipped with biogas recovery system in year y
$Q_{ww,y}$	Volume of the waste water treated in the year
$B_{o,ww}$	Methane generation capacity of the wastewater
UF_{PJ}	Model Correction factor to account for model uncertainities
GWP_{CH4}	Global Warming Potential for methane
$COD_{removed,PJ,k,y}$	Chemical oxygen demand removed by the treatment system k (120 m3 Mother Liquor Treatment Plant) of the project activity equipped with biogas recovery equipment in year y
$MCF_{ww,treatment,PJ,y}$	Methane correction factor for the project wastewater treatment systems k equipped with biogas recovery equipment
$PE_{fugitive,ww,y}$	**Methane fugitive emissions on account of inefficiencies in capture systems in WWTP**
$PE_{fugitive,y}$	**Methane fugitive emissions on account of inefficiencies in capture systems**

$PE_{fugitive,ww,y}$ for Mother Liquor Treatment Plant:

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

= ((45+75)*365)*0.25*1.12*(((146.31-29.26)/1000)*0.80)
= 43800 *0.25*1.12* (0.12*0.80)
= 1148.40 MT

$PE_{fugitive,ww,y}$ = (1-0.9) * 1148.40 *21
= 2411.64 tCO_2e/year
= 2412 tCO_2e/year (rounded up value)

$PE_{fugitive,ww,y}$ for Waste Water Treatment Plant:

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

= 1642500*0.25*1.12* (((1.818-1.179)/1000)*0.80)
= 1642500*0.25*1.12* (0.0006*0.80)
= 220.752 MT

$PE_{fugitive,ww,y}$ = (1-0.9) * 220.752*21
= 463.579 tCO_2e/year
= 464 tCO_2e/year (rounded up value)

Therefore,
$PE_{fugitive,y}$ = 2412 + 464
= 2876 tCO_2e/year

***Methane emissions due to incomplete flaring in year y* (PE$_{flaring,y}$)**

Step 1: Determination of the mass flow rate of the residual gas that is flared

PP has decided to use the biogas as a fuel in the boiler on continuous basis. In project scenario, residual gas will be flared if it is not used in any of the boiler. Hence,

$FM_{RG,h}$ = 0 (as $FV_{RG,h}$ is zero)

Step 2:

Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residualgas.

Mass fraction of carbon, hydrogen, oxygen and nitrogen will be derived if and when residual gas will be flared.

Step 5:

Determination of methane mass flow rate of the residual gas on a dry basis $TM_{RG,h}$

= 0 (as $FV_{RG,h}$ is zero)

Step 6:

Determination of the hourly flare efficiency

Hourly flare efficiency will be decided on the basis of flame detected per hour and accordingly the value 0.0 or 0.5 will be considered.

Step 7:

Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

Project emissions due to gas flaring will be calculated based on the actual data available.

Project activity emissions from the systems affected by the project activity are:

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

$= 3701 + 0 + 0 + 145 + 0 + 2876 + 0 + 0$

$= 6722\ tCO_2e/year$

$PE_{ww,y}$ = 6722 $tCO_2e/year$ (rounded up value)

Leakage:
The used technology equipment is not transferred from another activity hence leakage is not considered for this project activity.

Emission Reductions due to Mother Liquor Treatment ($ER_{ww,y}$)

$ER_{ww,y}$ = Baseline Emissions ($BE_{ww,y}$) – Project Emissions ($PE_{WW,y}$) – Leakage ($LE_{ww,y}$)

$= 16086.00 – 6722 – 0$

$= 9364.00\ t\ CO_2e/year$

As per AMS III. H. version 19, f*or cases 1 (b), 1 (c), 1 (d) and 1 (f)*, $ER_{y,ex\ post}$ will beas follows,

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

In following calculations for $ER_{y,ex\ post}$, the ex-ante values are considered only as a reference. $BE_{y,ex\ post}$ is calculated based on historical data of anaerobic lagoons and MD_y is calculated based on designed data for Mother Liquor Treatment Plant. During monitoring period actual values will be used for emission reduction calculations.

For Project activty,

$BE_{y,ex\ post} = BE_{ww,y} = BE_{ww,treatment,y}$

Hence,

$BE_{y,ex\ post}$ = 16086.00 $tCO_2e/year$

$PE_{y,ex\ post} = PE_{ww,y} = PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,discharge,y} + PE_{fugitive,y} + PE_{flaring,y}$

Hence,

$PE_{y,ex\ post} = 3701 + 0 + 145 + 2876 + 0$
$= 6722.00\ tCO_2e/year$

$LE_{y,ex\ post}$ = 0.00 $tCO_2e/year$

MD_y = 31920.00 $tCO_2e/year$

$PE_{power,y}$ = 3701.00 $tCO_2e/year$

$PE_{biomass,y}$ = 0.00 $tCO_2e/year$

$LE_{y,ex\ post}$ = 0.00 $tCO_2e/year$

Hence,

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

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

= min ((16086.00 - 6722.00 – 0.00), (31920.00 – 3701.00 – 0.00 – 0.00))

= min (9364.00, 28219.00)

= 9364.00 tCO_2e/year

Hence, Emission Reductions due to Mother Liquor Treatment

$ER_{ww,y}$ = $ER_{y,ex\ post}$
= 9364.00 tCO_2e/year

For AMS I.C.

__**Calculation of baseline emissions**__

As per paragraph 22 equation 2, the baseline emissions for steam produced using fossil fuels are calculated as follows:

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

Calculation for $EG_{thermal,y}$:

As per paragraph 17, $EG_{thermal,y}$ has been calculated based on historical data.

Steam flow : 100717803.00 kg/year (calculated as per historical data)
Steam pressure : 16.00 kg/cm^2 (g) (Historical data)
Steam temperature : 230^0C (Historical data)
Feed water temperature : 105^0C (Historical data)

Specific enthalpy of the steam at pressure of 16 kg/cm^2 (g) and 230^oC temperature = 684.25 kcal/kg

Net quantity of thermal energy supplied by the project activity during the year *y*
= 100717803.0 kg/year *(684.25 – 109.89) kcal/kg
= 57848277331.08 kcal/year
= 57848277331.08 kcal/year*4.186*10^{-9}
= 242.15 TJ/year

Net quantity of thermal energy supplied by the project activity during the year *y* = 242.15 TJ/year

As per AMS I.C. version 22, the efficiency of the baseline boiler has been determined based on the highest efficiency provided by both Thermal (89%) and Energy Pack (89%).

Therefore,

$\eta_{BL,thermal}$ = 89%

$EF_{FF,CO2}$ = 77.4 tCO_2/TJ

$BE_{thermal,y}$ = (242.15/89%) * 77.4

= **21059.14 tCO_2e/year**

$BE_{thermal,y}$ = 21059.00 tCO_2e/year (rounded down value)

<u>Calculation of project emissions due to FO consumption:</u>

$$PE_{FC,boiler,y} = \sum_{FO} FC_{FO,boiler,y} \times COEF_{FO,y}$$

Where,

Total project emissions ($PE_{thermal,y}$) **= 15,648.00 tCO_2e/year** (rounded up value)

Leakage ($LE_{thermal,y}$) **:**

Energy generating equipment is not transferred from another activity, hence leakage is notconsidered.

Biogas is generated, collected and transported within the project boundary, hence leakage is not considered.

$ER_{thermal,y}$ = $BE_{thermal,y}$ – ($PE_{thermal,y}$ + $LE_{thermal,y}$)
= 21059.00 – (15,648.00+ 0)
= 5411.00 tCO_2e/year

Total Emission Reduction:

The total Emission reductions by displacing the emissions from waste water treatment and FO forthermal energy generation are,

ER_y = $ER_{ww,y}$ + $ER_{thermal,y}$
= 9364.00 + 5411.00
= 14775.00 tCO_2e/year