



Monitoring Report

CARBON OFFSET UNIT (CoU) PROJECT



Title: Integrated Municipal Solid Waste Management Activities Programme, Nashik, India

Version 1.3

Date 22/04/2026

First CoU Issuance Period: 7 years, 11 months

Monitoring Period: 15/02/2017 to 31/12/2024

Monitoring Report (MR) CARBON OFFSET UNIT (CoU) PROJECT

Monitoring Report	
Title of the project activity	Integrated Municipal Solid Waste Management Activities Programme, Nashik, India
UCR Project Registration Number	UCR ID Number: 492
Version	1.3
Completion date of the MR	22/04/2026
Monitoring period number and duration of this monitoring period	Monitoring Period Number: 1 Duration of this monitoring Period: (first and last days included (15/02/2017 to 31/12/2024)
Project participants	Nashik Waste Management Pvt. Ltd. (NWMPL)
Host Party	INDIA
Applied methodologies and standardized baselines	Methodology Applied follows UNFCCC CDM Methodologies - ACM0022: Large-scale: Consolidated Methodology: Alternative waste treatment processes (Version 03.0) - AMS-I.D: Small-scale Methodology: Grid connected renewable electricity generation (Version 18.0)
Sectoral scopes	SS 1: Energy industries (renewable/non- renewable sources) SS 13: Waste handling and disposal
Estimated amount of GHG emission reductions for this monitoring period in the registered PCN	2017: 199785 CoUs (199785 tCO ₂ eq)
	2018: 82423 CoUs (82423 tCO ₂ eq)
	2019: 97914 CoUs (97914 tCO ₂ eq)
	2020: 105696 CoUs (105696 tCO ₂ eq)
	2021: 144560 CoUs (144560 tCO ₂ eq)
	2022: 151587 CoUs (151587 tCO ₂ eq)
	2023: 182800 CoUs (182800 tCO ₂ eq)
	2024: 134457 CoUs (134457 tCO ₂ eq)
Total:	1099221 CoUs (1099221 tCO₂eq)

SECTION A. Description of project activity

A.1. Purpose and general description of project activity >>

This Monitoring Report intends to document the ongoing project of an Integrated Municipal Solid Waste Management plant of Nashik City, Maharashtra, India, and assess the GHGs reduction accomplished by the project by converting the municipal solid waste (MSW) from the solid waste disposal site (SWDS) which would have emitted greenhouse gases (GHGs) into reusable, recyclable by-products akin to the Life Cycle Analysis (LCA) model. The project uses carbon accounting (CDM Methodology) to assess the carbon emissions reduced.

Collection of solid waste is done by the Nashik Municipal Corporation. Nashik Waste Management Private Limited (NWMPL) receives this solid waste (SW) from its management and further processing is done by NWMPL. The partial biodegradable component of mixed Municipal Solid Waste (MSW) is aerobically treated in a compost plant section to produce compost to be used in agriculture, and the leachate from the waste is anaerobically treated for energy recovery or biogas production. The partial-biodegradable/combustible component is further processed to make Refuse-Derived Fuel (RDF) to be used in boilers and incinerator project activity.

The plastic collected from dry waste is converted into fuel and part of it goes into Material Recovery Facility (MRF). The horticulture waste is used to manufacture biomass briquettes. Waste with a high organic pollution load that is leachate is converted into biogas ie. methane. The rejects go into a scientific landfill (SLF). The roof of the SLF is covered with plantation. Biomining targeted legacy waste from open landfills that have existed since 2000. Through biomining, materials were repurposed, and landfill space was reclaimed. The Dead Animal Carcass Incinerator processes dead animal carcasses using Refuse-Derived Fuel (RDF), plastic-to-fuel, and electricity generated from the biogas plant.

Installed solar panels on the site provide electricity to the plant, and are connected to the MSEB grid through a solar net metering system that allows for a "give and take" arrangement.

a) Purpose of the project activity and the measures taken for GHG emission reductions >>

Despite the Government of India's efforts to promote efficient waste management technologies and the Waste Management Rules, waste processing and disposal remains a challenge. The common practice is still of disposing MSW in landfills. In growing urban areas, the management of municipal solid waste (MSW) poses a significant environmental concern. The disposal of MSW, often in landfills, contributes to the emission of harmful gases like methane, carbon dioxide, and nitrous oxide further worsening air quality and accelerating climate change.

To address these pressing environmental challenges, the primary objective is to establish an integrated MSWM plant. This system aims to scientifically process the waste and efficiently utilise all its components, including biodegradable materials, RDF, inerts, and leachate. By doing so, we aim to minimize Methane and Carbon Dioxide emissions by processing and scientifically disposing all the MSW of Nashik city which will mitigate the adverse environmental impact associated with open dumping of MSW.

Before the implementation of Nashik Waste Management Private Limited (NWMPL) in 2017, the Municipal Solid Waste in Nashik was dumped in unsanitary landfills outside the city. The methane that was being released from the open waste would catch fire by afternoon. Hence there was release of methane and carbon dioxide, the two most hazardous greenhouse gases responsible for global

warming. This led to significant environmental damage to air, soil and water posing risk to both the environment and public health.

The MSW processing Plant was having a processing capacity of 500 Tons/day in 2017 and this has been augmented to an aggregate capacity to process 800 Tons/day in 2024, which is increased up to 1100 TPD during festivities.

The main purpose is to avoid methane and carbon dioxide emission through:

- *Composting and Compost Manufacturing* - Biodegradable municipal solid waste is processed in a compost plant using controlled aerobic decomposition. The windrow composting method is employed for this process. In windrow composting, organic materials are arranged in long rows called windrows. This method facilitates the efficient breakdown of waste. The result is nutrient-rich compost that supports soil health. It also reduces the need for chemical fertilizers. Additionally, this process helps divert organic materials from landfills. As a result, methane emissions are significantly reduced.
- *Biomass Briquettes* - Biomass briquettes are produced from horticulture waste. These briquettes serve as an alternative to fossil fuels, providing a renewable source of energy. This process not only reduces waste but also lowers carbon dioxide emissions by replacing coal.
- *Refuse-Derived Fuel (RDF) Plant* - The non-biodegradable portion of MSW is processed to manufacture RDF, which is used for generating electricity or supplied to various facilities as a source for thermal energy or electricity, replacing coal. This process reduces the volume of waste destined for landfills and provides an alternative energy source.
- *Plastic to Fuel* - This method involves converting plastic waste into fuel, addressing the issue of plastic pollution and reducing carbon emissions. By transforming plastic into a useful resource, the process mitigates the environmental impact of plastic waste. This reduces the plastic pollution and provides an alternative non fossil fuel.
- *Leachate to Gas* - In the leachate to gas process, waste with a high organic pollution load is converted into biogas. This biogas is then used as a fuel, reducing reliance on fossil fuels. Additionally, the biogas is converted into electricity for captive consumption, offering a sustainable energy solution. This process not only generates power but also supports environmental sustainability by providing an alternative to conventional energy sources.
- *Dead Animal Carcass Incinerator* - This incinerator processes dead animal carcasses with a capacity of 300 kg per hour. The use of diesel has been replaced by Refuse-Derived Fuel (RDF) and plastic-based fuel, reducing the carbon footprint and managing waste more effectively. It also takes care of the hazardous waste.
- *Biomining of Legacy Waste* - Biomining targeted legacy waste from open landfills that had existed since 2000. This process involved excavating and processing waste to separate and recycle valuable materials. The project spans 9 acres and was scheduled to last 60 months. Through biomining, materials were repurposed, and landfill space was reclaimed.
- *Scientific Landfill (SLF)* - The inerts from biomining of legacy waste and the inerts from daily MSW are disposed of in the sanitary landfill created for this purpose. This prevents the release of harmful gases into the atmosphere.

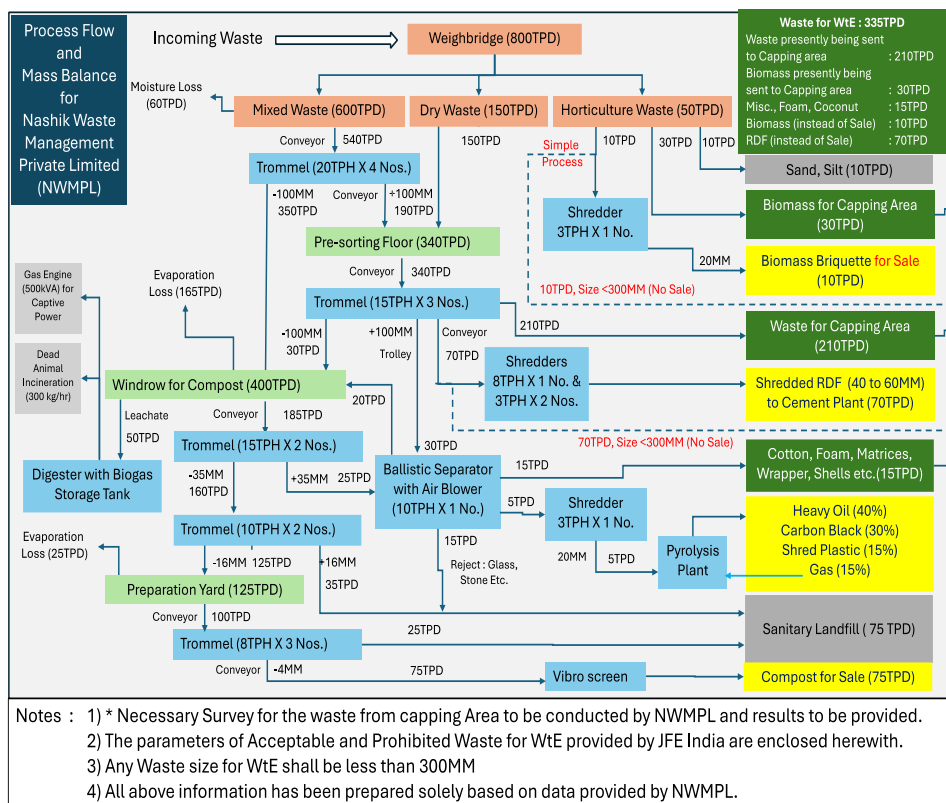
- *Solar Energy* –The integration of solar energy harnesses the power of the sun to generate clean electricity. This renewable energy source reduces dependence on fossil fuels and lowers greenhouse gas emissions. This dual approach—managing solid waste and harnessing solar power—demonstrates a comprehensive strategy to reduce carbon footprints and contribute to India's renewable energy targets. The NWMPL plant has recently installed solar panelling which reduces the dependence on energy produced by fossil fuel.

All these initiatives prevent the release of GHGs from MSW into the atmosphere, helping reduce the global warming and climate change risk.

b) Brief description of the installed technology and equipment>>

NWMPL employs a range of innovative waste management, renewable energy, and sustainable resource utilization technologies to reduce greenhouse gas (GHG) emissions and promote sustainable development. The technologies and measures included are:

1. *Composting*: Aerobic composting of organic waste with mechanized sorting and curing.
2. *Refuse Derived Fuel (RDF)*: Processing MSW into a fuel source through shredding, drying, and size reduction.
3. *Leachate Treatment*: Bio-methanation plant treating leachate and organic waste, producing biogas for energy generation.
4. *Biomass Briquetting*: Converting agricultural waste into briquettes for use as a fuel source.
5. *Plastic to Fuel*: Pyrolysis process converting plastic waste into fuel oil.
6. *Carcass/Dead Animal Incineration*: Controlled incineration of animal carcasses with proper emission controls.
7. *Scientific Landfill*: Scientific landfill with liners, leachate collection, and green cover.
8. *Solar Energy*: Solar photovoltaic (PV) modules are the basic power generators, which converts the sunlight into electrical power in the form of DC current.
9. *Biomining and capping of existing Legacy Waste*: Re-aligning and capping existing dumps to prevent environmental impacts.



Prepared & Checked by :
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Nashik Waste Management Pvt. Ltd.

Checked & Approved by :
Col. Suresh Rege
Nashik Waste Management Pvt. Ltd.

Date : 7th January, 2025

WtE Capacity Calculation	
Waste presently being sent to Capping area	: 210TPD
Biomass presently being sent to Capping area	: 30TPD
Misc., Foam, Coconut	: 15TPD
Biomass (instead of Sale)	: 10TPD
RDF (instead of Sale)	: 70TPD
Sub-Total of Waste (A)	: 245TPD
In Case, Biomass Briquette Sale & Shredded RDF Sale to Cement Plant is stopped, the said waste will be available for WtE. Plus, making the briquette and small size shredding for RDF can be stopped. And, Simple cutting up to 300MM size for WtE is sufficient. Hence, additional waste available would be -	
Waste from Biomass	: 10TPD
Waste instead of RDF	: 70TPD
Sub-Total of Waste (B)	: 80TPD
Total Waste Available (A+B)	: 335TPD
Waste Availability per Year	: 365 Days
Less Machinery Downtime days: 15 Days	
Waste Available Days	: 350 Days
WtE Plant Operation per Year	: 330 Days
Waste Available for WtE	= 335*350/330 = 355 TPD
WtE Capacity Selected = 450TPD	
Deficit Waste for WtE will be made up	

c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)>>

UCR Project ID or Date of Authorization: UCR ID Number: 492

Start Date of Crediting Period: 15/02/2017

Project Commissioned: 01/01/2017

The project activities dates are as follows:

Sl. No	Title of Project Activities	Starting Date of Project Activity	Last Date of the First Crediting Period
0	Pre-Sorting	15/02/2017	31/12/2024
1	Composting	15/02/2017	31/12/2024
2	RDF Production	15/08/2017	31/12/2024
3	Leachate Treatment Plant (LTP)/ Biomethanation	15/02/2017	31/12/2024
4	Biomass Briquetting	15/04/2022	31/12/2024
5	Nashik Plastic to Fuel	19/03/2023	31/12/2024
6	Dead Animal Incinerator	15/02/2017	31/12/2024
7	Reject To Landfill	15/06/2018	31/12/2024
8	Solar Energy	13/09/2024	31/12/2024
9	Biomining and capping of existing Legacy Waste	15/02/2017	31/12/2024

d) Total GHG emission reductions achieved or net anthropogenic GHG removals by sinks achieved in this monitoring period>>

The total GHG emission reductions achieved in this monitoring period is as follows:

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of this Monitoring Period	15/02/2017
Carbon credits claimed up to	31/12/2024
Total ERs generated (tCO ₂ eq)	1099221 tCO ₂ eq
Leakage	239497 tCO ₂ eq

e) Baseline Scenario>>

According to the CDM glossary ‘Baseline Scenario’ refers **Baseline for a CDM project activity** (non-A/R) or **CPA** (non-A/R), the scenario for the CDM project activity or CPA that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the CDM project activity or CPA.

And Baseline Emission refers to the GHG emissions that would occur in the baseline scenario.

When MSW lies untreated it emits a heavy amount of methane. The quantity of this methane emitted from open landfills forms the baseline emissions. Baseline emissions are assessed using methodology equation 1 from ACM0022 Version 3.0 (EB111) and are made up of the following:

The baseline scenario identified at the PCN stage of the project activity is:

- Methane emissions from the SWDS without any waste processing or treatment, of both legacy waste and daily waste.
- Carbon emissions from fossil fuel-based electricity consumed from the grid.
- Carbon emissions from transport within the plant.

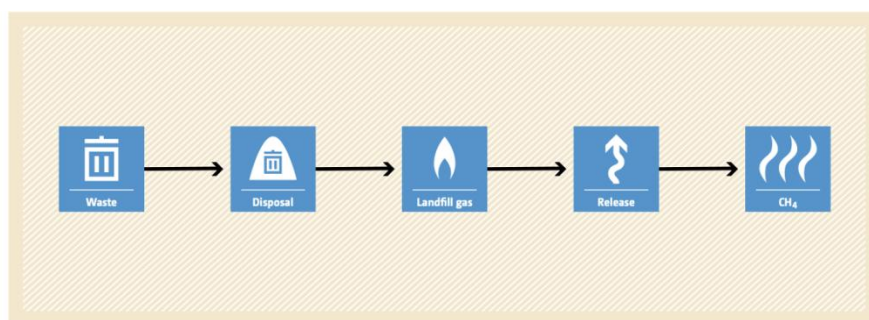
Baseline Scenario for a PCN project is the total amount of emissions that would occur in the absence of the project activity. In the absence of the project activity, open Municipal Solid Waste (MSW) emits huge amounts of methane (CH₄), and also some carbon dioxide (CO₂) and nitrous oxide (N₂O). The methane is multiple times more potent than carbon dioxide and is a huge factor in increasing the climate change risk. Thus, assessing the total GHG emissions of untreated legacy and daily waste gives the baseline scenario for a PCN project dealing with MSW.

In a project, if fossil-based electricity is consumed it has a carbon footprint due to the carbon emissions of fossil-based fuel. The carbon emissions that result from electricity thus produced, when assessed forms the baseline for fuel-based electricity consumed from the grid.

In the plant when there is movement of transport that uses fossil-based fuel, there are carbon emissions. The total carbon emissions, thus assessed assuming that only fossil fuel is used for transportation forms the carbon emissions from transport within the plant.

BASELINE SCENARIO

Disposal of the waste in a landfill site without capturing landfill gas or with partly capturing and subsequently flaring it.



A.2. Location of project activity>>>

The geographical area, within which all component project activities are included in this MR where the plant is situated in the state of Maharashtra, in the territorial boundary of India, the Host Country.

Country: India

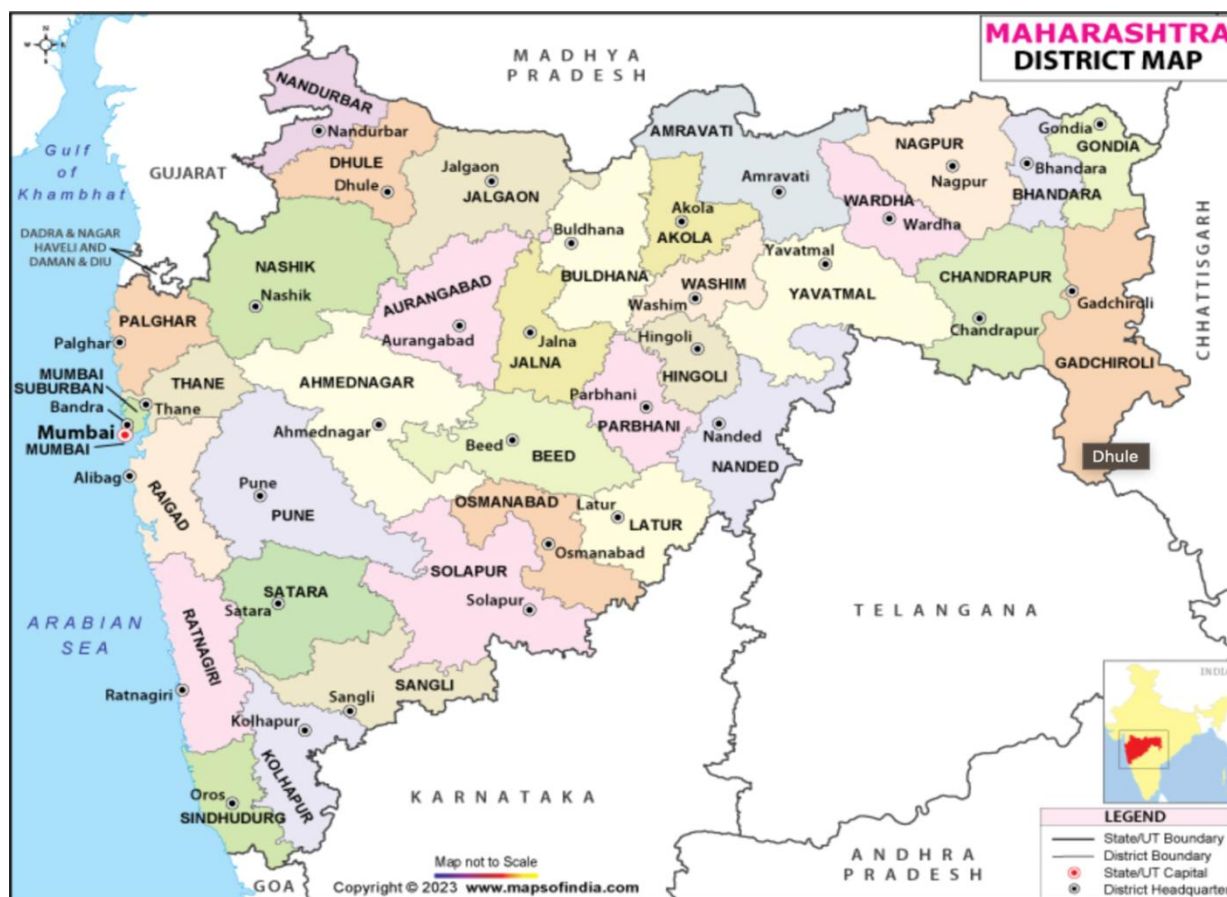
District: Nashik

Village: Pathardi Shivar

Tehsil: Nashik

State: Maharashtra

Pincode: 422010





Coordinates of the plant are:

	Co-ordinates
Latitude	19.933564
Longitude	73.7393

Address: Nashik Khat Prkalpa, Gaulane Phata, Pathardi Shivar, Mumbai - Agra Road, Nashik – 422 010

A.3. Parties and project participants >>

Party (Host)	Participants
India	Name of Project Owner: Nashik Waste Management Pvt. Ltd. (NWMPL) Aggregator: Dr. Priti Mastakar.

A.4. References to methodologies and standardized baselines >>

SECTORAL SCOPE - 01 Energy Industries (Renewable/Non-renewable sources)
13 Waste handling and disposal

TYPE 1 & 3 - Large-Scale Project – Waste Handling and Disposal

CATEGORY - Methodology Applied follows UNFCCC CDM Methodologies

- ACM0022: Large-scale: Consolidated Methodology: Alternative waste treatment processes (Version 03.0)
- AMS-I.D: Small-scale Methodology: Grid connected renewable electricity generation (Version 18.0)

Reference	Tools - Methodology - Large Scale & Small Scale	Version	EB
Tool 01	Tool for the demonstration and assessment of additionality	7.0.0	EB 70 annex 08
Tool 02	Combined tool to identify the baseline scenario and demonstrate additionality	7.0	EB 96 annex 03
Tool 03	Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion	3	EB 96 annex 4
Tool 04	Emissions from solid waste disposal sites	8.1	EB 94 annex 7
Tool 05	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation Table to calculate baseline, project and/or leakage emissions from electricity consumption	3.0	EB 96 annex 5
Tool 06	Project emissions from flaring Spreadsheet for calculating project emissions from flaring	4.0	EB 113 annex 10
Tool 07	Tool to calculate the emission factor for an electricity system Table to calculate the emission factor for an electricity system (version 04.0)	7.0	EB 100 annex 4
Tool 08	Tool to determine the mass flow of a greenhouse gas in a gaseous stream Table to determine the mass flow of a greenhouse gas in a gaseous stream	3.0	EB 87 annex 10
Tool 13	Project and leakage emissions from composting	2	EB 96 annex 6
Tool 14	Project and leakage emissions from anaerobic digesters	2	EB 96 annex 7

- For Project baseline emissions calculations for biomining of legacy waste, Chapter 3, Solid Waste Disposal, 2006 IPCC Guidelines for National Greenhouse Gas Inventories:
Microsoft Word - V5_Ch3_SWDS_Final_v2.doc

A.5. Crediting period of project activity >>

Length of the crediting period corresponding to this monitoring period: 7 years 11 months –
15/02/2017- 31/12/2024

A.6. Contact information of responsible persons/entities >>

1. Dr. Priti Mastakar
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SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity >>

a) Provide information on the implementation status of the project activity during this monitoring period in accordance with UCR PCN>>

List of Equipment & Machinery at NWMPL Nashik			
Sr. No	Sections	Machine Name	Nos.
1	Pre-sorting Section	Trommel 15 TPH	5
		Feeding Conveyors	5
		Discharge Conveyors	10
2	RDF Section	Trommel 15 TPH	1
		Feeding Conveyor	1
		Discharge Conveyors	2
		Trommel 15 TPH	1
		Feeding Conveyor	1
		Discharge Conveyors	2
		MRF Facility 8 TPH	1
		Apron Feeder	1
		Segregation belt	1
		Baling Machine 1 TPH	1
		Shredder 10 TPH	4
		Feeding Conveyors	4
		Discharge Conveyors	4
		Trommel screen-50 mm	2
		Ballistic Separator	1
		Feed-Discharge Conveyors & Hoppers	2
3	Preparatory Section	Trommel 15 TPH	2
		Feeding Conveyors	2
		Discharge Conveyors	4
4	Compost Section	Trommel 4mm	3
		Feeding Conveyors	3
		Discharge Conveyors	4
		Vibratory Screen	1
		Feeding Conveyors	1
		Discharge Conveyors	2
		Weighing & packing machines	2
5	Biomass Processing Section	Trommel 10 TPH	1
		Feeding Conveyors	1
		Discharge Conveyors	2
6	Biomass shredding machine	Mega and small Biomass shredders	3
		Feed & Discharge conveyors	2
7	Briquetting Machine	Briquetting machine with Screw Conveyor	1
		Biomass Shredder	2
8	Leachate Treatment Plant	Leachate Collection unit	1
		Leachate Processing & recycle unit	1
9	Biogas Plant	Pre-digester & Anaerobic Digesters	2
		Buffer Tank, Neuralization & Settling Tank	2
10	Incinerator	Loading and Feeding Unit	1
		Combustion Chambers	2

		Air Pollution Control Devices	3
11	Reject reprocessing Unit	Radial Loading System	1
		Feed Conveyors & Hoppers	2
		Trommel - 15 TPH	1
		Discharge and Product Conveyors	2
12	Biomining unit	Feed Conveyors & Hoppers	2
		Trommel & Vibroscreen - 10 TPH	2
		Discharge and Product Conveyors	3
13	Plastic to Fuel Plant	Pyrolysis Technology based Unit	1
14	Weigh Bridge unit	50 Tons Capacity electronic WB	2
15	Analytical Testing Lab	Instruments required for testing Waste, Water & Compost	1

Start Date of each project activity

Sl. No	Title of Project Activity	Starting Date
0	Pre-Sorting	15/02/2017
1	Composting	15/02/2017
2	RDF Production	15/08/2017
3	Leachate Treatment Plant (LTP)/ Biomethanation	15/02/2017
4	Biomass Briquetting	15/04/2022
5	Nashik Plastic to Fuel	19/03/2023
6	Dead Animal Incinerator	15/02/2017
7	Reject To Landfill	15/06/2018
8	Solar Energy	13/09/2024

b) For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate>>>

The description of the installed technologies, technical processes, equipment, and diagram for each project activities are as follows:

1. Compost Plant

List of Systems & facilities equipment: Typically involves a series of processing stages, from initial sorting and composting to curing and screening.

- Weighing machine
- Sorting Trommel 100 mm
- Mechanical Rotary Vibro-screens
- Composting windrows
- Excavators
- Microbial inoculant preparation system
- Trommel screens (35 mm & 16 mm)
- Gravity separators
- Refinement section

❖ **Aerobic Composting Methodology-** The bio-degradable part of the municipal solid waste is composted aerobically with suitable Bio-culture addition and properly maintaining moisture, air, temperature and the C: N components and the stabilized organic waste after completion of Composting, Maturing and Curing process is screened by mechanical Rotary and Vibro-screens to achieve fine quality City compost as a finished product.

❖ **Process Details:** The treatment of the municipal solid waste is fully mechanized and environment friendly too. The treatment process has three stages of treatment such as Pre-sorting, Composting and Mechanical processing.

❖ **Pre-sorting:** The solid waste received at the processing unit will be unloaded at the pre-sorting section after weighment. After manual sorting of large objects, the materials will be fed to the mechanized sorting trommel 100 mm, objects above 100 mm will be sent for RDF or as inert based on their nature and use. The matter below 100 mm will be high in organic contents and will be transferred to the composting yard for windrow preparation.

❖ **Composting Process:** The organic rich materials after pre-sorting will be unloaded in a pre-scheduled area of the composting yard. After applying the necessary quantity of microbial inoculant slurry preparation along with sufficient moisture, windrows (heap) are formed to facilitate composting. The width at the bottom of the windrow may be up to 3 or 4 meters and height is up to 2-3 M. The length varies depending on the quantity of material received. Further the windrows are layered with compostable organic materials and turned intermittently in such a way as to maintain the entire windrow contents in aerobic condition. The moisture content of the windrows is maintained as 45-55%. Within two days, temperature of the windrows goes up to 65-70 degree Celsius due to thermophilic bacterial and fungal activity. Once every week the windrows are turned and mixed thoroughly to homogenize the material using excavators. After 3 to 4 turnings during a period of 25 to 30 days, the partially composted garbage will be shifted for maturing and curing stages and further subjected to mechanical screening.

❖ **Mechanical Process:** The mechanical processing system consists of different types of automated trommel screens with different sieve sizes of 35 mm and 16 mm, in which majority of the inorganic and inert materials get removed and the sieved organic materials below 16 mm size will then keep for curing process. All pathogenic microorganisms in the garbage will be destroyed due to the high temperature persisting in the windrows and curing heaps and compost get sanitized. During the curing process, the composting process will gradually come to an end over a total period of 30-35 days. Later on, the composted matter will be refined through a 4 mm size trommel screen followed by gravity separators. In these stages materials above 4 mm size, sand, silt etc. are removed. The remaining free flowing powdery compost is then stored in batches for Quality check. Batches showing deviation from quality standards will be refined once again through the refinement section thus the excess inerts will be removed to ensure the quality. Mixing the refined compost collected over a period of two to three weeks will increase the homogeneity in the physical and chemical properties. Packing of the compost will be done on demand.

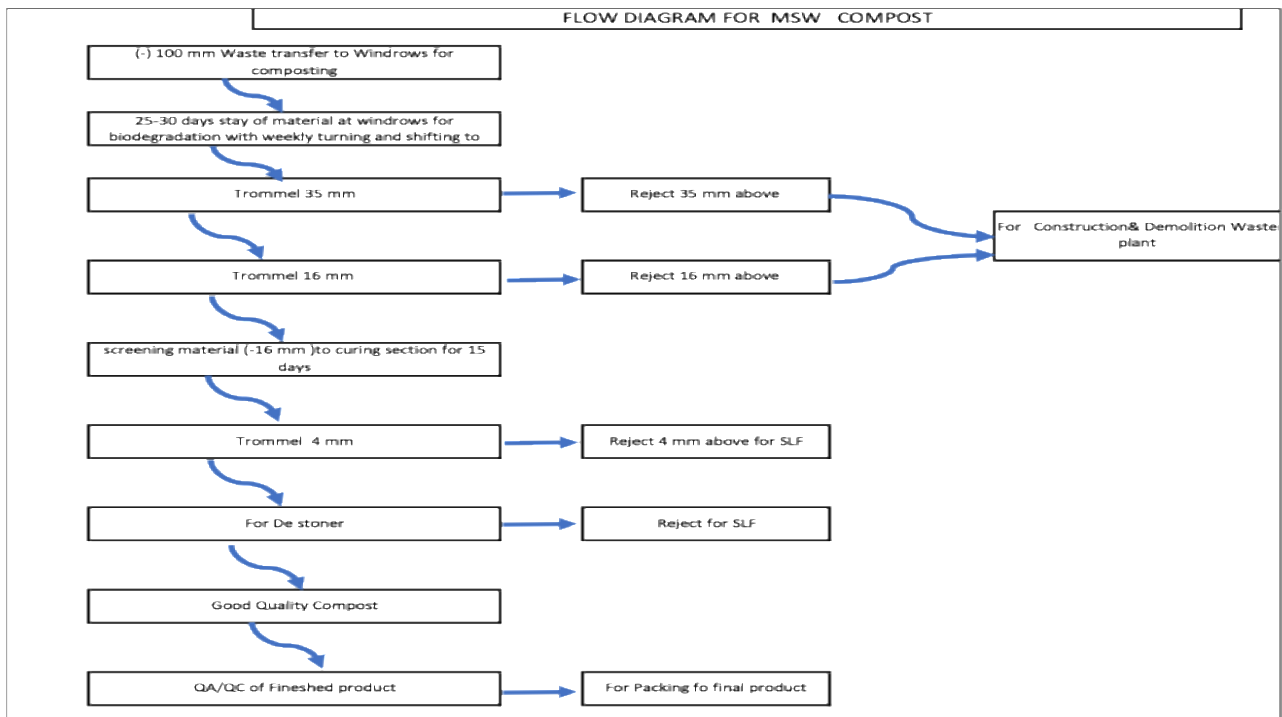


Figure 1: Composting



2. RDF Plant

List of Facilities, Systems and Equipment: Includes a sequence of processes: sorting, shredding, drying, size reduction, and optional densification.

- 100 mm & 50 mm Trommel screens
- Sorting belt conveyor
- Magnetic Separation Unit
- Shredding/Crushing System
- Drying system

- Size reduction Unit
- Densification / Palletisation Unit (optional)

Refinement cum Fuel Production Process

The conversion process of MSW into Coarse fuel fluff involves the following processes:

- Homogenizing
- Drying
- Segregation
- Size reduction (optional)
- Densification / Palletisation (Optional)

The particle size of MSW varies widely and it is difficult to handle MSW unless the particle size is homogenized. The incoming MSW fraction separated by initial 100 mm size trommels is further passed through a 50 mm size trommel screen for removal of small size organic matter, which sent back to composting. The oversize material is further sent to a Shredding/ Crushing System. Before putting the MSW into the crushing system, manual sorting of large pieces of stones, tyres, recyclables, etc. are done on a sorting belt conveyor. The heavy non-combustible fractions of MSW like stones, glass etc. and dense combustibles like woody biomass, large textiles etc are separated and sent for further re-disposal. A Magnetic Separation Unit is also attached to the sorting conveyor to remove ferrous particles. MSW coming out of the Primary Crushing System is spread over a paved yard to allow it to release the surface moisture.

MSW in Nashik (urban area) has generally been found to have high moisture content of up to 45-50% even during non-rainy days and requires drying to produce fuel fluff /pellet with reasonable heating value. Initial atmospheric or solar drying helps the MSW to have average moisture content of 35%. Additional drying system reduces its moisture content from 35% to 15%.

The dried and segregated material is further shredded to 25-50 mm particle size in a special purpose Size reduction Unit to produced FUEL FLUFF. For the purpose of storing and transportation of fuel fluff for further use at remote place, the same can be baled. In case of direct selling to market, the Fuel Fluff can be densified in the Special Purpose Densification Unit to produce fuel pellets.

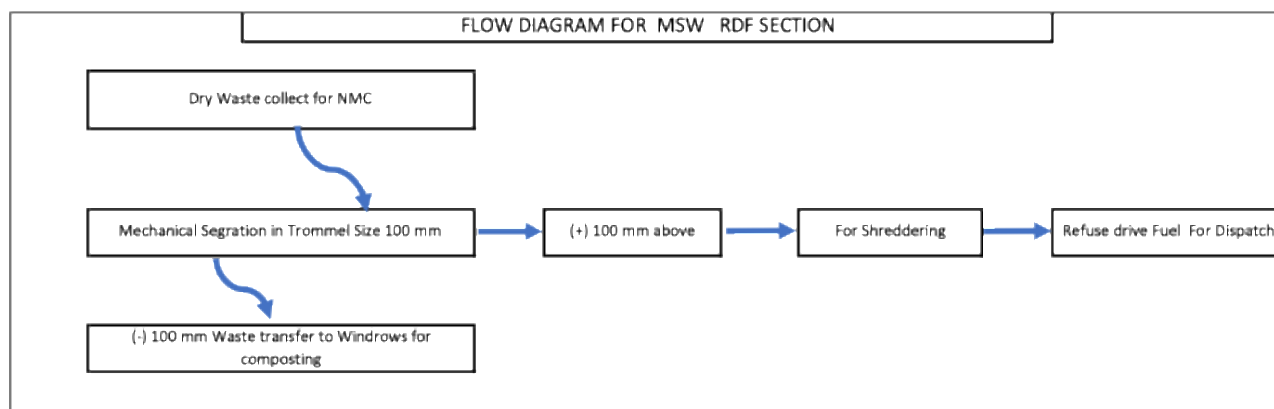
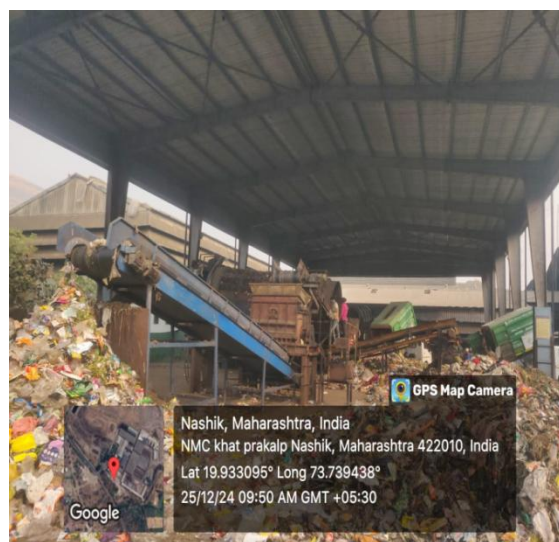


Figure 2: RDF Production



3. 600 cum/day Leachate Treatment Plant

List of Facilities, Systems and Equipment: A multi-stage process involving screening, equalization, anaerobic digestion, aeration, clarification, filtration, and biogas utilization.

- Screen Chamber (basket & bar screens)
- Equalization Pond
- Pulveriser
- Belt conveyor
- Mixing chamber
- Anaerobic Digester (MUASB)
- Biogas Balloon
- Aeration tank
- Clarifier tank
- Pressurized Sand Filter
- Activated Carbon Filter
- Biogas compressor
- Biogas scrubber
- Biogas Genset
- Sludge drying bed

Among the various types of the waste treatment, Biomethanation Plant is an effective method of treating the organic waste with high BOD and COD level. 5-10 Ton per day segregated organic municipal solid waste (comprising of hotel waste and high moisture dripping waste) and 0.4 MLD leachate from compost plant is treated through Biomethanation Plant.

In the first stage the segregated organic municipal solid waste will be taken on unloading ramp and inspection will be done to ensure that inappropriate materials like plastic, metal, rubber, glass, cloth etc. are not fed to the plant. The non – biodegradable waste will be removed. This reject waste will be collected and sent for onward disposal / recycle.

The leachate from compost area and other process area is conveyed through pipes and drains to the Screen Chamber. Screen chamber is provided with combination of basket & bar screens. The basket screens help in retaining bigger sized particles, pieces of plastic, paper & wood material, rags and other large debris.

The screened Leachate from all the lines will be then collected in the existing leachate well or Equalization Pond. The quantity of flow and concentration of leachate effluent is not constant and varies with season. The purpose of Equalization Pond is to dampen these variations or equalize the flow in terms of both quantity & concentrations.

In the second stage segregated organic municipal solid waste will be transferred from unloading ramp to pulveriser through belt conveyor. The organic waste will be then crushed in the pulveriser along with the water / overflow from digester to form slurry. This slurry will be then collected in mixing chamber and further under gravity / pumped into the Anaerobic Digesters.

The leachate collected in the equalization pond will be further screened and under gravity / pumped into the Anaerobic Digester.

In the third stage - High degree of BOD and COD reduction takes place in the anaerobic digester. The design principle is based on Modified Up-flow Anaerobic Sludge Blanket process (MUASB). The digester is equipped with internal proprietary modules, baffles and launders to ensure high solid retention. In the Anaerobic Digester, the segregated organic municipal solid waste and leachate will be converted to Biogas, Organic Manure and Liquid Organic Overflow.

Fourth Stage – The Biogas generated will be collected in a unique dry membrane type of biogas holder called biogas balloon.

The overflow from anaerobic digester will be allowed to flow to aeration tank for second stage of biodegradation. Aerobic degradation will be carried out using microorganisms and diffused aeration. Overflow from aeration tank will be allowed to go to clarifier tank for settling of suspended solids. Settled sludge from clarifier tank will be partly recycled back to aeration tank and the rest will be removed periodically. From clarifier tank the clear supernatant will overflow to the sump. The overflow will be pumped to the Filtration Unit - Pressurized Sand Filter & Activated Carbon Filter for removal of residual suspended solids, odour and colour. Disinfection will be done online to the outlet of Filtration Units. Part of the treated overflow will be recycled at the pulveriser for slurry preparation.

Fifth Stage – The Biogas stored in the Biogas Balloon will be pressurized with the help of biogas compressor. This pressurized biogas will be further passed through biogas scrubber for removal of H₂S up to the permissible limit and then fed to 100% Biogas Genset provided for generation of power i.e. electricity. If the Biogas is not in use, it will be flared. The electricity generated will be used for captive consumption of Biogas Plant and partly for supply to Dead animal Incineration system.

The sludge from the bottom of the digester will be removed periodically and collected in the drain chamber. Further it will be put on the sludge drying bed for the removal of moisture content through natural process of sun drying. The end product after sun drying can be used as good organic manure for gardening / agricultural purpose.

Biomass briquettes are built from recycled green waste, producing less greenhouse gas emissions because the matter has already completed part of the carbon cycle.

Process of Biomass Briquetting:

Nashik Waste Management Pvt. Ltd. utilizes horticultural waste as a primary raw material. This Horticultural waste is initially segregated to remove all the unwanted material; segregated material is then stored in a designated area within the plant. The collected waste is then shredded into smaller, uniform particles to facilitate efficient processing. Subsequently, the shredded material is subjected to a drying process, typically under the sun, to reduce its moisture content. Once sufficiently dried, the biomass is fed into a briquetting machine. This machine compresses the material under high pressure, forming dense, solid briquettes. These briquettes serve as a sustainable and environmentally friendly fuel source in Boiler/ furnaces etc, suitable for various industries that require combustion for their operations.



5. Plastic to Fuel:

List Facilities, Systems and Equipment: Involves stages of sorting, size reduction, pyrolysis, condensation, separation, and gas recycling.

- De-duster Machine
- Agglo Machine
- Pyrolysis reactor
- Condenser
- Gas liquid separation unit
- Gas holder balloon
- Compressor
- Burner
- Cooling tower

❖ Sorting and Size reduction:

After pre-sorting process, segregated plastic materials like HDPE, LDPE and PP material plastic are segregated and cleaned in De-duster Machine.

Agglo machine: Cleaned plastic materials are further shredded and made into granule. The process carried out is in the absence of oxygen with the temperature range from 450- 600 degree Celsius. Initially the reactor is heated with Primary fuel like LDO at a suitable flow rate. During the process, pyro gas generated is recycled back in the reactor and used as secondary fuel.

❖ Pyrolysis Process:

Heat is supplied to the bottom of reactor to raise its required temperature. The material is slowly fed into the reactor and required ratio of catalyst is added into the system. During the De-polymerization Process the long chain bonds are broken into small chain. The reactor is enclosed with Aluminium cladding for thermal insulation. This thermal insulation will reduce the heat losses and save the energy required for the process.

❖ **Condensation Process:**

After Small Chain depolymerization, gas vapours generated are passed through condenser to bring down high temperature gas vapours into room temperature and convert vapours into Pyro liquid and Pyro Gas.

Vapours are conveyed through tubes in counter flow direction for effective condensation.

Water is continuously circulated through mono-block pump in counter flow direction to absorb heat and despite heat in cooling tower.

❖ **Separation Process:**

The condensed fluid is collected in gas liquid separation unit, the liquid settles at bottom. The gas is collected in gas holder balloon. Settled Pyro liquid or Liquid Fuel is further transferred into fuel tanks and transported to end application usage.

❖ **Recycle of Pyro gas:**

Gas collected in balloon is recycled and reused as secondary fuel. Stored Gas is compressed at 0.4 to 0.6 bar by the compressor; the compressor is monitored with pressure gauge and operated in Auto mode. Both Compressed gas and compressed air mixed in unit is passed to burner. The combustion over the burner will raise the temperature of reactor to convert waste plastic into fuel. The excess unused gas is flared.

❖ **Online temperature display system:**

The process is mainly dependent on the temperature, the resistance-based sensor fitted in every stage to closely monitor it.

❖ **Safety measure:**

Mechanical pressure relief valve (PRV) is fitted over the reactor to maintain pressure less than 0.4 bar.

Electronic pressure switch is fitted over compressor to regulate pressure in compressed stored tank.

❖ **Application of Pyro oil:**

As a fuel for incinerator and other heat applications in process.



Figure 4: Nashik Plastic to Fuel

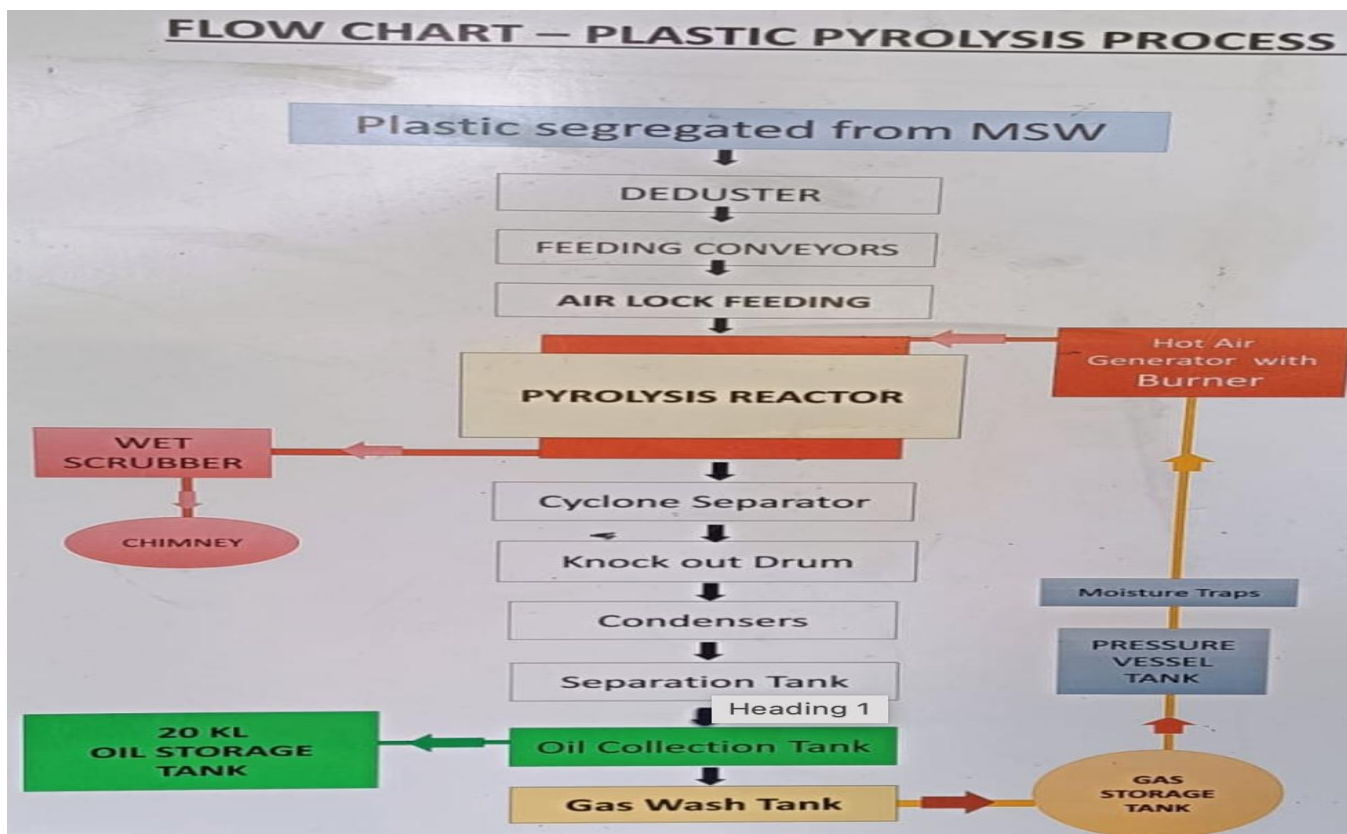


Figure 5: Nashik Plastic to Fuel



6. Dead Animal Carcass Incineration

List of Facilities, System and Equipment: A dedicated incineration facility with equipment for loading, combustion, and emission control.

Standard Operating Procedures:

Step One:	First load the animal waste (wt. Between 20 Kg to 500 Kg) at the furnace bed by overhead crane.
Step Two:	Then the dead animal waste is covered with a mixture of RDF & Biomass as a fuel.

Step Three:	Now after Closing the bed, primary burner is started with F.D. 1&2 and immediately turning on the I.D.
Step Four:	After few minutes the secondary burner is turned on, the secondary combustion must be done for 15-30 minutes after charging the incinerator with dead waste
Step Five:	Then Charging of the incinerator with small size waste and closing the Hydraulic gate is done after 30 mins of secondary combustion.
Step Six:	Maintain Two-hour average temperature of 500°C -700°C during waste combustion cycle until all waste is incinerated to ashes/bone-chips.
Step Seven:	All incinerator emissions must be vented through the single stack exhausting the incinerator.

List of Equipment

Sr. No	List of Equipment of Incinerator	Unit	Quantity
1.	F.D Fan with motor	5 H.P.	2
2.	I.D. Fan with motor	25 H.P.	1
3.	Incinerator Bed for Large Animals with motor	5 H.P.	1
4.	Small Animal Feeding Hydraulic Bed with motor	5 H.P.	1
5.	Diesel feeding pump with motor	0.5 H.P.	1
6.	Burner	0.33 H.P.	4
7.	Recirculating Pump	5 H.P.	1
8.	Venturi Scrubber		1
9.	Chimney (Height-30 mtr.)		1

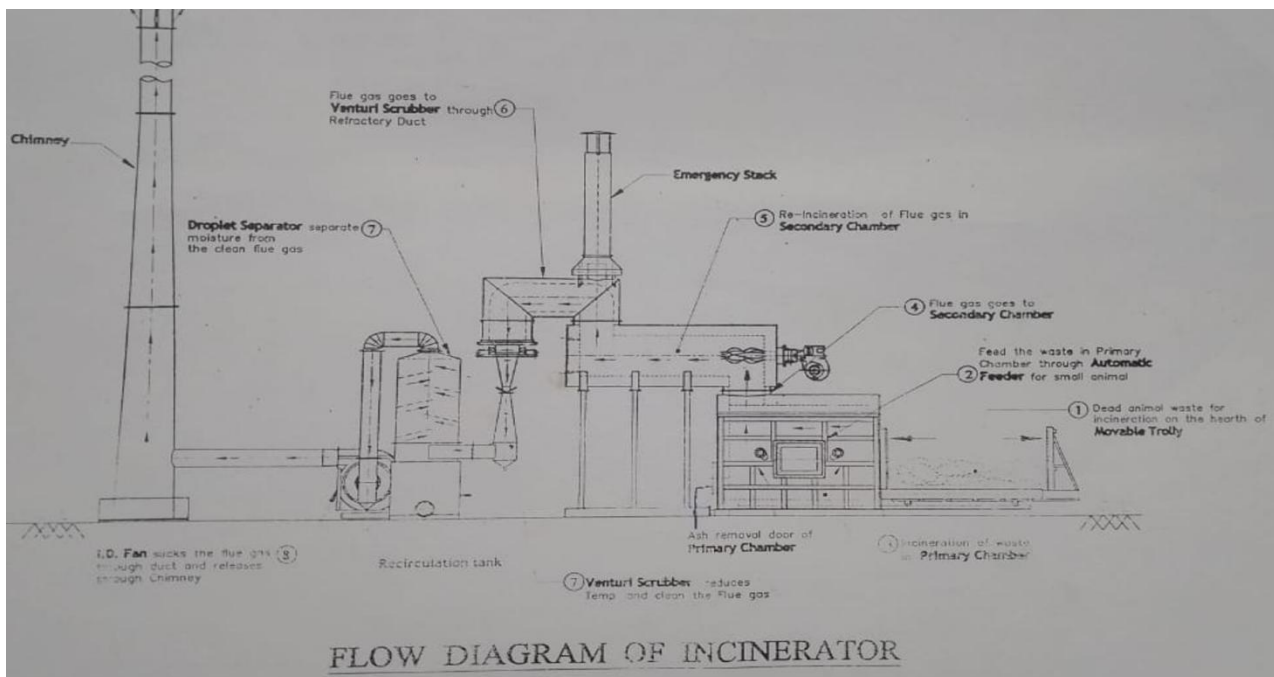


Figure 6: Dead Animal Incineration



7. Scientific Landfills (SLFs):

List of Facilities, System and Equipment: A carefully engineered site with layers of liners, drainage systems, and a final cover.

- Bulldozer
- Compactor
- Geo-synthetic Clay Liner (GCL)
- HDPE liner
- Geotextile (GT)
- Gravel layer
- HDPE Pipes

Conceptual Design of Landfills

The available area at existing waste Landfill site is properly utilized to fill and dispose the inert waste scientifically after separating the inerts and rejects from the MSW processing plants. Phase I of existing dump is being capped and Phase II is being capped presently.

Area cleared from shifting and Biomining of waste will be used for development of new landfill.

Landfill Base - Sealing System

SLF is designed in accordance with SWM Rules 2016.

- i. The side slopes will be 1V:2.5H. The slope and 300mm thick soil will be compacted with roller to get 95% proctor density compaction.
- ii. A Geo-synthetic Clay liner (GCL) will be placed on top of the compacted soil.
- iii. A 1.5 mm thick liner will be used on top of the GCL layer. The geomembrane layer is used as it has a very low permeability of 1×10^{-13} cm/sec. This is important to prevent the seepage of leachate.
- iv. A layer of Geotextile (GT) is placed on top of the HDPE liner as a cushion, which will prevent the puncturing of the liner and also on the Leachate collection layer to prevent clogging.
- v. A 300 mm thick Gravel / metal layer (size 20-25mm) is placed on top of the GT so that the leachate formed will be collected in the leachate collection system.
- vi. HDPE Pipes are laid in the above drainage layer for collecting the leachate and draining it to a point from where the same is taken for treatment and disposal/reuse. HDPE geomembrane with a standardized thickness less than 1.5 mm is not allowed. Only HDPE geomembranes should be

used, which comply with the requirements of American Society for Testing and Materials (ASTM) or GRI GM 13 specifications.

vii. Soil of 300 mm thick is placed on top of the GT as protection layer of liner system.

Landfilling Operation

All wastes will be unloaded in the designated working area of Landfill and systematically placing the loads of rejects will be assisted by the bulldozer to spread and compact the waste. The process reject and inert Waste will be landfilled and compacted on the same day of their arrival on site. If, for any particular reason, we can't landfill the waste the same day will be stocked, and we will ensure it does not fly around and also prevent leachate flowing. For the initial lift, a medium size bulldozer will be used to push and level the waste. Under no circumstances machines will be allowed to pass the liner system before filling and will ensure no damage to the liner system. Bulldozer drivers will take extreme care in levelling the waste, as no compaction should be applied other than during spreading of the initial lift. The bulldozer driver will not attempt to drive over leading edge of the lift. At no time the thickness of the waste on which the equipment is operating for the initial lift be less than 1 m above the upper element of the leachate collection system.

The tipping face is the active part of the landfill, where waste is placed and compacted on a daily basis. The location of the tipping face within the site changes as more waste is added. As waste accumulates in the landfill, the tipping face also proceeds higher in elevation along with the increase in the height of the deposited waste in the respective scientific landfill.

The operation at the tipping face consists of the following primary tasks:

- Directing the vehicle at the tipping face
- Spread waste to 0.5 m thick, and as a minimum, maintaining slope less than 1(V) to 3(H).
- Compact waste using the bulldozer

Waste shall be covered immediately at the end of the each working day with minimum of 10cm soil/ inerts/ construction material sieved during shifting of waste from C&D.

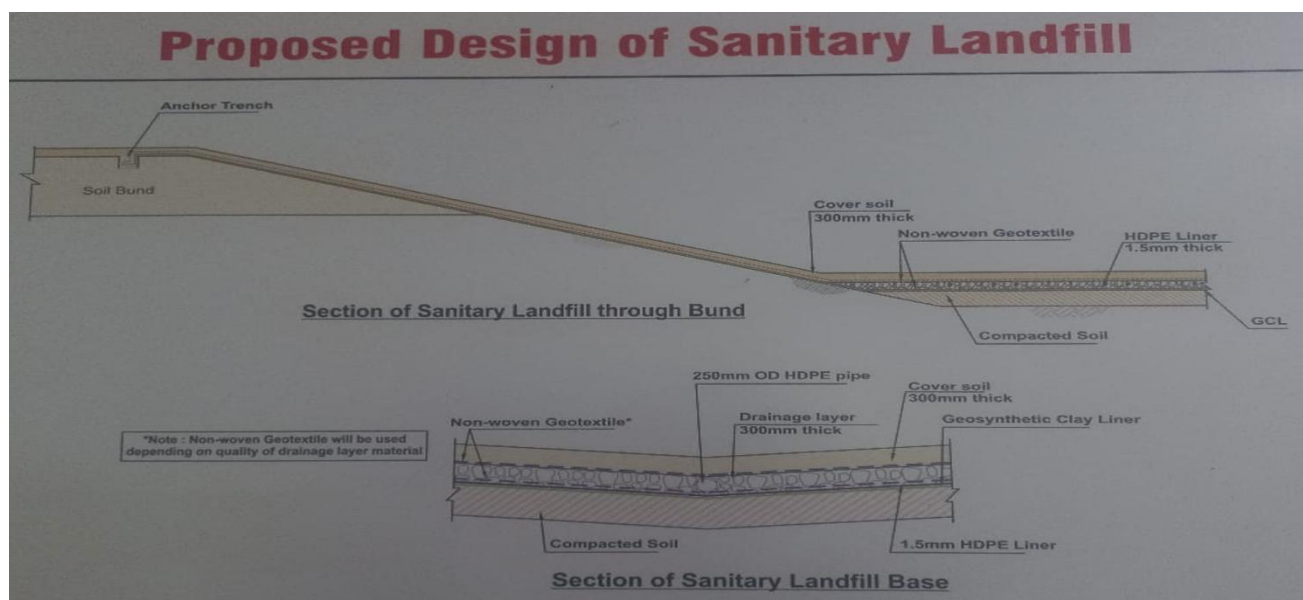


Figure 7: Reject to Landfill (SLF)

8. Solar Energy

A small-scale solar power plant with a capacity of 0.39 MW is installed in the NWMPL plant. The installed Solar Photovoltaic power plant is on grid-tie solar power system, connected to Maharashtra State Electricity Board (MSEB).

Solar photovoltaic modules i.e., panels installed capacity is 390 kW for higher generation. The inverter capacity for conversion into DC is 300 kW. The electrical generation from solar unit is in DC form and during its conversion into AC form there is a conversion loss of about 10-15 %. So even in extreme bad weather or low illumination conditions in order to have at least 300 kW power generation with enough margin, the installed solar panels capacity is on the higher side. Thus, the actual capacity of the solar system is 300 kW with AC current.

The key system building blocks of the Solar PV system, with their functions are mentioned below:

- Solar Photovoltaic (PV) modules
- Solar Photovoltaic Strings
- Power Cables
- String combiner box
- ACDB
- Solar Grid tied string convertors
- LT Panel with load management

Solar photovoltaic (PV) modules: these are the basic power generators, which converts the sunlight into electrical power in the form of DC current.

Solar Photovoltaic Array: made with Solar PV modules; interconnected with each other in suitable series / parallel combination to provide desired input voltage and current to power conditioning unit.

Module Mounting Structure: The module mounting structures (MMS) is MS (GI material) galvanised hot dipped or Aluminium with plated hardware is used to assemble the PV modules with the structures.

Power cables: Solar grade cables are used for interconnection of modules, modules strings, module strings to SCB, SCB to inverter. The cross sections of cables are selected in such a way that the voltage-drop and losses can be kept at a minimum.

Protection Systems: Earthing and surge protection devices (SPD) are incorporated with proposed SPV power plant to protect from current leakage, lightning and over / surge voltage protection. The String combiner Box provided for housing the protection devices and for interconnection / termination of various array strings.



Figure 8: Solar Energy

9. Capping of Existing Dump and Other SLF:

List of Facilities, System and Equipment: Involves the removal, transport, and placement of materials to create a final cover over the existing dump.

- Bulldozer
- Compactor
- Trucks
- Passive Gas vents
- Gravel layer
- Geo-textile
- Geo-coir

Conceptual Design of Capping of existing waste

We propose to re-align and utilize the existing Landfill area. After the landfill area is filled and covered, we intend to cap the area of existing dump.

Brief Process for Construction:

The open dumped waste at various locations will be lifted by machines into the truck. The truck will transport the waste to its designated location and unload it. The Dosers will dose the waste to its designed slopes and then compact it. The waste will have to be graded to maintain the waste stability. This waste will be removed from its dumped location and filled in the required areas and then compacted. The typical cross section of a Closure is shown below:

The first layer that will be placed on the waste is for the gas to be released to the gas vents. Passive Gas vents will be suitably placed in this layer so that the small quantity of gas that is formed would be released into air. This layer is provided where gas production is possible. It is not necessary in capping inert wastes as probability of gas generation is very low.

A soil layer will be placed over gravel. A gravel layer would be placed as a drainage layer.

On top of the drainage layer a soil layer would be placed for vegetation. A geo-textile would be placed on the gravel layer to separate the soil layer. Geo-coir are placed on top soil to reduce erosion of cover soil.

The inspection of the final cover in the first 3-5 years would be carried out twice a year. Once when

the vegetation growth is minimum and once when the vegetation growth is maximum. Over the period of time the inspection can be reduced to once a year. The important point is that care would be taken against cracks and the burrowing of rodents.

Advantages of carrying out Closure Dump site:

- i. Compliance to the SWM 2016 Rules. (https://cpcb.nic.in/uploads/MSW/SWM_2016.pdf)
- ii. There will be no leachate production and hence no pollution around the site.
- iii. No bird and Fly menace.
- iv. Stray animals like dogs will be kept away.
- v. The ugly site (eye sore) would not exist.
- vi. The same land could be used as garden and landscaping or some other suitable public use.



Figure 9: Biomining of Legacy Waste

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

This project increases and improves waste management through the implementation of methane recovery projects, achieving an improvement of the livelihoods and the attainment of sustainable economic growth of the countries. More specifically, the successful implementation will contribute to:

Sustainable development benefits

There are social, environmental, economic and technological benefits which contribute to sustainable development.

- **Social benefits:**

The project contributes to improving the environmental condition in the region of by hygienic treatment of municipal solid waste resulting in improvement of health standard in the city. The manual as well as mechanical segregation of waste prior to feeding the solid waste for size reduction results in separation of substantial quantity of inert non-biodegradable matter like plastics, rags, stones, metals, glass, tyres etc. Some of these items like organics, textiles, large woody mats etc. will be recycled within the plant itself as feed for the dryer furnace to produce flue gas for the dryer. Other recyclable items are disposed of through local contractors/kabari, thereby providing monetary benefits to the local population. Without the project the rag pickers would have operated in the same unhygienic conditions prevailing in the region and would have been exposed to serious health risks while collecting the recyclables from the open dumping sites. Dead animals lying around in unmanaged waste sites pose health risks by creating conditions for diseases to spread. Additionally, greenhouse gas emissions from these sites can cause airborne diseases, adversely affecting the quality of life.

The project provides both direct and indirect employment opportunities to the people of the region.

- **Environmental benefits:**

From an environmental perspective, the project helps in the avoidance of methane emission as well as any leachate that would otherwise have been generated from the current practice of waste disposal. The land required for land will be reduced significantly and thus saves the requirement of further landfilling area for SWDS equivalent amounts of waste. This indirectly enables the region towards a better way of land utilization, like the construction of housing, hospitals, etc. The project also results in a net decrease in transportation distance for MSW due to the optimization of transportation routes. This again reduces emissions associated with the transportation of MSW. Further, by generating electricity through utilizing the RDF, the project helps in replacing fossil fuel-intensive power generation in the region. The installation of solar panels provides clean, renewable energy, reducing reliance on fossil fuels and decreasing greenhouse gas emissions. Biomining of legacy waste extracts valuable materials from old dumpsites, reducing landfill volume, mitigating pollution, and reclaiming land for productive use.

By diverting waste from open burning, which releases toxic fumes and particulate matter, NWMPL lowers air pollution levels and reduces health risks associated with respiratory issues and other air quality-related diseases.

NWMPL uses leachate collection and treatment systems to handle the liquid that percolates through the waste. By treating leachate before it reaches water bodies, these systems prevent the contamination of groundwater and surface water with harmful chemicals and pollutants.

By segregating non-biodegradable and hazardous materials from organic waste, NWMPL reduces the harmful substances that could leach into the soil. This prevents soil contamination and degradation

The use of composting processes transforms organic waste into nutrient-rich compost, which can be

safely used to enrich soil. This practice improves soil health and fertility, reducing the need for chemical fertilizers that can contribute to soil and water pollution.

- **Economic benefits:**

The project activities under this project will not reduce the income of the local community. In fact, the construction and operation of project activities will require skill-full manpower from diverse backgrounds (i.e. engineering, science, and finance). Thus, the implementation of this project activities will potentially increase employment opportunities in the host country. It will also result in savings of public money that is otherwise being utilised by Municipal Corporations in the present scenario. Additionally, the avoidance of methane emissions will reduce the unpleasant odour and the risk of explosions and fires associated with the waste management systems without methane recovery. Further, unmanaged landfilling of MSW may cause health hazards in the locality, which is in close proximity with the landfill site resulting in additional health-related expenditure. The project by avoiding landfilling and scientifically treating the MSW shall improve the hygienic conditions, resulting in reduced health related expenditure in the nearby localities. The project converts solid waste into electricity which helps in reducing the demand on limited natural resources. The project will also earn additional revenue for the local and central government.

NWMPL provides raw materials such as recycled plastics and compost to various industries, supporting their production processes and creating a circular economy.

The 3Rs (Reduce, Reuse, Recycle) system approach fosters a sustainable business ecosystem by promoting resource efficiency and reducing waste.

Following are the details of the persons employed, male and female at NWMPL for the various project activities, from 2017- 2024

The detailed number of employees are provided in the following table:

Year	Total No of employees	No. of Male Employees	No. of Female Employees	No. of Permanent Employees	No. of Contract Employees
2017	33	20	1	21	12
2018	76	58	2	60	16
2019	84	64	2	66	18
2020	128	105	3	108	20
2021	114	101	1	102	12
2022	113	97	1	98	15
2023	132	101	1	102	30
2024	160	124	4	128	32

- **Technological well-being**

The Technologies employed in the NWMPL MSW Project for different project activities have substantial contribution towards increasing the Sustainability of the Project.

The by-products generated from the project like City Compost, RDF, Shredded Biomass, Briquettes,

Plastic to Fuel, recycled thermacol blocks, Solar energy, Biogas, etc. make the Project eco-friendly and unique from Carbon footprint and generation of Renewable resources point of view.

Municipal Solid Waste Management and the 17 Sustainable Development Goals to be Achieved by 2030



Though Municipal Solid Waste Management does not hold a separate title in the 17SDGs, it is connected to twelve SDGs due to its importance as one of the top three emitters of GHGs, responsible for increasing the global warming risk (Rodric, and Wilson). SDG Goals 2, 4 and 13 are directly affected by undertaking MSWM – Goal 2: Extension of adequate, safe and affordable solid waste collection services to all, to prevent pollution causing diseases as well as eliminate uncontrolled dumping inhibiting waste (particularly plastics) ending up in the oceans; Goal 4: Reducing waste generation through prevention and the 3Rs (reduce, reuse, recycle) policy have a significant potential for employment creation through ‘green’ jobs; Goal 13: Take urgent action to combat climate change and its impacts. Sustainable SWM can prevent emissions of GHGs. Whereas SDG Goals 1,3,5,6,7,8,11,12,14 and 15 are indirectly affected as well.

The relationship of MSWM to the 17 SDGs are explained below.

Goal 1: Ensure that everyone in particular the poor and the vulnerable, have equal rights to economic resources, public services, financial services including microfinance and alleviating poverty.

Goal 2: Zero hunger – achieve food security and improved nutrition, promote sustainable agriculture.

Goal 3: Guarantees good health and well-being by putting an end to preventable deaths, like deaths from malaria or water-borne diseases, reducing illnesses from hazardous chemicals, pollutants and contaminants. Achieve environmentally sound management of all wastes, particularly hazardous wastes (chemical or biological).

Goal 4: Reducing waste generation through prevention and the 3/4/5 Reduce-Recycle-Reuse policy have a significant potential for employment creation through green jobs.

Goal 1 and Goal 4: Any measures applied to support individuals, small and microenterprises aid improved livelihoods and directly contribute to SDGs 1 (ending poverty) and 8 (decent work and economic growth) in 5 developing countries, Goal 4, ensure inclusivity, giving equal opportunities to women and men through employment in this green sector.

Goal 5: Women have been given employment in the MSWM sector through various opportunities,

empowering them financially.

Goal 6: Provide clean water and sanitation. Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous toxic materials.

Goal 7: Provide affordable and clean energy by increasing the share of renewable energy in the global energy mix.

Goal 8: Access to decent work and economic growth by promoting inclusivity and sustenance with employment in developing countries too.

Goal 11: Extension of sustainable, adequate, safe and affordable solid waste collection services to all, to prevent diseases caused by pollution, as well as eliminate uncontrolled dumping especially plastic ending up in the oceans. Also facilitate eradication of uncontrolled open burning of waste as the first stepping stone to achieving environmentally sound SWM. Creating sustainable cities including upgrading slums, by reducing the adverse environmental impact with emphasis on waste management.

Goal 12: Responsible production and consumption. Environmentally sound management of chemicals and wastes to minimize adverse impact on human health and environment. This SDG also contributes to SDG 2. Reducing waste generation through prevention and the 3Rs (reduce, reuse, recycle) policy have a significant potential for employment creation.

Goal 13: Take urgent action to combat climate change and its impacts. Sustainable SWM can prevent emissions of GHGs. Methane a major emission from MSW and twenty-five times more potent than CO₂ is a strong contributor to increasing the climate change risk, processing and eliminating MSW reduces GHGs which reduces the climate change risk

Goal 14: Preserving life under water by preventing marine pollution from land-based activities including waste and debris.

Goal 15: Safeguarding terrestrial life by ensuring the conservation of terrestrial and inland freshwater ecosystems and their diversity, (Rodic and Wilson, 2017). These SDGs are to be achieved by 2030 as per the UN guidelines. The entire world has synchronised to these goals, the MSW Rules of India are an example.

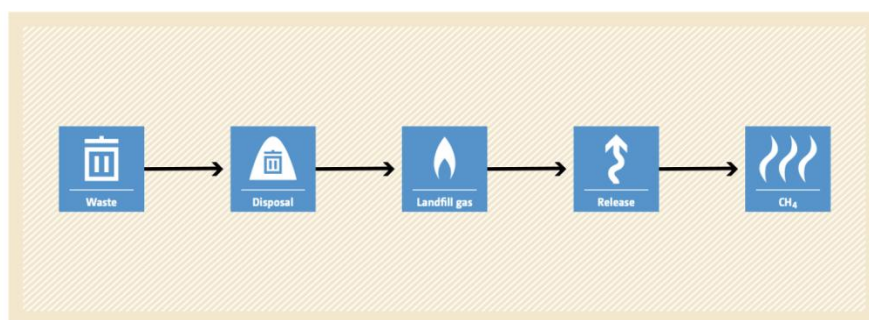
B.3. Baseline Emissions>>

The baseline scenario identified at the PCN stage of the project activity is:

- Methane emissions from the SWDS without any waste processing or treatment, of both legacy waste and daily waste.
- Carbon emissions from fossil fuel-based electricity consumed from the grid.
- Carbon emissions from transport within the plant.

BASELINE SCENARIO

Disposal of the waste in a landfill site without capturing landfill gas or with partly capturing and subsequently flaring it.



Despite the Government of India's efforts to promote efficient waste management technologies and the Waste Management Rules, the compliance rate remains poor.

In 2017 when the project became operational, the MSW plant was at baseline scenario. All Nashik's waste was being dumped in an open landfill, two hills had formed with this legacy waste and dumping of daily waste daily, posing a significant environmental concern. The disposal of MSW, often in landfills, contributes to the emission of harmful gases like Methane, Carbon Dioxide, and Nitrous Oxide further worsening air quality and accelerating climate change.

Before the implementation of Nashik Waste Management Private Limited (NWMPL) in 2017, the Municipal Solid Waste in Nashik was dumped in unsanitary landfills outside the city. The methane that was being released from the open waste would catch fire by afternoon. Hence there was release of methane and carbon dioxide, the two most hazardous greenhouse gases responsible for global warming. This led to significant environmental damage to air, soil and water posing risk to both the environment and public health.

To address these pressing environmental challenges, the primary objective when NWMPL established the Integrated Municipal Solid Waste plant is to establish an integrated MSWM plant. This system aims to scientifically process the waste and efficiently utilise all its components, including biodegradable materials, Residual Derived Fuel, inerts, and leachate. By doing so, we aim to minimise Methane and Carbon Dioxide emissions by processing and scientifically disposing all the MSW of Nashik city which will mitigate the adverse environmental impact associated with open dumping of MSW.

B.4. De-bundling>>>

This Integrated Municipal Solid Waste Management Activities project is not a de-bundled component of a larger project activity.

There is no registered large- scale UCR project activity but not any other small-scale project activity with the following conditions:

- by the same project participant,
- in the same project category and technology/measure.

SECTION C. Application of methodologies and standardized baselines

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

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)

13 Waste Handling and disposal

TYPE 1 & 3 – Large Scale Project - Waste handling and Disposal

CATEGORY- Methodology Applied follows UNFCCC CDM Methodologies

- ACM0022: Large-scale: Consolidated Methodology: Alternative waste treatment processes (Version 03.0)
- AMS-I.D: Small-scale Methodology: Grid connected renewable electricity generation (Version 18.0)

Reference	Tools - Methodology - Large Scale & Small Scale	Version	EB
Tool 01	Tool for the demonstration and assessment of additionality	7.0.0	EB 70 annex 08
Tool 02	Combined tool to identify the baseline scenario and demonstrate additionality	7.0	EB 96 annex 03
Tool 03	Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion	3	EB 96 annex 4
Tool 04	Emissions from solid waste disposal sites	8.1	EB 94 annex 7
Tool 05	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation Table to calculate baseline, project and/or leakage emissions from electricity consumption	3.0	EB 96 annex 5
Tool 06	Project emissions from flaring Spreadsheet for calculating project emissions from flaring	4.0	EB 113 annex 10
Tool 07	Tool to calculate the emission factor for an electricity system Table to calculate the emission factor for an electricity system (version 04.0)	7.0	EB 100 annex 4
Tool 08	Tool to determine the mass flow of a greenhouse gas in a gaseous stream Table to determine the mass flow of a greenhouse gas in a gaseous stream	3.0	EB 87 annex 10
Tool 13	Project and leakage emissions from composting	2	EB 96 annex 6
Tool 14	Project and leakage emissions from anaerobic digesters	2	EB 96 annex 7

- For Project baseline emissions calculations for biomining of legacy waste, Chapter 3, Solid Waste Disposal, 2006 IPCC Guidelines for National Greenhouse Gas Inventories:
Microsoft Word - V5_Ch3_SWDS_Final_v2.doc

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

As per table 1 of applied methodology ACM0022 the proposed CPA will use following combination of waste treatment

- Composting process under aerobic conditions;
- Anaerobic digestion with biogas recovery and flaring and/or its use);
- Mechanical/thermal treatment to produce refuse- derived fuel (RDF)/stabilized biomass (SB) and its use;
- Incineration of fresh waste to produce thermal/electric energy;

Table 1: Methodology Key Elements

Typical projects	Project activities involve the installation and operation of new plants for the treatment of fresh waste through any combination of the following processes: • Composting process under aerobic conditions; • Gasification process to produce syngas and its use; • Anaerobic digestion with biogas recovery and flaring and/or its use); • Mechanical/thermal treatment to produce refuse-derived fuel (RDF)/stabilized biomass (SB) and its use; • Incineration of fresh waste to produce thermal/electric energy; • Co-composting/anaerobic digestion of wastewater in combination with solid waste.
Type of GHG emissions mitigation action	• Greenhouse gas (GHG) emissions avoidance: CH₄ emissions due to anaerobic decay of organic waste are avoided by alternative waste treatment processes. • Renewable energy: Fresh waste is used as renewable source of energy.

The project will avoid CH₄ and CO₂ emission due to anaerobic decay of organic waste in baseline scenario.

Applicability according to ACM0022 are as follows:

Conditions	Applicability (Yes/No)	Justifications
(a) Composting process under aerobic conditions;	Yes	Biodegradable MSW is aerobically composted
(b) Anaerobic digestion with biogas recovery and flaring and/or its use;	Yes	Entire liquid and residual solid waste is treated in the anaerobic digestion process
(c) Co-composting of wastewater in combination with solid waste;	No	N/A
(d) Anaerobic co-treatment of wastewater in combination with solid waste;	No	N/A

(e) Mechanical/thermal treatment process to produce refuse-derived fuel (RDF) or stabilized biomass (SB) that is produced within the project boundary and its use	Yes	Waste from SWDS is processed to by-products RDF and SB. If not processed, it would have been lying in the SWDS, in this process they are avoiding the GHGs from the SWDS.
(f) Gasification process to produce syngas and its use;	No	N/A
(g) Incineration of fresh waste for the generation of thermal/electric energy.	No	N/A
(h) The following conditions apply to all project activities using this methodology:		
(i) The project plant only treats fresh waste/wastewater for which emission reductions are claimed, except for cases involving composting, co-composting and anaerobic digestion;	Yes	NWMPL receives the fresh waste on daily basis, which is processed on the same day
(j) Neither the fresh waste nor the products from the project plant are stored on-site under anaerobic conditions;	Yes	Necessary precautions are taken to maintain aerobic condition
(k) Any wastewater discharge resulting from the project activity is treated in accordance with applicable regulations;	Yes	The waste water generated is treated in a Leachate Treatment Plant (LTP) which is an integral part of the project
(l) The project activity does not reduce the amount of waste that would be recycled in the absence of the project activity. This shall be justified and documented in the clean development mechanism project design document (CDM-PDD);	Yes	The recyclable waste from the fresh waste coming to NWMPL is totally separated and sent for recycling
(m) When applicable regulations mandate any waste treatment process implemented under the project activity, the rate of compliance with such regulations for the treatment process is below 50 per cent ² ;	No	N/A
(n) Hazardous wastes/wastewater are not eligible under this methodology.	Yes	NWMPL does not receives hazardous waste. It only treats MSW

Conditions	Applicability (Yes/No)	Reasons
(a) The disposal of the fresh waste in a SWDS with or without a partial LFG capture system (M2 or M3)3;	No	Fresh waste comes to the site daily is processed. There no LFG capture system present yet. There is no facility to capture LFG in the host country i.e. India. Also, about flaring, technology is not there in the host country.
(b) In the case of co-composting or co-treatment of wastewater in an anaerobic digester, the treatment of organic wastewater in either an existing or new anaerobic lagoon or sludge pit without methane recovery (W1 or W4);	No	N/A
(c) In the case of electricity generation, the electricity is generated in an existing/new captive fossil fuel fired power-only plant, captive cogeneration plant and/or the grid (P2, P4 or P6);	Yes	The NWMPL plant is connected to an existing grid-connected power plant of the Western electrical Grid in India
(d) In the case of heat generation, the heat is generated in an existing/new fossil fuel fired cogeneration plant, boiler or air heater (H2 or H4).4	Yes	RDF generated inside the project facility is used for heat generation in Dead Animal Carcass Incineration Process

Table 2. Specific applicability conditions for the different waste treatment processes

Waste treatment option under the project activity	Applicable types of wastes that may be treated	Applicable products and their use	Applicable waste by-products	Specific applicability conditions
Composting or co-composting	Types of waste as specified in the scope and applicability section of “TOOL13: Project and leakage emissions from composting”;	Compost: any use applicable	Leachate	Any applicability conditions specified in “TOOL13: Project and leakage emissions from composting”
Anaerobic digestion	Leachate	Biogas used to generate electricity or heat and the rest is flared	Wastewater discharge Digestate	Any applicability conditions specified in “TOOL14: Project and leakage emissions from anaerobic digesters”
Thermal treatment	-	-	-	-

Mechanical treatment	Fresh waste	RDF/SB: any use is applicable	Recyclables that have market value (i.e. Cloth, paper, plastic, leather, metal, glass)	-
Gasification	Plastic waste	Pyro-gas and pyro-oil is used to generate heat	Gasification by-products is char	-
Incineration	Dead animal carcasses	-	Incineration by-product - ash generated is used to enrich the compost	Incineration technology is hearth or grate type

Applicability according to AMS-I.D are as follows:

Applicability of AMS I.D.	Justification
This methodology comprises of renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass for: Supplying electricity to the grid.	Applicable and fulfilled The proposed Component Activity comprises of a renewable energy generation through installation of solar photovoltaic modules and will replace electricity from the state grid by supplying to the grid itself. Hence this criterion is applicable and fulfilled.
2. Illustration of methodology under ASM-I.D.	Applicable and fulfilled The proposed Component comprises of a renewable energy generation through installation of solar photovoltaic modules and will supply electricity to the grid.
3. This methodology is applicable to project activities that: Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity, that is a Greenfield plant.	Applicable and fulfilled The proposed Component Activity involves installation of solar panels at the project sites where there was no renewable energy power plant operating prior to implementation of project. Hence this criterion is applicable and fulfilled.
4. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	Applicable and fulfilled The proposed Component Activity refers to renewable solar energy with no cofiring of fossil fuel. The total capacity of the individual Component Activity will be less than or equal to 15 MW, which is within the eligibility limit of 15 MW for a type-I small-scale project activity.
	Not Applicable

5. Combined heat and power (co-generation) systems are not eligible under this category.	The Component Activity is not implementing any cogeneration system. Since the Component Activity is for solar power, incineration is covered as a separate item.
6. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW, and should be physically distinct from the existing units.	Not Applicable The proposed Component Activity is implementing solar power plants.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not Applicable The proposed Component is implementing solar power plants.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Not Applicable The Component Activity is implementing a solar power plant is less than 15 MW and is not a retrofit or replacement activity.

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

The project activity does not incur any double accounting of emission reductions as the project is not registered in any other registry other than UCR.

Under UCR registration is being considered with crediting period only from 15/02/2017 to 31/12/2024. Following reasons contribute to the avoidance of double accounting of emission reductions in the project activity:

- Project is uniquely identifiable based on its location coordinates,
- Project has dedicated commissioning certificate and connection point and plant operation data have been taken from calibrated monitoring equipment installed at project site,
- Project have eight components which are associated with distinct and unique codes.

Sl. No	Title of project activity	Reference Number (Unique Code)
1	Composting	NWMPL-IN-COMP-2024-CPA-01
2	RDF Production	NWMPL-IN-RDF-2024-CPA-02
3	Leachate Treatment Plant (LTP) / Biomethanation	NWMPL-IN-BIOM2024-CPA-03
4	Biomass Briquetting	NWMPL-IN-BRIQS-2024-CPA-04
5	Nashik Plastic to Fuel	NWMPL-IN-PTF-2024-CPA-05
6	Dead Animal Incinerator	NWMPL-IN-INC-2024-CPA-06

7	Reject To Landfill	NWMPL-IN-SLF-2024-CPA-07
8	Solar Energy	NWMPL-IN-EC-2024-CPA-08

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

The geographical area, within which all component project activities are included in this Project, where the plant is situated is the territorial boundary of India, the Host Country.

Each project activity will be limited by the territorial boundary of the Host Country in which it is located, and the physical location of that CPA will form the actual CPA boundary.

The project boundary includes the physical, geographical site(s) of:

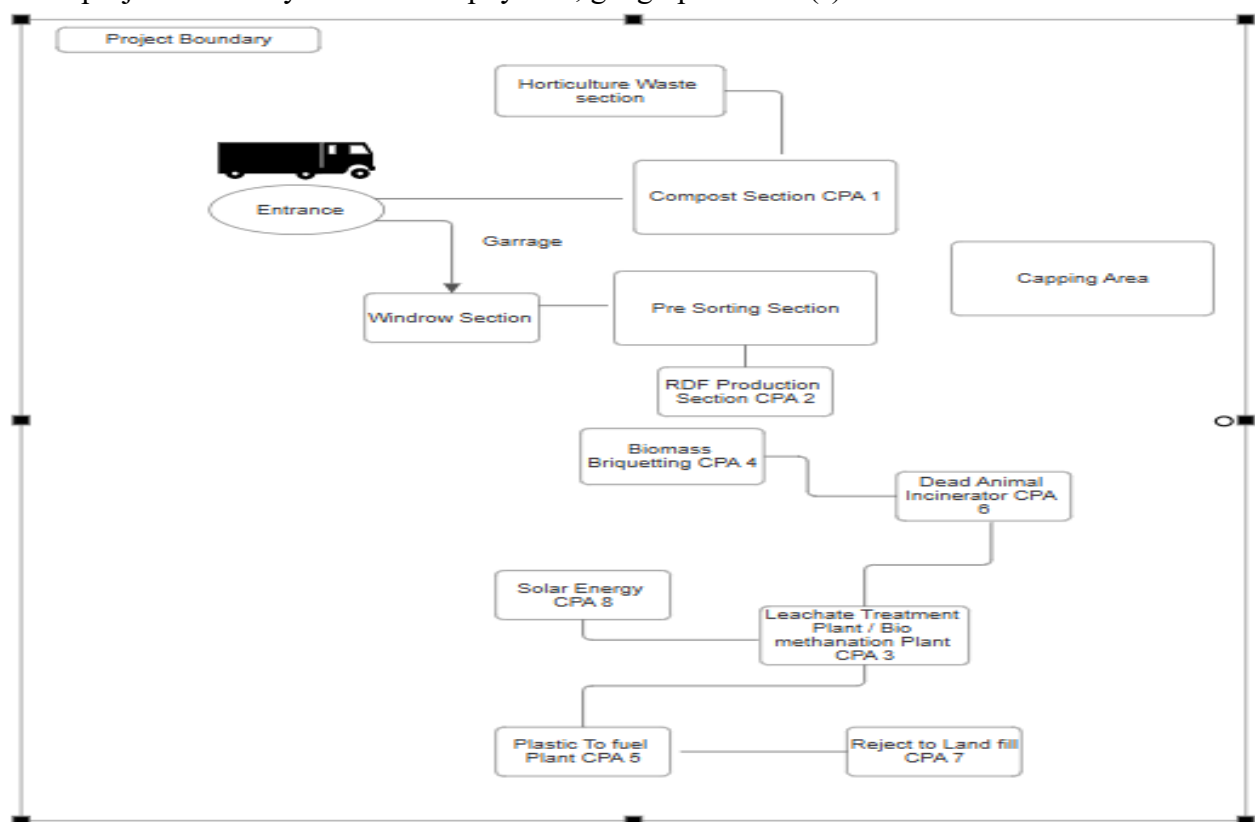


Figure 10: Project Boundary

The Following Table Depicts Ghg Sources (Included and Excluded)

Source		GHG	Included?	Justification/Explanation
Baseline	Emission from heat generation	CO ₂	Yes	Major emission source if heat generation is included in the project activity and displaces more carbon intensive heat generation in the baseline
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small

Source		GHG	Included?	Justification/Explanation
	Emission from SWDS	CO ₂	No	CO ₂ emissions from the decomposition of fresh waste are not accounted for
		CH ₄	Yes	The major source of emissions in the baseline
		N ₂ O	Yes	N ₂ O emissions are small compared to CH ₄ emissions from landfills. Exclusion of this gas is conservative
Project activity	Emissions from anaerobic lagoons or sludge pits	CO ₂	Yes/No	Major source if electricity generation is included in the project activity and is sent to the grid or displaces fossil fuel fired electricity generation in the baseline
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from use of natural gas	CO ₂	No	Excluded for simplification. This is conservative
		CH ₄	Yes/No	Major emission source if supply of upgraded biogas through a natural gas distribution network is included in the project activity
		N ₂ O	No	Excluded for simplification. This is conservative
	Emissions from on-site fossil fuel consumption due to the project activity other than for electricity generation	CO ₂	Yes	May be an important emission source. Includes heat generation for mechanical/thermal treatment process, start-up of the gasifier, auxiliary fossil fuels needed to be added into incinerator, etc. It does not include transport
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the waste treatment processes	CO ₂	Yes	N ₂ O may be emitted from composting, incineration, syngas produced and RDF/SB combustion
		CH ₄	Yes	CO ₂ emissions from incineration, gasification or combustion of fossil-based waste shall be included. CO ₂ emissions from the decomposition or combustion of fresh waste are not accounted
		N ₂ O	No	CH ₄ leakage from the anaerobic digester and incomplete combustion in the flaring process are potential sources of project emissions. CH ₄ may be emitted from incineration, gasification, composting and RDF/SB combustion
	Emissions from wastewater treatment	CO ₂	No	CO ₂ emissions from the decomposition of fresh waste are not accounted

Source		GHG	Included?	Justification/Explanation
		CH ₄	Yes	CH ₄ emissions from anaerobic treatment of wastewater are accounted for. Aerobic treatment of wastewater shall not result in CH ₄ emissions
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small

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

Baseline emissions:

Baseline emissions are determined as follows:

$$BE_y = \sum_t (BE_{CH_4,t,y} + BE_{WW,t,y}) \times (1 - RATE_{compliance,t}) \quad \text{Equation (1)}$$

Where,

BE_y = Baseline emissions in year y (t CO₂e)

$BE_{CH_4,t,y}$ = Baseline emissions of methane from SWDS in year y (t CO₂e)

$BE_{WW,t,y}$ = Baseline methane emissions from anaerobic treatment of the wastewater in open anaerobic lagoons or of sludge in sludge pits in the absence of the project activity in year y (t CO₂e)

$RATE_{compliance,t}$ = Discount factor to account for the rate of compliance of a regulatory requirement that mandates the use of alternative waste treatment process t.

In addition, several other activities contribute to baseline emissions. The total baseline emissions, hence, are given as follows:

$$BE = BE_y + BE_{RDF} + BE_{AD} + BE_{PtoF} + BE_{Briq} + BE_{solar} + BE_{Biomining} \quad \text{Equation (2)}$$

Where,

BE = Total baseline emissions in year y (t CO₂e)

BE_y = Baseline emissions in year y (t CO₂e)

BE_{RDF} = Baseline emissions due to RDF use instead of coal in year y (t CO₂e)

BE_{AD} = Baseline emissions avoided due to use of electricity produced from biogas in year y (t CO₂e)

BE_{PtoF} = Baseline emissions avoided by using pyro oil produced in Plastic to fuel process in year y. (t CO₂e)

$BE_{Biomining}$ = Baseline emissions avoided due to biomining (t CO₂e)

(a) Baseline emissions of methane from the SWDS ($BE_{CH_4,t,y}$):

Baseline methane emissions from the SWDS are determined using —TOOL04: Emissions from solid waste disposal sites.

The emissions are calculated using the formula given below:

$$BE_{CH_4,SWDS,y} = \phi_y \times (1 - f_y) \times GWP_{CH_4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^y \sum_j (W_{j,x} \times DOC_j \times e^{-k(y-x)} \times (1 - e^{-k_j})) \quad \text{Equation (3)}$$

Where, for the yearly model

$BE_{CH_4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year y
$PE_{CH_4,SWDS,y}$	=	generated from waste disposal at a SWDS during a time period ending
$LE_{CH_4,SWDS,y}$	=	in year y (t CO ₂ e/yr).
X	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)
y	=	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	=	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t).
ϕ	=	Model correction factor to account for model uncertainties for year y.
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere year y.
GWP_{CH_4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the material soil or other covering the waste)
J	=	Type of residual waste or types of waste in the MSW
F	=	Fraction of methane in the SWDS gas (volume fraction).
MCF_y	=	Methane correction factor for year y.
DOC_j	=	Fraction of degradable organic carbon in the waste type j (weight fraction)
K	=	Decay rate for the waste type j (1 / yr).

Given equation consists of two parts (part A and part B) as represented below:

$$BE_{CH_4,SWDS,y} = \underbrace{\phi_y \times (1 - f_y) \times GWP_{CH_4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y}_{A} \times \underbrace{\sum_{x=1}^y \sum_j (W_{j,x} \times DOC_j \times e^{-K_j(y-x)} \times (1 - e^{-K_j}))}_{B} \quad (3.1)$$

The values of the parameters in this equation are mentioned in the table below:

Parameter	SI Unit	Description	Value	
ϕ_y	ton/yr or m ³ /yr	Model correction factor to account for model uncertainties for year y	Default value	1
f_y	tC/mass	Weighted average mass fraction of carbon in fuel type i in year y		0
GWP_{CH_4}	Mass unit/volume unit	Weighted average density of fuel type i in year y	Default value	21
OX	GJ/m ³ , GJ/ton	Weighted average net calorific value of fuel type i in year y	Default value	0.1
F	Volume fraction	Fraction of methane in the SWDS gas	Default value	0.5

$DOC_{f,y}$	Weight fraction	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)	Default value	0.5
MCF_y		Methane correction factor for year y	Default value	1
$W_{j,x}$	tonnes	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x	Calculate using the waste characterisation	
DOC_j	weight fraction	Fraction of degradable organic carbon in the waste type j	Default value	
k	1 / yr	Decay rate for the waste type j	Default value	
j		Type of residual waste or types of waste in the MSW		
x		Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year y ($x = y$)		
y		Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)		

Part A of the equation is calculated using default values of the parameters and part B is calculated using the plant data measured by following the monitoring procedures.

Part A:

Determination of the methane correction factor (MCF_y)

The MCF is selected as a default value ($MCF_y = MCF_{\text{default}}$) provided in the section —Data and parameters not monitored of the PDD.

Determining the model correction factor (ϕ_y)

The model correction factor (ϕ_y) depends on the uncertainty of the parameters used in the FOD model. For Baseline emissions the value applicable to application B as per the location of the project is $\phi_y = 0.85$.

All the parameters of the part A are default values as given below:

ϕ_y	1
f_y	0
1- f_y	1
GW_{CH_4}	21
OX	0.1
1- OX	0.9
F	0.5
MCF_y	1
$DOC_{f,\text{default}}$	0.5
A	5.4

Part B:

Determining the amounts of waste types j disposed in the SWDS ($W_{j,x}$ or $W_{j,i}$)

$W_{j,x}$ is the weight of organic waste type j disposed in SWDS in a year.

Where different waste types j, are disposed or prevented from disposal in the SWDS (for example, in the case of MSW), it is necessary to determine the amount of different waste types ($W_{j,x}$ or $W_{j,i}$). The amount of different waste types is determined through sampling and the mean is calculated from the samples using equation (5) to determine the value of $W_{j,x}$ for the yearly model as follows:

$$W_{j,x,x} = W_x + p_j \quad \text{Equation (4)}$$

Where:

- W_x = Amount of solid waste type j disposed or prevented from disposal in the SWDS
- W_x = Total amount of solid waste disposed or prevented from disposal in the SWDS
- $p_{j,x}$ = Average fraction of the waste type j in the waste in year x (weight fraction).
- J = Type of residual waste or types of waste in the MSW
- X = Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year y ($x = y$)

The fraction of the waste type j in the waste for the year x are calculated according to equation (4) as follows:

$$p_{j,x} = \frac{\sum_{n=1}^{z_x} p_{n,j,x}}{z_x} \quad \text{Equation (5)}$$

- $p_{j,x}$ = Average fraction of the waste type j in the waste in year x (weight fraction).
- z_x = Number of samples collected during the year x.
- $p_{n,j,x}$ = Fraction of the waste type j in the sample n collected during the year x (weight Fraction)

Determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$):

Application A

$DOC_{f,y}$ is given as a default value ($DOC_{f,y} = DOC_{f,default}$) provided in the section —Data and parameters not monitored of the PCN.

Plant data provided the characterisation of incoming waste, with four samples collected annually. Each sample consists of approximately 100 kg of mixed waste, which is sorted into six categories: Wood and wood products; Pulp, paper, and cardboard (excluding sludge); Food, food waste, beverages, and tobacco (excluding sludge); Textiles, Garden, yard, and park waste; and Glass, plastic, metal; and other inert waste. The degradable organic carbon fraction (DOC_j) in each waste type is a critical parameter used to estimate carbon emissions. Each waste type has a default DOC_j value, as shown in the accompanying table.

Default values for DOC_j

Waste type j	DOC_j (% wet waste)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Source: IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)

Another critical parameter in the formula for estimation of carbon emissions is the decay rate for the waste type j . Following table gives the default value of this parameter for different waste types.

Default values for the decay rate (k_j)

Waste type j		Boreal and Temperate (MAT $\leq 20^\circ\text{C}$)		Tropical (MAT $> 20^\circ\text{C}$)	
		Dry (MAP/PET < 1)	Wet (MAP/PET > 1)	Dry (MAP $< 1000\text{mm}$)	Wet (MAP $> 1000\text{mm}$)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

Source: IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)

Sample calculation for part B:

The amount of waste of a particular type is calculated based on the data gathered for quantity of incoming waste and waste characterisation samples. The waste characterisation is done by quadrant method. Total Weight of MSW is constantly measured digitally and recorded both manually and on digital system.

year	x	y	Waste type	$W_{j,x}$	DOC_j	k_j	$y-x$	$e^{-k_j(y-x)}$	$\exp[-k_j]$	$1-\exp[-k_j]$	product	B	CO ₂ e t/yr
2017	1	1	Food, food waste, beverages and tobacco	66541	0.15	0.4	0	1	0.67032	0.32968	3290.57	3560.54	3,560.54
			Garden, yard and park waste	5012	0.2	0.17	0	1	0.843665	0.156335	156.71		
			Pulp, paper and cardboard (other than sludge)	4189	0.4	0.07	0	1	0.932394	0.067606	113.27		
			Textiles	7366	0.24	0	0	1	1	0	0.00		
			Wood and wood products		0.43	0.035	0	1	0.965605	0.034395	0.00		
			Glass, plastic, metal, other inert waste	59290	0	0	0	1	1	0	0.00		
2018	1	2	Food, food waste, beverages and tobacco	102587	0.15	0.4	1	0.67032	0.67032	0.32968	3400.61	4,772.90	11,344
			Garden, yard and park waste	8806	0.2	0.17	1	0.8436648	0.843665	0.156335	232.29		
			Pulp, paper and cardboard (other than sludge)	8139	0.4	0.07	1	0.9323938	0.932394	0.067606	205.23		
			Textiles	61789	0.24	0.07	1	0.9323938	0.932394	0.067606	934.77		
			Wood and wood products	0	0.43	0.035	1	0.9656054	0.965605	0.034395	0.00		
			Glass, plastic, metal, other inert waste	15527	0	0	1	1	1	0	0.00		
2018	2	2	Food, food waste, beverages and tobacco	102587	0.15	0.4	0	1	0.67032	0.32968	5073.12	6,571.11	11,344
			Garden, yard and park waste	8806	0.2	0.17	0	1	0.843665	0.156335	275.33		
			Pulp, paper and cardboard (other than sludge)	8139	0.4	0.07	0	1	0.932394	0.067606	220.11		
			Textiles	61789	0.24	0.07	0	1	0.932394	0.067606	1002.55		
			Wood and wood products	0	0.43	0.035	0	1	0.965605	0.034395	0.00		
			Glass, plastic, metal, other inert waste	15527	0	0	0	1	1	0	0.00		

As given above, the calculations are further carried out for a crediting period of 7 years.

The total baseline emissions of methane from the SWDS ($BE_{CH_4,t,y}$) for 7 years crediting period are accounted to be 951915 t CO₂ e.

(b) Baseline emission from organic wastewater ($BE_{WW,t,y}$):

Baseline emissions are determined using equation (6). Out of the values of amount of methane emissions from wastewater and baseline methane emissions determined using the Methane Conversion Factor, whichever is minimum, is chosen as the Baseline methane emissions from anaerobic treatment of the wastewater in open.

$$BE_{WW,t,y} = \min \{Q_{CH_4}; BE_{CH_4,MCF,y}\} \quad \text{Equation (6)}$$

Where:

$BE_{WW,t,y}$ = Baseline methane emissions from anaerobic treatment of the wastewater in open anaerobic lagoons or of sludge in sludge pits in the absence of the project activity in year y (t CO₂e).

$Q_{CH_4,MCF,y}$ = Amount of methane produced from wastewater in year y after the implementation of the project activity (t CO₂e).

$BE_{CH_4,MCF,y}$ = Baseline methane emissions determined using the Methane Conversion Factor (tCO₂e)

As per equation 5, the baseline emissions are the total amount of methane produced from wastewater in year y after the implementation of the project activity for 7 years which is accounted to be 225 t CO₂ e.

Baseline methane emissions determined using the methane conversion factor ($BE_{CH_4, MCF,y}$):

$$BE_{CH_4,MCF,y} = GWP_{CH_4} \times MCF_{BL,y} \times B_0 \times COD_{BL,y} \quad \text{Equation (7)}$$

Where:

$BE_{CH_4,MCF,y}$ = Baseline methane emissions determined using the Methane Conversion Factor (tCO₂e)

GWP_{CH_4} = Global Warming Potential of methane valid for the commitment period (t CO₂e/t CH₄)

$MCF_{BL,y}$ = Average baseline methane conversion factor (fraction) in year y, representing the fraction of (COD_{BL,y} x B₀) that would be degraded to CH₄ in the absence of the project activity.

B_0 = Maximum methane producing capacity, expressing the maximum amount of CH₄ that can be produced from a given quantity of chemical oxygen demand (t CH₄/tCOD)

$COD_{BL,y}$ = Quantity of chemical oxygen demand that would be treated in anaerobic lagoons or sludge pits in the absence of the project activity in year y (t COD).

The total baseline emissions from organic wastewater ($BE_{WW,t,y}$) using methane correction factor for 7 years crediting period are accounted to be 0.03205 t CO₂ e.

The minimum value is of the methane emissions determined using the methane conversion factor

(BE_{CH₄,MCF,y})

Hence the Baseline methane emissions from anaerobic treatment of the wastewater in open anaerobic lagoons in the absence of the project activity are 0.03205 t CO₂

$$BE_y = \sum_t (BE_{CH_4,t,y} + BE_{WW,t,y}) \times (1 - RATE_{compliance,t})$$

Total Baseline emissions as per equation (1) are 759819 t CO₂ e for the crediting period of 7 years.

Baseline, project and leakage emissions contributed by some other processes are mentioned further.

(c) Anaerobic digestion/Leachate Biomethanation:

Leachate generated from various sections of the plant—including pre-sorting, sorting, and RDF processing—is directed to the leachate biomethanation unit, where it is used for biogas production. The resulting biogas is then converted into electricity using a biogas generator (BG-set). This conversion is carried out in a batch process. The biogas is first stored in a balloon, and the BG-set is operated once the balloon is fully filled. The electricity produced is utilized for heating purposes in the incinerator.

The baseline emissions for Leachate bio-methanation have been calculated using tool 7 as follows:

$$BE_{AD} = BE_{EC} = \sum EC_{BE} \times EF_{EF} \quad \text{Equation (8)}$$

In the absence of this project activity, coal-based electricity would have been used instead. The baseline emissions avoided through the use of this renewable electricity amount to 254 tCO₂e.

(d) RDF manufacturing.

The dry fraction of the daily incoming municipal solid waste (MSW) is utilized for the production of Refuse-Derived Fuel (RDF). The final product—RDF—has a high calorific value, making it an effective alternative fuel for use in boilers. The RDF produced at this facility is partially used internally and partially supplied to various vendors who use it for heating purposes. By replacing coal, a high carbon-emitting energy source, with RDF, significant emission reductions are achieved.

The baseline emissions for RDF manufacturing have been calculated using tool 3 as follows:

$$BE_{RDF} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \text{Equation (9)}$$

Where,

FC_{i,j,y} = Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

CO_{EFi,y} = Is the CO₂ emission coefficient of fuel type i in year y (tCO₂/mass or volume unit)

In order to calculate CO_{EFi,y}, the following formula is use:

$$COEF_{i,y} = NCV_{i,y} + EF_{CO_2,i,y} \quad \text{Equation (10)}$$

Where,

NCV_{RDF} = Is the weighted average net calorific value of the RDF in year y

$EF_{CO_2,yRDF}$ = Is the weighted average CO₂ emission factor of RDF in year y (tCO₂/GJ).

Over a period of seven years, a total of 324,548 tonnes of RDF has been produced, resulting in the avoidance of approximately 590,029 tonnes of CO₂ emissions. These represent the baseline emissions savings.

(e)Incineration:

Dead animals are treated through incineration at the facility. In the absence of this activity, the carcasses would have been left to decompose naturally, leading to significant greenhouse gas emissions. According to a research paper (), a carcass weighing 1,000 kg emits approximately 858 kg of CO₂ through natural decomposition. Over a period of seven years, the facility has treated a total of 2,733,150 kg of dead animals, resulting in avoided emissions of approximately 2,345 tCO₂. These avoided emissions contribute to the baseline emission reductions associated with the project.

(f)Plastic to fuel:

Plastic to fuel is a pyrolysis process decomposing heavy plastics to produce pyro oil and pyro gas. The pyro gas produced here in this plant, is stored in a balloon and reused as a fuel for the pyrolysis chamber. The pyro oil produced here is also used in incineration. This pyro oil is replacing fuel in incineration. Considering the oil is replacing diesel, this process is avoiding 24 t CO₂.

(g)Solar:

The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.”

The solar power plant supplements the facility's electricity needs alongside the existing grid supply. During the daytime, solar panels generate electricity, while at night, the facility draws power from the grid. To accurately monitor the flow of electricity, a bidirectional meter has been installed outside the project boundary to record both the import from and export to the grid. A company named *Surya Logic* has implemented the plant's control system, which tracks all data related to electricity generation, supply, and consumption through a dedicated mobile application.

$$BE_{EC} = \sum EG_{PJ} \times EF_{EF} \quad \text{Equation (11)}$$

BE_{EC} = Project emissions due to electricity consumption in year y (tCO₂e)

EG_{PJ} = Net electricity supplied to the grid facility by the project activity

$EF_{EF,y}$ = Emission factor for electricity generation in year y (t CO₂/MWh)

The value of CO₂ emission for coal power grid plants is obtained by referring the UCR document “UCR CoU Standard Update: 2024 Vintage UCR Indian Grid Emission Factor Announced”. The solar plant became operational on 15th September 2024. Within just three and a half months, the 0.39 MWh installation has successfully avoided approximately 57 tonnes of CO₂ emissions.

(h)Briquetting:

In addition to daily municipal solid waste (MSW), the plant also processes horticulture and garden waste. The weight data for this waste stream is documented in Annexure 4. Garden waste, being organic in nature, can emit significant amounts of greenhouse gases (GHGs) if left untreated or left to decompose in open fields. At the facility, this biomass is either converted into briquettes or, in some cases, dried and used directly as fuel for industrial combustion. Over a period of seven years, the treatment of 120,889 tonnes of horticulture waste has prevented an estimated 47893 tonnes of CO₂ emissions. These avoided emissions represent the baseline for this process.

(i) Baseline emissions avoided due to biomining (t CO₂e)

Biomining is a mechanical–biological process used for the remediation of legacy municipal solid waste dumpsites. It involves excavation, segregation, and processing of old waste to recover recyclables, inert materials, and soil-like fractions, while stabilizing or disposing of residuals in an environmentally sound manner. By removing the remaining degradable organic matter from anaerobic conditions, biomining halts future methane generation that would have occurred if the waste had remained in place. In this project, baseline methane emissions from the dumpsite were estimated using the IPCC 2006 First-Order Decay (FOD) model, and these are quantified as avoided emissions.

Baseline emissions avoided due to biomining are calculated using the following steps:

Step 1:

$$DOC = \sum_i f_i \times DOC_i \quad \text{Equation (12)}$$

Where,

DOC = fraction of degradable organic carbon in bulk waste, Gg C/Gg waste

DOC_i = fraction of degradable organic carbon in waste type i e.g., the default value for paper is 0.4 (wet weight basis)

W_i = fraction of waste type i by waste category e.g., the default value for paper in MSW in Eastern Asia is 0.188 (wet weight basis)

Step 2:

$$DDOC_m = W \times DOC \times DOC_f \times MCF \quad \text{Equation (13)}$$

Where,

DDOC_m = mass of decomposable DOC deposited, t

W = mass of waste deposited, t

DOC = degradable organic carbon in the year of deposition, fraction, Gg C/Gg waste

DOC_f = fraction of DOC that can decompose (fraction) CH₄ correction factor for aerobic decomposition in the year of deposition (fraction)

MCF = CH₄ correction factor for aerobic decomposition in the year of deposition (fraction)

Step 3:

$$CH_4 \text{ Generated} = DDOC_m \times F \times \frac{16}{12} \quad \text{Equation (14)}$$

Where,

CH₄ generated = amount of CH₄ generated from decomposable material

DDOC_m = mass of decomposable DOC deposited, t

F = fraction of CH₄, by volume, in generated landfill gas (fraction)
 16/12 = molecular weight ratio CH₄/C (ratio)

Step 4:

$$CH_4 \text{ emissions} = [\sum_x CH_4 \text{ Generated} - R_T] \times (1 - OX_T) \quad \text{Equation (15)}$$

Where,

CH₄ Emissions = CH₄ emitted in year T, t
 T = inventory year
 x = waste category or type/material
 R_T = recovered CH₄ in year T, Gg
 OX_T = oxidation factor in year T, (fraction),

Step 5:

$$BE_{Bioimining} = CH_4 \text{ emissions} \times GWP \quad \text{Equation (16)}$$

Where,

BE_{Bioimining} = Baseline emissions avoided due to biomining
 CH₄ emissions = CH₄ emitted in year T, t
 GWP = Global warming potential of CH₄

Total waste mass present in the intervention area (W) = 80,244.5 t (based on contour mapping)
f_i is the measured waste composition (mass fraction of food, paper, garden, wood, textiles) for the year 2017.

F - fraction of CH₄, by volume, in generated landfill gas (fraction) is chosen as default value.

R_T - recovered CH₄ in year T, Gg-The landfill gas is not recovered at the present facility

MCF - CH₄ correction factor for aerobic decomposition in the year of deposition (fraction) is default value from IPCC

OX_T - oxidation factor in year T, (fraction), is default value from IPCC

GWP - Global warming potential of CH₄ (GWP for methane to be conservative as per UCR guidelines at 21 when applied for baseline calculations)

Total baseline emissions avoided due to biomining are 167760 t CO₂ e.

Project Emissions:

Project emissions shall be calculated using the following equation:

$$PE_y = PE_{elec,y} + PE_{fuel,y} + PE_{Comp,y} + PE_{AD,y} + PE_{INC,y} \quad \text{Equation (17)}$$

Where,

PE_y = Project emissions in year y (tCO₂e)

PE_{elec}, = Project emissions due to electricity consumption in year y (tCO₂e)

PE_{fuel}, = Project emissions due to fossil fuel consumption in year y (tCO₂e)

PE_{comp}, = Project emissions associated with composting in year y (t CO₂e/yr)

PE_{AD}, = Project emissions associated with the anaerobic digester in year y (t CO₂e)

a) Project emissions due to electricity consumption in year y (PE_{elec} , tCO₂e)

The emissions include electricity consumption $PE_{elec,y}$ associated with the all the activities in the plant including Leachate biomethanation, RDF manufacturing, composting, plastic to fuel, incineration, etc, calculated as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

Here the electricity is drawn from the national grid.

For the calculation of PE_{elec} ,

$$PE_{EC} = \sum EC_{PJ} \times EF_{EF} \quad \text{Equation (18)}$$

PE_{EC} = Project emissions due to electricity consumption in year y (tCO₂e)

EC_{PJ} = Quantity of electricity consumed by the project electricity consumption in year y (MWh/yr)

$EF_{EF,y}$ = Emission factor for electricity generation in year y (t CO₂/MWh)

Total PE from electricity consumption for monitoring period is = 3205 tCO₂e

(b) Project emissions due to fossil fuel consumption in year y (tCO₂e)

The emissions include fossil fuel consumption $PE_{fuel,y}$ associated with the transportation of fuel within the project boundary and diesel generator set which is used as a backup. Project emissions due to the fuel combustion are calculated as per the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”. The project activity operates approx. 310 trucks for waste transport within the boundary and consists of two DG sets of capacity 400 kVA.

Project emission due to fuel consumption is calculated as followed

$$PEFC_{j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \text{Equation (19)}$$

Where,

PE_{FC} = Project emissions due to fuel consumption in year y (tCO₂e)

FC_i = Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

$COEF_{i,y}$ = Is the CO₂ emission coefficient of fuel type i in year y (tCO₂/mass or volume unit)

The quantity of diesel combusted in DG set and transportation during the year y is obtained from the purchased fuel invoices/bills, where the purchased fuel can be identified specifically for the CDM project.

The CO₂ emission coefficient, is calculated based on net calorific value and CO₂ emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} + EF_{CO2,i,y} \quad \text{Equation (20)}$$

Where:

$COEF_{i,y}$ = Is the CO₂ emission coefficient of fuel type i in year y (tCO₂/mass or volume)

$NCV_{i,y}$ = Is the weighted average net calorific value of the fuel type i in year y

$EF_{CO2,i,y}$ = Is the weighted average CO₂ emission factor of fuel type i in year y (tCO₂/GJ)

i = Are the fuel types combusted in process j during the year y

Total PE from fossil fuel consumption = 519 tCO₂e

(c) Project emissions associated with composting in year y ($PE_{COMP,y}$ tCO₂e/yr)

MSW that is received every day is sorted into organic and inorganic waste. The organic waste is pre-sorted and sent to the composting unit.

The UNFCCC ACM0022 methodology provides a standardized framework for calculating emissions from composting activities. Specifically, Tool 13 ("Project and leakage emissions from composting") outlines the procedures for determining both project and leakage emissions from composting and co-composting processes. In this case, only composting is conducted at the site; co-composting is not applicable.

Composting results into project and leakage emissions. Following parameters are obtained using this methodology.

The project emissions will be calculated using the below equation:

$$PE_{COMP,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH_4,y} + PE_{N_2O,y} + PE_{RO,y} \quad \text{Equation (21)}$$

Where,

$PE_{COMP,y}$ = Baseline emissions of methane from the SWDS in year y (t CO₂e)

$PE_{EC,y}$ = Baseline methane emissions from anaerobic treatment of the wastewater in open anaerobic lagoons or of sludge in sludge pits in the absence of the project activity in year y (t CO₂e).

$PE_{FC,y}$ = Project emissions from fossil fuel consumption associated with composting in year y (t CO₂/yr).

$PE_{CH_4,y}$ = Project emissions of methane from the composting process in year y (tCO₂e/yr)

$PE_{N_2O,y}$ = Project emissions of nitrous oxide from the composting process in year y (t CO₂e/yr)

$PE_{RO,y}$ = Project emissions of methane from run-off wastewater associated with co-composting in year y (t)

From the equation 21, $PE_{EC,y}$ and $PE_{FC,y}$ are excluded as they are already calculated earlier using equation 18,19 and 20.

Determination of project emissions of methane ($PE_{CH_4,y}$)

For the estimation of $PE_{CH_4,y}$ following equation is used:

$$PE_{CH_4} = Q_y \times EF_{CH_4,y} \times GWP_{CH_4} \quad \text{Equation (22)}$$

Where:

PE_{CH_4} = Project emissions of methane from the composting process in year y (t CO₂e/yr).

Q_y = Quantity of waste composted in year y (t/yr)

EF_{CH_4} = Emission factor of methane per tonne of waste composted valid for year y (t CH₄ / t)

GWP_{CH_4} = Global Warming Potential of CH₄ (t CO₂e / t CH₄)

In the above equation, the following parameters have default values:

Parameter	value
$EF_{CH_4,y}$	0.002
GWP_{CH_4}	28

Quantity of waste composted in year y (wet basis) is measured using a weighbridge.

Determination of project emissions of nitrous oxide ($PE_{N_2O,y}$)

For estimating $PE_{N_2O,y}$, following equation is used:

$$PE_{N_2O,y} = Q_y \times EF_{N_2O,y} \times GWP_{N_2O} \quad \text{Equation (23)}$$

$PE_{N_2O,y}$ = Project emissions of methane from the composting process in year y (t CO₂e/yr).

Q_y = Quantity of waste composted in year y (t/yr)

$EF_{N_2O,y}$ = Emission factor of methane per tonne of waste composted valid for year y (t CH₄ / t)

GWP_{N_2O} = Global Warming Potential of CH₄ (t CO₂e / t CH₄)

Global Warming Potential of N₂O value is obtained from the latest version of —Standard for application of the global warming potentials to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto protocol.

Parameter	value
$EF_{N_2O,y}$	0.0002
GWP_{N_2O}	265

Calculations for the $PE_{RO,y}$:

Project emissions of methane from run-off wastewater ($PE_{RO,y}$) are calculated only for the case of co-composting. In this case there is no co-composting.

Project emissions amount associated with the composting for the period of 7 years = 112375 tCO₂e.

(d) Project emissions associated with the anaerobic digester in year y (t CO₂e) / Leachate biomethanation (LB):

The leachate biomethanation process involves treating landfill leachate using anaerobic digestion to produce methane (CH₄). Methane is then either captured and utilized for energy generation (electricity production or heating) or flared.

In the current case, methane is partially used for electricity generation and heating purposes and partially flared to prevent its release into the atmosphere.

We calculate the emissions from this activity, using following steps:

Parameter	SI Unit	Description
$PE_{AD,y}$	t CO ₂ e	Project emissions associated with the anaerobic digester in year y (t CO ₂ e)
$LE_{AD,y}$	t CO ₂ e	Leakage emissions associated with the anaerobic digester in year y (t CO ₂ e)

Project emissions calculation:

The project emissions will be calculated using the equation below:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH_4,y} + PE_{flare,y} \quad \text{Equation (24)}$$

Where:

- $PE_{AD,y}$ = Project emissions associated with the anaerobic digester in year y (t CO₂e)
 $PE_{EC,y}$ = Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO₂e).
 $PE_{FC,y}$ = Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO₂e).
 $PE_{CH4,y}$ = Project emissions of methane from the anaerobic digester in year y (t CO₂e)
 $PE_{flare,y}$ = Project emissions from flaring of biogas in year y (t CO₂e).

From the equation (19), $PE_{EC,y}$ and $PE_{FC,y}$ are excluded as they are calculated separately.

For $PE_{CH4,y}$, following equation is used:

$$PE_{CH4} = Q_{CH4} \times EF_{CH4,default} \times GWP_{CH4} \quad \text{Equation (25)}$$

- $Q_{CH4,y}$ = Amount of biogas collected at the digester outlet in year y .
 $EF_{CH4,default}$ = Default emission factor for the fraction of CH₄ produced that leaks from the anaerobic digester which is 0.002 .

Global warming potential (GWP_{CH4}) is 28.

The gas flow is measured based on the capacity of the pump delivering the gas.

$PE_{flare,y}$ is calculated using Tool 8. Following equation provides emissions due to flaring based on mass flow measurement of gas in the minute.

However, at the plant site, annual volumetric gas flow measurement is given for biogas in m³.

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,m} \times (1 - \eta_{flare,m}) \times 10^{-3} \quad \text{Equation (26)}$$

Where:

- $PE_{flare,y}$ = Project emissions from flaring of the residual gas in year y (tCO₂e)
 GWP_{CH4} = Global warming potential of methane valid for the commitment period (t CO₂e/t)
 $F_{CH4,m}$ = Mass flow of methane in the residual gas in the minute m (kg)
 $\eta_{flare,m}$ = Flare efficiency in the minute m

Mass flow of methane is obtained using tool 8. The equation provides mass flow of methane in the residual gas:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \quad \text{Equation (27)}$$

Where:

- $F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
 $V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)
 $v_{i,t,db}$ = Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas)
 $\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³ gas i)
 Volumetric fraction of methane in biogas is 0.6.
 Density of methane in biogas is 0.716 kg/m³.

The mass flow of gas is measure based on the capacity of the pump delivering the gas. Calculations are explained on page _final step of the tool 14.

$$PE_{flare,y} = BG_{flare,y} \times w_{CH4} \times GWP_{CH4} \times (1 - CEF) \quad \text{Equation (28)}$$

For simplification, the emissions from flaring are calculated based on annual data instead of

minutes. Following equation is use.

Where:

$PE_{flare,y}$ = Project emissions from flaring of the residual gas in year y (tCO₂e)

$BG_{flare,y}$ = Amount of biogas flared (kg)

W_{CH_4} = Fraction of methane in gas generated in digester (0.6)

GWP_{CH_4} = Global warming potential of methane (28)

CEF= Combustion efficiency for open flare (0)

Project emissions due to leachate bio-methanation for 7 years are 170 tCO₂

Incineration:

In the incineration process, dead animal carcass is fed to the incinerator. Pyro oil, RDF and shredded biomass are used as a fuel to burn dead animal waste. Biogas from leachate biomethanation plant is used as a fuel for electricity generation. This electricity is used in incineration to heat up the feed. The gases of this completed combustion are passed through venturi scrubber where particulate matters, SO₂ and HCL are stripped off with the help of alkaline water.

Project emissions from this process of incineration are obtained using the following equation:

$$PE_{INC,y} = PE_{COM,y} + PE_{EC,y} + PE_{FC,y} + PE_{WW,y} \quad \text{Equation (29)}$$

Where,

$PE_{INC,y}$ = Project emissions from incineration in year y (t CO₂e).

$PE_{COM,y}$ = Project emissions from combustion within the project boundary of fossil waste associated with incineration in year y (t CO₂).

$PE_{EC,y}$ = Project emissions from electricity consumption associated with incineration in year y (t CO₂e).

$PE_{FC,y}$ = Project emissions from fuel combustion associated with incineration in year y (t CH₄)

$PE_{WW,y}$ = Project emissions from the wastewater treatment associated with incineration in year y.

$$PE_{COM,y} = PE_{COM,CO_2,y} + PE_{COM,CH_4,N_2O,y} \quad \text{Equation (30)}$$

Where:

$PE_{COM,y}$ = Project emissions from combustion within the project boundary associated with combustor c in year y (t CO₂e)

$PE_{COM,CO_2,y}$ = Project emissions of CO₂ from combustion within the project boundary associated with combustor c in year y (t CO₂)

$PE_{COM,CH_4,N_2O,y}$ = Project emissions of CH₄ and N₂O from combustion within the project boundary associated with combustor c in year y (t CO₂).

c = Combustor used in the project activity: gasifier or syngas burner, incinerator RDF/SB combustor

Project emissions of CO₂ from combustion within the project boundary ($PE_{COM_CO_2,c,y}$):

$$PE_{COM,CO_2,c,y} = \frac{44}{12} \times FF_{COM,y} \times Q_{waste,c,y} \times FFC_{waste,c,y} \quad \text{Equation (31)}$$

$Q_{waste,y}$ = Quantity of fresh waste (dead animals) fed into incinerator in year y (t)

$FF_{COM,c,y}$ = Fraction of fossil-based carbon in waste fed into incinerator in year y (t C/t).

Source: <https://4vultures.org/wp-content/uploads/2023/10/Mitigating-GHG>

Emissions_vultures_PlazaandLambertucci2022.pdf

$FFC_{waste,y}$ = Combustion efficiency of incinerator c in year y (fraction).

Source: Chapter 5, Volume 5 (Incineration and open burning of waste) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, page 5.20, para 5.4.1.3; —For waste incinerators it is assumed that the combustion efficiencies are close to 100 percent

Different categories of dead animals (eg: pigs, cows, dogs, etc) are brought at the site every day. A

log of the count of no of animals of each category is maintained. There is no arrangement of weighing the waste, but it is made sure that the incinerator is operated at its maximum capacity i.e 250kg/hr. The data for number of working hours of the incinerator is obtained from the plant. The quantity of fresh waste is obtained by multiplying the number of dead animals to the capacity of incinerator and number of working hours, the calculations for which are as given below:

$$Q_{waste,y} = \frac{\text{No. of waste animals incinerated} \times \text{No. of working hours of incinerator}}{\text{Capacity of incinerator}} \quad \text{Equation (32)}$$

Other than dead animals, incinerator also involves burning of RDF as fuel.

Emissions due to RDF combustion can be calculated either using tool 3- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion or equation (28) above.

Project emissions of CH₄ and N₂O from combustion within the project boundary (PE_{COM,CH₄,N₂O,c,y})

$$PE_{COM,CH_4,N_2O,y} = Q_{waste,c,y} \times (EF_{N_2O,t} \times GWP_{N_2O} + EF_{CH_4,t} \times GWP_{CH_4}) \quad \text{Equation (33)}$$

Where:

- PE_{COM,CH₄,N₂O,y} = Project emissions of CH₄ and N₂O from combustion within the project boundary of fossil carbon in combustor c in year y (t CO₂).
- Q_{waste,c,y} = Quantity of fresh waste or RDF/SB fed into combustor c in year y (t).
- EF_{N₂O,t} = Emission factor for N₂O associated with waste treatment process t (t N₂O/t waste).
- EF_{CH₄,t} = Emission factor for CH₄ associated with treatment process t (t CH₄/t waste).
- GWP_{N₂O} = Global Warming Potential of nitrous oxide (t CO₂e/t N₂O)
- GWP_{CH₄} = Global Warming Potential of methane valid for the commitment period (t CO₂e/tCH₄)

Default values for this equation are:

Parameter	N ₂ O	CH ₄
EF	1.21*60*10 ⁻⁶	1.21*237*10 ⁻³
GWP	265	28

Source: ACM0022, data and parameters not monitored, table 7 Thereby,

Project emissions due to incineration: 113194 t CO₂ e.

Plastic to Fuel (PtoF):

The pyrolysis plastic-to-fuel process is a chemical process that converts waste plastic into usable fuels, such as diesel, gasoline, etc. In this process, plastics are heated in absence of oxygen to temperatures typically between 600–800°C. This high heat causes the plastic polymers to break down into smaller molecules, producing a mixture of liquid hydrocarbons (pyro oil), pyro gas, and char (a solid residue). Pyrolysis helps reduce plastic waste and provides an alternative energy source, making it an attractive option for waste management and sustainable energy production.

In this process since the plastic is burned in absence of oxygen, there are no carbon emissions. However, the fuel required for heating can emit carbon. But in the present case, pyro-gas is recycled and used for heating the plastic. Another product, pyro-oil, is combusted in incineration causing carbon emissions. The by-product char is stored.

The plastic-to-fuel process employed in this plant cannot be classified as gasification, as the process operates under pyrolysis, which involves the thermal decomposition of plastic waste in the absence of oxygen, unlike gasification, which requires partial oxidation. As mentioned before, the pyrolysis gas (pyro-gas) is partly converted into oil, while a portion is reused as a heat source for processing the feed material, thus reducing external energy requirements. The remaining pyro-gas is stored in a gas balloon. Since the pyro-gas is either utilized within the process or stored, and there is no direct release of emissions, the net emissions from the plastic-to-fuel process are considered zero. There are no leakage emissions in plastic to fuel process.

Briquetting:

Horticulture waste is converted to briquettes by shredding and compacting. This process consumes electricity. The equation 28, accounts for these emissions. The product from this process i.e briquettes are sold outside the project boundary. There are no project emissions.

Leakage emissions:

Composting (COMP)

Leakage emissions from composting ($LE_{COMP,y}$) shall be accounted for if compost is subjected to anaerobic storage or disposed of in a SWDS.

In this case, the compost is sun dried and then packed into bags for selling purpose. Hence $LE_{COMP,y}$ is zero.

Leachate biomethanation (LB):

The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. They include emissions as:

$$LE_{AD,y} = LE_{storage,y} + LE_{COM,y} \quad \text{Equation (34)}$$

Where,

$LE_{storage,y}$ = Leakage emissions associated with storage of digestate in year y (t CO₂e)

$LE_{COM,y}$ = Leakage emissions associated with composting of digestate ($LE_{COMP,y}$).

Leakage emissions associated with storage of digestate in year y (t CO₂e)

$LE_{storage,y}$ is applied in the case that the digestate is stored under the following anaerobic conditions:

- (a) In an un-aerated lagoon that has a depth of more than one meter; or
- (b) In a SWDS, including stockpiles that are considered a SWDS as per the definitions section.

Storage of digestate under anaerobic conditions can cause CH₄ emissions due to further anaerobic digestion of the residual biodegradable organic matter. The procedure for determining $LE_{storage,y}$ is distinguished for liquid digestate and solid digestate.

In the present case, digestate is in liquid state, emissions for which can be calculated using following equation:

$$LE_{storage,y} = LE_{SD,CH_4,default} \times Q_{CH_4} \times GWP_{CH_4} \quad \text{Equation (35)}$$

Where:

$LE_{storage,y}$ = Leakage emissions associated with storage of digestate in year y (t CO₂e)

$LE_{SD,CH_4,default}$ = Default factor for the methane generation capacity of solid digestate (fraction)

Q_{CH_4} = Quantity of methane produced in the anaerobic digester in year y (t CH₄)
 GWP_{CH_4} = Global warming potential of CH₄ (t CO₂/t CH₄)

Leakage emissions associated with composting of digestate ($LE_{COMP,y}$).

The digestate is not composted in the present case. Hence, $LE_{COMP,y}$ will be 0. Leakage emissions are amounted to be 176 tCO₂.

RDF manufacturing (RDF):

Leakage emissions: RDF manufacturing has leakage emissions which are calculated as given below:

Leakage emissions associated with RDF/SB are accounted for the organic waste by products of the treatment process (not by-products from the RDF/SB combustor), which may be composted or disposed of in a SWDS, and the end-use of RDF/SB that is exported.

The leakage emissions from RDF manufacturing are calculated by the following equation:

$$LE_{RDF_{SB},y} = LE_{ENDUSE,RDF_{SB}} + LE_{SWDS,WBP_{RDF_{SB},y}} \quad \text{Equation (36)}$$

Where:

$LE_{RDF_{SB},y}$ = Leakage emissions associated with RDF/SB in year y (t CO₂e)
 $LE_{ENDUSE,RDF_{SB},y}$ = Leakage emissions associated with the end-use of RDF/SB
 $LE_{SWDS,RDF_{SB},y}$ = Leakage emissions associated with disposing of waste by products associated with RDF/SB production in a SWDS in year y (t CO₂e).

The leakage emissions associated with disposing of waste by products associated with RDF/SB production in a SWDS in year y (t CO₂e) is considered to be zero as in the present case, the organic waste associated with RDF are sent for composting and not sent to the SWDS.

Leakage emissions associated with the end-use of RDF/SB that is exported outside the project boundary in year y are that it may be combusted or decomposed anaerobically.

In the present case, the RDF/SB exported in year y has end use as a fuel that is combusted. Documented evidence is provided that the RDF/SB exported off-site is combusted. Leakage emissions $LE_{ENDUSE,RDF_{SB},y}$ shall be calculated, according to procedure below;

Leakage emissions from combusted off-site end use of RDF/SB ($LE_{ENDUSE,RDF_{SB},y}$):

$$LE_{ENDUSE,RDF_{SB},y} = Q_{RDF_{SB},COM,y} \times NCV_{RDF,y} \times EF_{CO_2,RDF_{SB},y} \quad \text{Equation (37)}$$

Where:

$LE_{ENDUSE,RDF_{SB},y}$ = Leakage emissions of CO₂ from off-site combustion of RDF/SB in year y (t CO₂)
 $Q_{RDF_{SB},COM,y}$ = Quantity of RDF/SB exported off-site with potential to be combusted in year y (t)
 $EF_{CO_2,y}$ = CO₂ emissions factor for RDF/SB in year y (t CO₂/GJ)
IPCC guidelines, Chapter1-Introduction-table 1.4 - Municipal waste (non biomass fraction)
 $NCV_{RDF_{SB},y}$ = Net calorific value of RDF in year y (TJ/Gg)
IPCC guidelines, Chapter1-Introduction-table 1.2 – Municipal waste (non biomass fraction)

The emissions due to combustion of RDF sold outside the project boundary are as follows:

Amount of coal replaced by the RDF produced is calculated as:

$$M_{\text{coal}} = M_{\text{RDF}} * (\text{NCV}_{\text{RDF}} / \text{NCV}_{\text{coal}})$$

Leakage emissions are amounted to be 239327 t CO₂.

Emissions reduction:

Hence emission reduction is calculated:

$$\text{Emissions reduction} = \text{Baseline emissions} - \text{Project emissions} - \text{Leakage emissions}$$

Year	BE	PE	LE
2017	233058	14859	18414
2018	136102	21686	31993
2019	159773	28564	33294
2020	166442	30287	30458
2021	209958	33831	31568
2022	216615	31838	33190
2023	252825	32268	37757
2024	193410	36130	22823
Total	1568181	229463	239497

$$\text{ER} = 1568181 - 229463 - 239497 = 1099221 \text{ tCO}_2\text{e.}$$

As per calculations, with help of various project activities to treat the daily MSW, emissions that have been reduced for a period of 7 years from 2017 to 2024: **1099221 tCO₂ e.**

In the absence of this project activity, there would have been tremendous health issues and adverse social consequences.

C.6. Prior History>>

The project activity has not been applied for any other GHG program for generation or issuance of carbon offsets or credits for the said crediting period. This can be verified from the project databases of different GHG standards.

C.7. Monitoring period number and duration>>

First Issuance Period: 7 years, 11 months – 15/02/2017 to 31/12/2025

C.8. Changes to start date of crediting period >>

There is no change in the start date of crediting period.

C.9. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN monitoring plan and applied methodology.

C.10. Monitoring plan>>

The project activity involves management of waste by composting, RDF manufacturing, leachate biomethanation, briquetting, and plastic to fuel. Also, for some part of the project activity, solar electricity is generated avoiding coal-based electricity. The following parameters are monitored:

- Amount of total MWS collected every day.
- Quantity of gross electricity generation by the project plant/unit in year y.
- Waste characterization of the incoming waste.
- Amount of biogas generated per day from the leachate treatment.
- Amount of RDF produced combusted inside the plant and exported outside.
- Mass of fuel consumed.
- Amount of electricity consumed.

Description:

The monitoring plan outlines continuous or periodic measurement of key environmental parameters such as waste quantities, wastewater characteristics, biogas production, and electricity flows. Data is collected using calibrated equipment (e.g., weighbridges, energy meters, lab instruments), with QA/QC procedures including regular calibration, representative sampling, and dual recording methods to ensure reliability. Measurements are aggregated annually and support emission calculations across waste disposal, combustion, wastewater treatment, and energy generation activities.

Details of the parameters are as follows:

1. The parameter W_x or W_i monitors the total waste disposed in a SWDS for year X, it is measured on a wet basis using a weighbridge at the entry point, with daily readings recorded both manually and digitally. This data is monitored continuously and aggregated annually. The weighbridge undergoes yearly calibration as per supplier guidelines, and QA/QC procedures ensure data reliability, with calibration reports serving as key evidence.
2. The parameter $p_{n,j,x}$ or $p_{n,j,i}$ indicate the wet-basis weight fraction of waste type j in sample n, collected annually or monthly. QA/QC procedure uses Quadrant method of sampling, with at least three samples taken every three months. Data from these samples, sourced from project participants, supports methane emission calculations for SWDS based on waste characterization reports.
3. The parameter z_x records the number of waste samples collected annually, with a minimum of three samples every four months. QA/QC procedures used are representative sampling due to the presence

of multiple waste types, and data is continuously monitored and aggregated yearly.

4. The parameter $Q_{waste,c,y}$ measures the annual quantity of fresh waste or RDF/SB fed into combustor c , using calibrated scales and continuous monitoring. QA/QC procedures ensure accuracy through pre-sorting and weighing, supporting emission calculations within the project boundary.

5. The parameter $EC_{t,y}$ captures electricity consumption (in MWh) from the grid for waste treatment under process t , monitored continuously via energy meters and recorded monthly. QA/QC procedures include the use of calibrated energy meters, calibration is done annually, and annual data summarisation to support emission calculations under TOOL05.

6. The parameter EC_{BE} records electricity generation (in MWh) by the biogas generator during leachate bio-methanation, used for heating in the incinerator. QA/QC procedures involve regular maintenance and testing of the electricity meter as per supplier guidelines to ensure measurement accuracy.

7. The parameter $Q_{RDF_SB,COM,y}$ tracks the quantity (in tonnes) of RDF/SB exported off-site for potential combustion, based on sale invoices and dispatch records. QA/QC procedures include weighing RDF-filled trucks before they leave the project boundary to ensure accurate measurement.

8. The parameter $QRDF_SB,y$ records the daily quantity (in tonnes) of RDF/SB produced during year y , measured using a weighbridge. QA/QC procedures include periodic calibration of the weighbridge to ensure accurate and reliable data.

9. The parameter $Q_{ww,y}$ measures the volume of wastewater (in m^3) discharged from the project activity, either untreated or treated anaerobically, based on the tank's capacity and daily monitoring aggregated annually. If the wastewater is treated aerobically, monitoring is not required as emissions are assumed to be zero.

10. The parameter $COD_{BL,y}$ measures the Chemical Oxygen Demand (COD) concentration of wastewater discharged by the project in year y , expressed in $tCOD/m^3$. It is monitored monthly and averaged annually, with weekly in-house testing and monthly external lab analysis using standardized methods. This data is essential for calculating baseline emissions from wastewater.

11. The parameter $Q_{biogas,y}$ tracks the volume of biogas (in m^3) collected at the digester outlet, measured continuously under actual pressure and temperature. Biogas is stored in a balloon with a tie rope indicator for volume estimation and then sent for incineration to produce electricity.

12. The parameter $EF_{grid,y}$ defines the CO_2 emission factor for grid electricity in year y , set at $0.757 tCO_2e/kWh$. It is a fixed value recommended by UCR and sourced from the 2024 Vintage Indian Grid Emission Factor document, applied using the standard emission factor calculation tool.

13. The parameter $EG_{PJ,facility,y}$ records the net electricity (in MWh) supplied to the grid by the project, measured continuously using a bidirectional energy meter and recorded monthly. Data is archived electronically via the Surya Logix mobile app and summarized annually.

Data storage and archiving

All data regarding MSW recorded at the weighbridge is stored two ways, automatic digital documentation and manual documentation. MIS sheets are generated monthly. All data is stored both at the MSWM plant at Nashik as well as at the project participant's head office. The monitored data will be made available to the emission reduction assigned auditors. The project participants have developed the necessary records of documents for the MSW, and solar unit administration of operations and legal agreements. This is how the monitoring protocol has been established. These records have been maintained for the crediting period, 2017 to 2024.

Training and Maintenance Procedures

The project participant has trained all concerned employees of each project activity at the plant in the operation and maintenance of the MSWM plant, as well as, individually trained each project activity administration in their monitoring protocol to follow the Monitoring Plan.

Furthermore, the project participant ensures that Fire & Safety Training sessions and Health Checkups are conducted and recorded on an annual basis. Also, precautionary instructions are systematically communicated to the rag pickers to promote safe working practices.

Details of Monitoring Personnel

Details of the Monitoring Personnel for each Project Activity at NWMPL				
Sl. No	Unique Code	Title of Project Activity	Supervisor	Qualification of The Supervisor
1	NWMPL-IN-PRES-2024-CPA-00	Pre-Sorting	Vikas Kumar	M.Sc. Environmental Science, 15 year's experience
2	NWMPL-IN-COMP-2024-CPA-01	Composting	Rahul Kushwaha	B.Tech Mechanical Engineering, MBA. Production and Operation Management, 10 year's experience
3	NWMPL-IN-RDF-2024-CPA-02	RDF Production	Amiyakumar Barik	B.Sc. Chemistry, 10 years experience
4	NWMPL-IN-BIOM2024-CPA-03	Leachate Treatment Plant(LTP)/ Biomethanation	Rohit Bhamare	M.Sc. Environmental Science B.Sc Chemistry , Diploma in Sanitary Inspector, 7 years experience
5	NWMPL-IN-BRIQS-2024-CPA-04	Biomass Briquetting	Promod Thorat	FYJC, Training for Waste handling at Municipal Corporation Project, 15 years experience
6	NWMPL-IN-PTF-2024-CPA-05	Nashik Plastic to Fuel	Md Tauhid Alam	B. Tech Mechanical Engineer, 8 years experience

7	NWMPL-IN-INC-2024-CPA-06	Dead Animal Incinerator	Rohit Bhamare & Krishna Shinde	Rohit Bhamare - M.Sc. Environmental Science , B.Sc Chemistry, Diploma in Sanitary Inspection, 7 years experience + Krishna Shinde - SYJC, Trained at Municipal Corporation Project for Waste Handling Activities, 14 Years Experience
8	NWMPL-IN-SLF-2024-CPA-07	Reject To Landfill	Akshay Wakchaure	Diploma in Civil Engineering, 8 years experience
9	NWMPL-IN-EC-2024-CPA-08	Solar Energy	Anil Ahire	SSC, Training in Industrial Electrical and Wiring Work, 16 years experience

Ex-Post Parameters

Data and Parameters not monitored:

Data / Parameter table 1

Data / Parameter:	$RATE_{COMPLIANCE,t}$
Data unit:	fraction
Description:	Rate of compliance with a regulatory requirement to implement the alternative waste treatment t implemented in the project activity
Source of data:	https://cpcb.nic.in/uploads/MSW/MSW_AnnualReport_2016-17.pdf
Values(s) applied	0.2018
Measurement methods and procedures	Fraction is calculated as the number of instances of compliance divided by the number of instances of compliance plus non-compliance
Monitoring frequency	Annually
Purpose of data	Calculation of baseline emissions
Any comment:	Calculated based on the number of instances of compliance identified at the time of the investment decision and updated once for every subsequent crediting period.

Data / Parameter table 2

Data/Parameter	Φ_y ; $\Phi_{default}$
Data unit	--
Description	Default value for the model correction factor to account for model uncertainties
Source of data	"Emissions from solid waste disposal sites" Tool, Table 1
Value(s) applied	0.85
Choice of data or Measurement methods and procedures	Application B, humid/ Wet conditions
Additional comment	--

Data/Parameter table 3

Data / Parameter:	OX
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data:	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.1
Monitoring frequency:	Fixed parameter
QA/QC procedures:	IPCC 2006 Guidelines
Any comment:	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO ₂ . The oxidation factor represents the proportion of methane that is oxidized to CO ₂ . This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS

Data/Parameter table 4

Data / Parameter:	F
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Monitoring frequency:	Fixed parameter
QA/QC procedures:	IPCC 2006 Guidelines
Any comment:	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data/Parameter table 5

Data / Parameter:	DOC_{f,default}
Data unit:	Weight fraction
Description:	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Monitoring frequency:	Fixed parameter
QA/QC procedures:	This default value can be used for Application B if the Tool is applied to MSW
Any comment:	

Data/Parameter table 6

Data / Parameter:	MCF_{default}
Data unit:	-

Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	The value of 1.0 is appropriate because waste disposal practices at landfill sites in the host country prior to the project activity include waste levelling and coverage with soil
Monitoring frequency:	Fixed parameter
QA/QC procedures:	-
Any comment:	MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS. In case of a water table above the bottom of the SWDS, a larger proportion of the SWDS is anaerobic and MCF shall be estimated according to equation (12)

Data / Parameter table 7

Data / Parameter:	DOC _j
Data unit:	-
Description:	Fraction of degradable organic carbon in the waste type <i>j</i> (weight fraction)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)

Value to be applied:	For MSW, the following values for the different waste types j should be applied: Default values for DOC_j <table border="1"> <thead> <tr> <th>Waste type j</th><th>DOC_j (% wet waste)</th></tr> </thead> <tbody> <tr> <td>Wood and wood products</td><td>43</td></tr> <tr> <td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr> <tr> <td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr> <tr> <td>Textiles</td><td>24</td></tr> <tr> <td>Garden, yard and park waste</td><td>20</td></tr> <tr> <td>Glass, plastic, metal, other inert waste</td><td>0</td></tr> </tbody> </table> For the following residual waste types, project participants may use or derive default values, as follows: (a) For empty fruit branches (EFB), as their characteristics are similar to garden waste, the value for garden, yard and park waste in the table above may be used as a default (b) For industrial sludge, either a value of 9 per cent (% wet sludge) may be used as a default, assuming an organic dry matter content of 35 percent, or alternatively, if the percentage of organic dry matter content is known, then the DOC value may be calculated as follows: DOC_j (% wet sludge) = $9 * (\% \text{ organic dry matter content} / 35)$; (c) For domestic sludge, either a value of 5 per cent (% wet sludge) may be used as a default, assuming an organic dry matter content of 10 per cent, or alternatively, if the percentage of organic dry matter content is known, then the DOC value may be calculated as follows: DOC_j (% wet sludge) = $5 * (\% \text{ organic dry matter content} / 10)$.	Waste type j	DOC_j (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard (other than sludge)	40	Food, food waste, beverages and tobacco (other than sludge)	15	Textiles	24	Garden, yard and park waste	20	Glass, plastic, metal, other inert waste	0
Waste type j	DOC_j (% wet waste)														
Wood and wood products	43														
Pulp, paper and cardboard (other than sludge)	40														
Food, food waste, beverages and tobacco (other than sludge)	15														
Textiles	24														
Garden, yard and park waste	20														
Glass, plastic, metal, other inert waste	0														
Monitoring frequency:	Fixed parameter														
QA/QC procedures:	As per IPCC														
Any comment:	The procedure for the ignition loss test is described in BS EN 15169:2007 Characterization of waste. Determination of loss on ignition in waste, sludge and sediments. The percentages listed in table above are based on wet waste basis which are concentrations in the waste as it is delivered to the SWDS. The IPCC Guidelines also specify DOC values on a dry waste basis, which are the concentrations after complete removal of all moist from the waste, which is not believed practical for this situation														

Data / Parameter table 8

Data / Parameter:	k_j
Data unit:	1/yr
Description:	Decay rate for the waste type j
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value to be applied:	Apply the following default values for the different waste types j: Default values for the decay rate (k_j)

Waste type <i>j</i>	Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)		
	Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP<1000m m)	Wet (MAP >1000 mm)	
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40
	<u>Note:</u> MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.				
Monitoring frequency:	Fixed parameter				
QA/QC procedures:	As per IPCC				
Any comment:	Document in the CDM-PDD the climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration). Use long-term averages based on statistical data, where available. Provide references				

Data / Parameter table 9

Data / Parameter:	GWP_{CH4}
Data unit:	t CO ₂ e/t CH ₄
Description:	Global Warming Potential of methane
Source of data:	IPCC
Value to be applied:	21 for baseline emissions calculations and 28 for Project and leakage emissions.
Monitoring frequency:	Annually
QA/QC procedures:	As per IPCC
Any comment:	-

Data / Parameter table 10

Data / Parameter:	FCC_j																								
Data unit:	%																								
Description:	Fraction of total carbon content in waste type j																								
Source of data:	Table 2.4, chapter 2, volume 5 of IPCC 2006 guidelines																								
Value to be applied:	For MSW the following values for the different waste types j may be applied: Table 5: Default values for $FCC_{j,y}$ <table> <tr> <th>Waste Type j</th><th></th></tr> <tr> <td>Paper/cardboard</td><td>50</td></tr> <tr> <td>Textiles</td><td>50</td></tr> <tr> <td>Food Waste</td><td>50</td></tr> <tr> <td>Wood</td><td>54</td></tr> <tr> <td>Garden and Park waste</td><td>55</td></tr> <tr> <td>Nappies</td><td>90</td></tr> <tr> <td>Rubber and Leather</td><td>67</td></tr> <tr> <td>Plastics</td><td>85</td></tr> <tr> <td>Metal*</td><td>NA</td></tr> <tr> <td>Glass*</td><td>NA</td></tr> <tr> <td>Other, inert waste</td><td>100</td></tr> </table> *Metal and glass contain some carbon of fossil origin. Combustion of significant amounts of glass or metal is not common The project participants also have the option to apply the balance method (Appendix 2 of ACM0022) to measure $FCC_{j,y}$	Waste Type j		Paper/cardboard	50	Textiles	50	Food Waste	50	Wood	54	Garden and Park waste	55	Nappies	90	Rubber and Leather	67	Plastics	85	Metal*	NA	Glass*	NA	Other, inert waste	100
Waste Type j																									
Paper/cardboard	50																								
Textiles	50																								
Food Waste	50																								
Wood	54																								
Garden and Park waste	55																								
Nappies	90																								
Rubber and Leather	67																								
Plastics	85																								
Metal*	NA																								
Glass*	NA																								
Other, inert waste	100																								
Any comment:	Data and parameters to be monitored in respect of the balance method are shown in the Appendix 2 of ACM0022 additionally																								

Data / Parameter table 11

Data / Parameter:	FFC_j
Data unit:	%
Description:	Fraction of fossil carbon in total carbon content of waste type j
Source of data:	Table 2.4, chapter 2, volume 5 of IPCC 2006 guidelines

Value to be applied:	For MSW the following values for the different waste types j may be applied: Table 4: Default values for FFCj,y <table border="1"> <tr> <th>Waste Type j</th><th></th></tr> <tr> <td>Paper/cardboard</td><td>5</td></tr> <tr> <td>Textiles</td><td>50</td></tr> <tr> <td>Food Waste</td><td>-</td></tr> <tr> <td>Wood</td><td>-</td></tr> <tr> <td>Garden and Park waste</td><td>0</td></tr> <tr> <td>Nappies</td><td>10</td></tr> <tr> <td>Rubber and Leather</td><td>20</td></tr> <tr> <td>Plastics</td><td>100</td></tr> <tr> <td>Metal*</td><td>NA</td></tr> <tr> <td>Glass*</td><td>NA</td></tr> <tr> <td>Other, inert waste</td><td>100</td></tr> </table> Metal and glass contain some carbon of fossil origin. Combustion of significant amounts of glass or metal is not common. If a waste type is not comparable to a type listed in Table 4, or cannot clearly be described as a combination of types in this table above, or if the project participants wish to measure FFCj, then project participants shall measure FFCj,y using the following standards, or similar national or international standards: ASTM D6866: "Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis"; ASTM D7459: "Standard Practice for Collection of Integrated Samples for the Speciation of Biomass (Biogenic) and Fossil Carbon Dioxide Emitted from Stationary Emissions Sources". The frequency of measurement shall be as a minimum four times in year y with the mean value valid for year y The project participants also have the option to apply the balance method (Appendix 2 of ACM0022) to measure FFCj,y	Waste Type j		Paper/cardboard	5	Textiles	50	Food Waste	-	Wood	-	Garden and Park waste	0	Nappies	10	Rubber and Leather	20	Plastics	100	Metal*	NA	Glass*	NA	Other, inert waste	100
Waste Type j																									
Paper/cardboard	5																								
Textiles	50																								
Food Waste	-																								
Wood	-																								
Garden and Park waste	0																								
Nappies	10																								
Rubber and Leather	20																								
Plastics	100																								
Metal*	NA																								
Glass*	NA																								
Other, inert waste	100																								
Any comment:	Data and parameters to be monitored in respect of the balance method are shown in the Appendix 2_of ACM0022 additionally																								

Data / Parameter table 12

Data/Parameter	EF _{CH₄} , default;
Data unit	tCH ₄ /t
Description	Default emission factor of methane per tonne of waste composted (wet basis)
Source of data	The emission factor was selected based on studying published results of emission measurements from composting facilities, literature reviews on the subject and published emission factors. Data from recent, high-quality sources was analysed and a value conservatively selected from the higher end of the range in results.
Value(s) applied	0.002
Choice of data or Measurement methods and procedures	Applicable to Option 2 in the step "Determination of methane and nitrous oxide emissions from the composting process"
Purpose of data	project emission calculation

Additional comment	Applicable for incineration
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Data / Parameter table 13

Data/Parameter	$EF_{N_2O, default}$
Data unit	tN ₂ O/t
Description	Default emission factor of nitrous oxide per tonne of waste composted (wet basis)
Source of data	The emission factor was selected based on studying published results of emission measurements from composting facilities, literature reviews on the subject and published emission factors. Data from recent, high-quality sources was analysed and a value conservatively selected from the higher end of the range in results.
Value(s) applied	0.0002
Choice of data or Measurement methods and procedures	Applicable to Option 2 in the step "Determination of methane and nitrous oxide emissions from the composting process"
Purpose of data	project emission calculation
Additional comment	Applicable for incineration

Data / Parameter table 14

Data / Parameter:	$EF_{CH_4,t}$																												
Data unit:	t CH ₄ /t waste (wet basis)																												
Description:	Emission factor for CH ₄ associated with waste treatment process t																												
Source of data:	Table 5.3, chapter 5, volume 5 of IPCC 2006 guidelines																												
Value to be applied	1.21*237*10 ⁻⁶																												
Measurement procedures (if any):	The default values for fluidized bed batch type incineration are selected. IPCC 2006 Guidelines. Table 6. CH₄ emission factors for combustion <table><tr><th>Waste type</th><th colspan="2">Type of incineration/technology</th><th>CH₄ emission factors (t CH₄ / t waste) wet basis</th></tr><tr><td rowspan="6">MSW</td><td rowspan="2">Continuous incineration</td><td>stoker</td><td>1.21x 0.2x10⁻⁶</td></tr><tr><td>fluidised bed</td><td>~0</td></tr><tr><td rowspan="2">Semi-continuous incineration</td><td>stoker</td><td>1.21x 6x10⁻⁶</td></tr><tr><td>fluidised bed</td><td>1.21x 188x10⁻⁶</td></tr><tr><td rowspan="2">Batch type incineration</td><td>stoker</td><td>1.21x 60x10⁻⁶</td></tr><tr><td>fluidised bed</td><td>1.21x 237x10⁻⁶</td></tr><tr><td colspan="3">Sludge (semi-continuous or batch type incineration)</td><td>1.21x 9 700x10⁻⁶</td></tr><tr><td colspan="3">Waste oil (semi-continuous or batch type incineration)</td><td>1.21x 560x10⁻⁶</td></tr></table> A conservativeness factor of 1.21 has been applied to account for the uncertainty of the IPCC default values	Waste type	Type of incineration/technology		CH ₄ emission factors (t CH ₄ / t waste) wet basis	MSW	Continuous incineration	stoker	1.21x 0.2x10 ⁻⁶	fluidised bed	~0	Semi-continuous incineration	stoker	1.21x 6x10 ⁻⁶	fluidised bed	1.21x 188x10 ⁻⁶	Batch type incineration	stoker	1.21x 60x10 ⁻⁶	fluidised bed	1.21x 237x10 ⁻⁶	Sludge (semi-continuous or batch type incineration)			1.21x 9 700x10 ⁻⁶	Waste oil (semi-continuous or batch type incineration)			1.21x 560x10 ⁻⁶
Waste type	Type of incineration/technology		CH ₄ emission factors (t CH ₄ / t waste) wet basis																										
MSW	Continuous incineration	stoker	1.21x 0.2x10 ⁻⁶																										
		fluidised bed	~0																										
	Semi-continuous incineration	stoker	1.21x 6x10 ⁻⁶																										
		fluidised bed	1.21x 188x10 ⁻⁶																										
	Batch type incineration	stoker	1.21x 60x10 ⁻⁶																										
		fluidised bed	1.21x 237x10 ⁻⁶																										
Sludge (semi-continuous or batch type incineration)			1.21x 9 700x10 ⁻⁶																										
Waste oil (semi-continuous or batch type incineration)			1.21x 560x10 ⁻⁶																										
Any comment:	Applicable to estimate PECOM,c,y for incineration																												

Data / Parameter table 15

Data / Parameter:	$EF_{N_2O,t}$																		
Data unit:	t N ₂ O/t waste (wet basis)																		
Description:	Emission factor for N ₂ O associated with treatment process <i>t</i>																		
Source of data:	Table 5.6, chapter 5, volume 5 of IPCC 2006 guidelines																		
Value applied	1.21*237*10 ⁻⁶																		
Measurement procedures (if any):	If country-specific data is available, then this shall be applied, and the method used to derive the value as well as the data sources need to be documented in the CDM-PDD. If country-specific data are not available, then apply the default values listed in Table 7. Table 7. N₂O emission factors for combustion <table><tr><th>Type of waste</th><th>Technology Management practice</th><th>Emission factor (t N₂O/t waste wet basis)</th></tr><tr><td><u>MSW</u></td><td>Continuous and semi-continuous incinerators</td><td><u>1.21x 50x10⁻³</u></td></tr><tr><td><u>MSW</u></td><td>Batch-type incinerators</td><td><u>1.21x 60x10⁻³</u></td></tr><tr><td>Industrial waste</td><td>All types of incineration</td><td><u>1.21x 100x10⁻³</u></td></tr><tr><td>Sludge (except sewage sludge)</td><td>All types of incineration</td><td><u>1.21x 450x10⁻³</u></td></tr><tr><td>Sewage sludge</td><td>Incineration</td><td><u>1.21x 900x10⁻³</u></td></tr></table> A conservativeness factor of 1.21 has been applied to account for the uncertainty of the IPCC default values	Type of waste	Technology Management practice	Emission factor (t N ₂ O/t waste wet basis)	<u>MSW</u>	Continuous and semi-continuous incinerators	<u>1.21x 50x10⁻³</u>	<u>MSW</u>	Batch-type incinerators	<u>1.21x 60x10⁻³</u>	Industrial waste	All types of incineration	<u>1.21x 100x10⁻³</u>	Sludge (except sewage sludge)	All types of incineration	<u>1.21x 450x10⁻³</u>	Sewage sludge	Incineration	<u>1.21x 900x10⁻³</u>
Type of waste	Technology Management practice	Emission factor (t N ₂ O/t waste wet basis)																	
<u>MSW</u>	Continuous and semi-continuous incinerators	<u>1.21x 50x10⁻³</u>																	
<u>MSW</u>	Batch-type incinerators	<u>1.21x 60x10⁻³</u>																	
Industrial waste	All types of incineration	<u>1.21x 100x10⁻³</u>																	
Sludge (except sewage sludge)	All types of incineration	<u>1.21x 450x10⁻³</u>																	
Sewage sludge	Incineration	<u>1.21x 900x10⁻³</u>																	
Any comment:	Applicable to estimate PECOM,c,y for Incineration																		

Data / Parameter table 16

Data / Parameter:	$f_{CH_4,default}$
Data unit:	m ³ CH ₄ / m ³ biogas corrected to reference conditions ²
Description:	Default value for the fraction of methane in the biogas
Source of data:	The default value was derived based on reported values from registered projects and research papers (Davidsson, 2007)
Value to be applied:	0.6
Any comment:	Use this value for Option 2 of the step "Determination of the quantity of methane produced in the digester"

Data / Parameter table 17

Data / Parameter:	ρ_{CH_4}
Data unit:	t CH ₄ / m ³ CH ₄
Description:	Density of methane at normal conditions
Source of data:	'Thermophysical properties of fluids. II. Methane, Ethane, Propane, Isobutane and Normal Butane' by B.A. Younglove, J.F. Ely < https://www.nist.gov/sites/default/files/documents/srd/jpcrd331.pdf >
Value to be applied:	0.00067
Any comment:	corrected to reference conditions

Data / Parameter table 18

Data / Parameter:	$EF_{CH_4, default}$
Data unit:	t CH ₄ leaked / t CH ₄ produced
Description:	Default emission factor for the fraction of CH ₄ produced that leaks from the anaerobic digester
Source of data:	IPCC (2006), Flesch et al. (2011) and Kurup (2003)
Value to be applied:	Use the default value corresponding to the type of digester used in the project activity. The digester type shall be identified by manufacturer information. If this is not possible, then the factor 0.1 shall be applied (upper range of the IPCC values). • 0.028: Digesters with steel or lined concrete or fiberglass digesters and a gas holding system (egg shaped digesters) and monolithic construction; • 0.05: UASB type digesters, floating gas holders with no external water seal; • 0.10: Digesters with unlined concrete/ferrocement/brick masonry arched type gas holding section; monolithic fixed dome digesters, covered anaerobic lagoon³ The digester is concrete lined with a gas holding system. Value applied is 0.028.
Any comment:	Applicable to the step "Determination of project emissions of methane from the anaerobic digester"

Data / Parameter table 19

Data / Parameter:	$EFF_{COM,c,y}$
Data unit:	Fraction
Description:	Combustion efficiency of combustor <i>c</i> in year <i>y</i>
Source of data:	The source is IPCC default values
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	As per guidance from the Board, IPCC default values shall be used only when country or project specific data are not available or difficult to obtain

Data / Parameter table 20

Data / Parameter:	$NCV_{RDF_SB,y}$
Data unit:	GJ/mass or volume units
Description:	Weighted average net calorific value of RDF/SB in year <i>y</i>
Source of data:	IPCC
Measurement procedures (if any):	Default value of Net calorific value of RDF obtained from IPCC(2006), table 1.2, V2_1, chapter 1-Introduction
Monitoring frequency:	Fixed parameter
QA/QC procedures:	IPCC

Any comment:	This parameter is required for the procedure to calculate leakage emissions for the combustion of RDF/SB outside the project boundary
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Data / Parameter table 21

Data / Parameter:	MCF_{ww}
Data unit:	Fraction
Description:	Methane conversion factor
Source of data:	The source of data shall be the following, in order of preference: 1. Project specific data; 2. Country specific data; or 3. IPCC default values (table 6.3, chapter 6, volume 5 of IPCC 2006 guidelines)
Measurement procedures (if any):	-
Any comment:	

Data / Parameter table 22

Data / Parameter:	B_o
Data unit:	t CH ₄ /tCOD
Description:	Maximum methane producing capacity, expressing the maximum amount of CH ₄ that can be produced from a given quantity of chemical oxygen demand (t CH ₄ /tCOD)
Source of data:	Section 6.2.3.2, chapter 6, volume 5 of IPCC 2006 guidelines
Value to be applied:	0.25
Any comment:	Applicable to the "Procedure to calculate project emissions from wastewater treatment"

Data / Parameter table 23

Data / Parameter:	$EF_{CO_2, RDF_SB, y}$
Data unit:	t CO ₂ /GJ
Description:	Weighted average CO ₂ emission factor for RDF/SB in year <i>y</i>
Source of Data	IPCC default values at the upper/lower limit 20 of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of The 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	Measurements shall be undertaken in line with national or international fuel standards
Monitoring frequency:	any future revision of the IPCC Guidelines shall be taken into account
QA/QC procedures:	-
Any comment:	This parameter is required for the procedure to calculate leakage emissions for the combustion of RDF/SB outside the project boundary

Data/Parameters monitored:

Data / Parameter table 24

Data / Parameter:	W_x or W_i																		
Data unit:	t																		
Description:	Total amount of waste disposed in a SWDS in year x																		
Source of data:	MIS data.																		
Measurement procedures (if any):	Measurement on wet basis. Weight of daily incoming waste is measured on weighing bridge as soon as the truck enters the gate. Readings are recorded manually as well as digitally for each incoming truck. The data will be summed up annually. <table border="1"> <thead> <tr> <th>Year</th><th>Total MSW (tonnes)</th></tr> </thead> <tbody> <tr><td>2017</td><td>142397</td></tr> <tr><td>2018</td><td>199279</td></tr> <tr><td>2019</td><td>210099</td></tr> <tr><td>2020</td><td>211952</td></tr> <tr><td>2021</td><td>232014</td></tr> <tr><td>2022</td><td>238638</td></tr> <tr><td>2023</td><td>273912</td></tr> <tr><td>2024</td><td>132228</td></tr> </tbody> </table>	Year	Total MSW (tonnes)	2017	142397	2018	199279	2019	210099	2020	211952	2021	232014	2022	238638	2023	273912	2024	132228
Year	Total MSW (tonnes)																		
2017	142397																		
2018	199279																		
2019	210099																		
2020	211952																		
2021	232014																		
2022	238638																		
2023	273912																		
2024	132228																		
Monitoring frequency:	Daily. Continuously. For calculations purpose aggregated annually for year x .																		
QA/QC procedures:	Weighbridge will be subject to periodical (yearly) calibration (in accordance with stipulation of the weighbridge supplier), QA/QC-procedures for these data are applicable. Yearly calibration reports are evidential documents.																		
Any comment:	-																		

Data / Parameter table 25

Data / Parameter:	$p_{n,j,x}$ or $p_{n,j,i}$
Data unit:	-
Description:	Weight fraction of the waste type j in the sample n collected during the year x or month i
Source of data:	Sample measurements by project participants
Measurement procedures (if any):	Sample the waste composition, using the waste types j , as provided in the table for DOC_j and k_j , and weigh each waste fraction (measure on wet basis)
Monitoring frequency:	Minimum of three samples every three months
QA/QC procedures:	Sampling is done by Quadrant method
Any comment:	This parameter has been obtained from the waste characterization reports. It is applicable to calculations for methane emissions from SWDS.

Data / Parameter table 26

Data / Parameter:	z_x
Data unit:	-
Description:	Number of samples collected during the year x

Source of data:	Project participants
Measurement procedures (if any):	Minimum of three samples every four months.
Monitoring frequency:	Continuously, aggregated annually
QA/QC procedures:	The sample size and sampling technique must ensure the sample is representative.
Any comment:	This parameter is monitored once in four months as the waste includes more than one waste type <i>j</i>

Data / Parameter table 27

Data / Parameter:	$Q_{waste,c,y}$																		
Data unit:	t																		
Description:	Quantity of fresh waste or RDF/SB fed into combustor <i>c</i> in year <i>y</i>																		
Source of data:	Project participants																		
Measurement procedures (if any):	Measured with calibrated scales. <table> <tr> <th>year</th><th>RDF combusted ($Q_{waste,c,y}$)</th></tr> <tr> <td>2017</td><td>5335</td></tr> <tr> <td>2018</td><td>6749</td></tr> <tr> <td>2019</td><td>9519</td></tr> <tr> <td>2020</td><td>9311</td></tr> <tr> <td>2021</td><td>11884</td></tr> <tr> <td>2022</td><td>7981</td></tr> <tr> <td>2023</td><td>8384</td></tr> <tr> <td>2024</td><td>4396</td></tr> </table>	year	RDF combusted ($Q_{waste,c,y}$)	2017	5335	2018	6749	2019	9519	2020	9311	2021	11884	2022	7981	2023	8384	2024	4396
year	RDF combusted ($Q_{waste,c,y}$)																		
2017	5335																		
2018	6749																		
2019	9519																		
2020	9311																		
2021	11884																		
2022	7981																		
2023	8384																		
2024	4396																		
Monitoring frequency:	Continuously, aggregated at least annually																		
QA/QC procedures:	The waste from the pre-sorting section is sent for weight measurement on the weighing scale.																		
Any comment:	Parameter required for procedure to calculate project emissions from combustion within the project boundary																		

Data / Parameter table 28

Data / Parameter:	$EC_{t,y}$
Data unit:	MWh
Description:	Electricity consumption from the grid
Source of data:	Electricity meter

Measurement procedures (if any):	Coal based electricity is generated by the MSEB and supplied to the plant facility. Regular daily monitoring of units consumed takes place at a meter in MSEB office. Monthly bills are generated. <table border="1"> <thead> <tr> <th>Year</th><th>Total electricity consumed (MWH)</th></tr> </thead> <tbody> <tr><td>2017</td><td>355</td></tr> <tr><td>2018</td><td>575</td></tr> <tr><td>2019</td><td>473</td></tr> <tr><td>2020</td><td>483</td></tr> <tr><td>2021</td><td>481</td></tr> <tr><td>2022</td><td>445</td></tr> <tr><td>2023</td><td>697</td></tr> <tr><td>2024</td><td>726</td></tr> </tbody> </table>	Year	Total electricity consumed (MWH)	2017	355	2018	575	2019	473	2020	483	2021	481	2022	445	2023	697	2024	726
Year	Total electricity consumed (MWH)																		
2017	355																		
2018	575																		
2019	473																		
2020	483																		
2021	481																		
2022	445																		
2023	697																		
2024	726																		
Monitoring frequency:	Continuous																		
QA/QC procedures:	Monitoring equipment: Energy Meters are used for monitoring with the following meter numbers 065-04576712 24005723 Recording Frequency: Continuous monitoring and Monthly recording from Energy Meters, Summarized Annually																		
Any comment:	This parameter is required for calculating project emissions from electricity consumption due to waste treatment under the project activity process t (PE _{EC,t,y}) using the "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"																		

Data / Parameter table 29

Data / Parameter:	EC_{BE}																		
Data unit:	MWh																		
Description:	Electricity generated by the Biogas generator in Leachate bio-methanation processes used for heating purpose in the incinerator.																		
Source of data:	BG set																		
Measurement procedures (if any):	Measurement of electricity generation is based on generation of gas. <table border="1"> <thead> <tr> <th>Year</th><th>Electricity generated - kWh</th></tr> </thead> <tbody> <tr><td>2017</td><td>22465</td></tr> <tr><td>2018</td><td>41862</td></tr> <tr><td>2019</td><td>49216</td></tr> <tr><td>2020</td><td>45714</td></tr> <tr><td>2021</td><td>45811</td></tr> <tr><td>2022</td><td>47991</td></tr> <tr><td>2023</td><td>48190</td></tr> <tr><td>2024</td><td>33948</td></tr> </tbody> </table>	Year	Electricity generated - kWh	2017	22465	2018	41862	2019	49216	2020	45714	2021	45811	2022	47991	2023	48190	2024	33948
Year	Electricity generated - kWh																		
2017	22465																		
2018	41862																		
2019	49216																		
2020	45714																		
2021	45811																		
2022	47991																		
2023	48190																		
2024	33948																		
Monitoring frequency:	Continuous																		

QA/QC procedures:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy
Any comment:	-

Data / Parameter table 30

Data / Parameter:	$Q_{RDF_SB,COM,y}$																		
Data unit:	T																		
Description:	Quantity of RDF/SB exported off-site with potential to be combusted in year y																		
Source of data:	Project site																		
Measurement procedures (if any):	Sale invoices of the RDF/SB is kept at the project site. They contain customer contact details, physical location of delivery, type, amount (in tons) and purpose of RDF/SB (use as fuel. A list of customers and delivered SD amount is kept at the project site. <table> <tr> <th>Year</th><th>RDF exported (tonns)</th></tr> <tr><td>2017</td><td>20,069</td></tr> <tr><td>2018</td><td>34,866</td></tr> <tr><td>2019</td><td>36,281</td></tr> <tr><td>2020</td><td>33,189</td></tr> <tr><td>2021</td><td>34,399</td></tr> <tr><td>2022</td><td>36,167</td></tr> <tr><td>2023</td><td>41,148</td></tr> <tr><td>2024</td><td>24,869</td></tr> </table>	Year	RDF exported (tonns)	2017	20,069	2018	34,866	2019	36,281	2020	33,189	2021	34,399	2022	36,167	2023	41,148	2024	24,869
Year	RDF exported (tonns)																		
2017	20,069																		
2018	34,866																		
2019	36,281																		
2020	33,189																		
2021	34,399																		
2022	36,167																		
2023	41,148																		
2024	24,869																		
Monitoring frequency:	Whenever a batch has to be dispatched. Upto 3 pm, the production takes place and after 3 pm, the trucks are dispatched outside the project boundary.																		
QA/QC procedures:	RDF is filled in trucks and Weighed while leaving the project boundary.																		
Any comment:	See procedure to calculate leakage emissions associated with RDF/SB for further information																		

Data / Parameter table 31

Data / Parameter:	$Q_{RDF_SB,y}$												
Data unit:	t												
Description:	Quantity of RDF/SB produced in year y												
Source of data:	Project participants												
Measurement procedures (if any):	Weighbridge <table> <tr> <th>Year</th><th>RDF produced (tonns)</th></tr> <tr><td>2017</td><td>25,403</td></tr> <tr><td>2018</td><td>41,615</td></tr> <tr><td>2019</td><td>45,800</td></tr> <tr><td>2020</td><td>42,501</td></tr> <tr><td>2021</td><td>46,284</td></tr> </table>	Year	RDF produced (tonns)	2017	25,403	2018	41,615	2019	45,800	2020	42,501	2021	46,284
Year	RDF produced (tonns)												
2017	25,403												
2018	41,615												
2019	45,800												
2020	42,501												
2021	46,284												

	2022	44,148	
	2023	49,532	
	2024	29,266	
Monitoring frequency:	Daily		
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)		
Any comment:	The waste sorted in the pre-sorting section with		

Data / Parameter table 32

Data / Parameter:	$Q_{ww,y}$																		
Data unit:	m ³																		
Description:	Amount of wastewater discharge generated by the project activity and treated anaerobically or released untreated from the project activity in year y																		
Source of data:	Calculated value based on volume of tank.																		
Measurement procedures (if any):	The amount of wastewater collected is measured the volume of the tank collecting the discharged water. <table border="1"> <thead> <tr> <th>Year</th><th>Leachate treated - m3</th></tr> </thead> <tbody> <tr><td>2017</td><td>8030</td></tr> <tr><td>2018</td><td>13933</td></tr> <tr><td>2019</td><td>15954</td></tr> <tr><td>2020</td><td>16219</td></tr> <tr><td>2021</td><td>16557</td></tr> <tr><td>2022</td><td>16875</td></tr> <tr><td>2023</td><td>16490</td></tr> <tr><td>2024</td><td>11140</td></tr> </tbody> </table>	Year	Leachate treated - m3	2017	8030	2018	13933	2019	15954	2020	16219	2021	16557	2022	16875	2023	16490	2024	11140
Year	Leachate treated - m3																		
2017	8030																		
2018	13933																		
2019	15954																		
2020	16219																		
2021	16557																		
2022	16875																		
2023	16490																		
2024	11140																		
Monitoring frequency:	Daily, aggregated annually																		
QA/QC procedures:																			
Any comment:	If the wastewater is treated aerobically, emissions are assumed to be zero, and hence this parameter does not need to be monitored																		

Data / Parameter table 33

Data / Parameter:	$COD_{BL,y}$
Data unit:	tCOD/m ³
Description:	COD of the wastewater discharge generated by the project activity in year y
Source of data:	Internal and external Lab analysis reports
Measurement procedures (if any):	
Monitoring frequency:	Monthly and averaged annually
QA/QC procedures:	COD analysis is done in-house once in a week. Monthly analysis is done by an external agency using standardized methods
Any comment:	This parameter is used for calculations of baseline emissions from Wastewater

Data / Parameter table 34

Data / Parameter:	$Q_{biogas,y}$																		
Data unit:	m ³ biogas																		
Description:	Amount of biogas collected at the digester outlet in year y																		
Measurement procedures:	The volumetric flow measurement refers to the actual pressure and temperature. The gas is collected in balloon. The balloon has a tie rope indicator based on which the volume of gas generated is recorded. Once the balloon is filled, it is sent to incinerator in the form of electricity. <table border="1"> <thead> <tr> <th>Year</th><th>Qty of Biogas produced (Tonns)</th></tr> </thead> <tbody> <tr><td>2017</td><td>14</td></tr> <tr><td>2018</td><td>27</td></tr> <tr><td>2019</td><td>31</td></tr> <tr><td>2020</td><td>30</td></tr> <tr><td>2021</td><td>30</td></tr> <tr><td>2022</td><td>31</td></tr> <tr><td>2023</td><td>31</td></tr> <tr><td>2024</td><td>22</td></tr> </tbody> </table>	Year	Qty of Biogas produced (Tonns)	2017	14	2018	27	2019	31	2020	30	2021	30	2022	31	2023	31	2024	22
Year	Qty of Biogas produced (Tonns)																		
2017	14																		
2018	27																		
2019	31																		
2020	30																		
2021	30																		
2022	31																		
2023	31																		
2024	22																		
Monitoring/recording frequency:	Continuously measured																		
QA/QC procedures:																			
Any comment:	-																		

Data and Parameters not monitored for AMS I.D:

Data / Parameter table 35

Data / Parameter:	$EF_{grid,y}$
Data unit:	t CO ₂ e/kWh
Description:	CO ₂ emission factor of the grid electricity in year y
Source of data	The value of CO ₂ emission for coal power grid plants is obtained by referring the UCR document "UCR CoU Standard Update: 2024 Vintage UCR Indian Grid Emission Factor Announced".
Value to be applied	0.757
Measurement procedures (if any):	As per the requirements in "Tool to calculate the emission factor for an electricity system"
Monitoring frequency:	Fixed parameter
Any comment:	UCR recommended emission factor

Data and Parameters monitored for AMS I.D:

Data / Parameter table 36

Data / Parameter:	$EG_{PJ,facility,y}$
Data unit:	MWh

Description:	Net electricity supplied to the grid facility by the project activity.
Source of data	Bidirectional Electricity meter- Joint metering reading report of monthly generation by MSEB
Measurement procedures (if any):	Measured Monitoring equipment: Energy Meter is used for monitoring electricity supply. The meter has the serial no. 24005723 Recording Frequency: Continuous monitoring and Monthly recording from Energy Meter, summarized Annually.
Monitoring frequency:	Monthly
QA/QC procedures applied	Continuous monitoring, daily measurement daily/monthly recording.
Any comment:	Data is archived electronically in a mobile app by Surya Logix