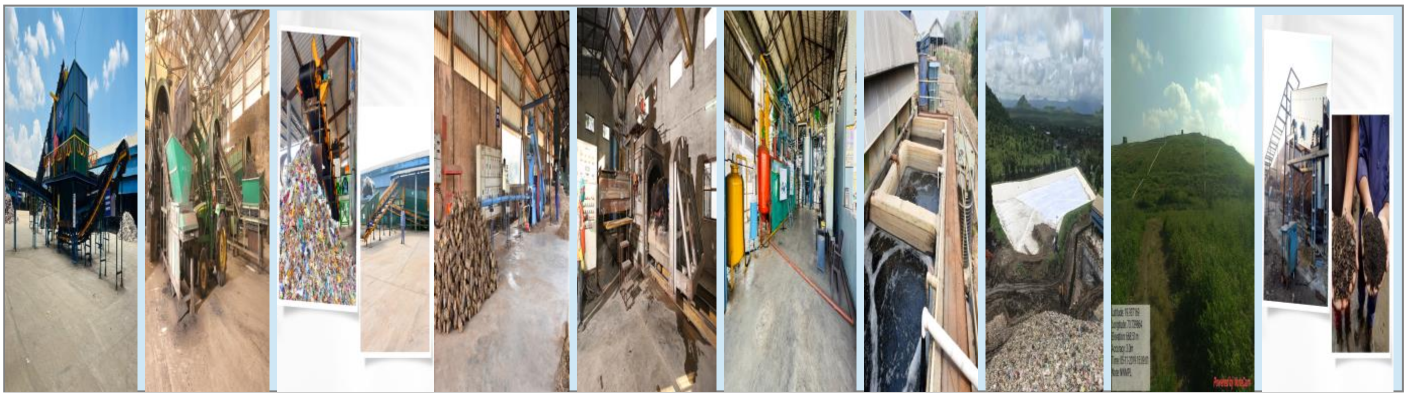
PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT



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

Version 1.0
Date 24/01/2025
First CoU Issuance Period: 7 years, 11 months
Date: 15/02/2017 to 31/12/2024

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

BASIC INFORMATION

Title of the project activity	Integrated Municipal Solid Waste Management Activities Programme, Nashik, India
Scale of the project activity	Large Scale
Completion date of the PCN	24/01/2025
Project participants	Nashik Waste Management Pvt. Ltd. (NWMPL)
Host Party	INDIA
Applied methodologies and standardized baselines	Methodology Applied follows UNFCCC CDM Methologies • 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	SELECT SCOPE SS 1: Energy industries (renewable/non- renewable sources) SS 13: Waste handling and disposal
Estimated amount of total GHG emission reductions	14,99,785.442 tCO_{2eq}

SECTION A. Description of project activity

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

This PCN 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 green house gases (GHGs) into reusable, recyclable byproducts 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 Pvt 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 CPA.

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.

There is also a proposed action plan for a bamboo plantation on the site and will be registered with the CDM later for a carbon capture CPA.

This PCN contains different technologies and hence CPAs will be identified as per the technology used.

The details of the registered project are as follows:

Purpose of the project activity:

Despite the Government of India's efforts to promote efficient waste management technologies and the Waste Management Rules, the compliance rate remains poor and there is no documented compliance rate in government literature. Calculations from CPCB documents give the amount of waste collected and processed, using this to calculate the compliance rate, 20.18% rate shows for 2017 when the project became operational. Currently it is 53.72%, however this is not an evidence based number. 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.

The project component activities (CPAs) date of are as follows:

Sl. No	**Title of Component of Project Activity (CPA)**	**Starting Date of CPA**
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

A.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 contribute in 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 amount of 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 CPAs under this project will not reduce the income of the local community. In fact, the construction and operation of CPAs 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.

- **Technological well-being**

The Technologies employed in the NWMPL MSW Project for different CPAs 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 (Rodic 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 1 and Goal 4: Any measures applied to support individuals, small and microenterprises aid improved livelihoods and directly contribute to SDGs (ending poverty).

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 5: Halve per capita global food waste at all levels and reduce food losses in the supply chain contributing towards reduction of waste generation. Supplementary in the supply chain contributing towards reduction of waste generation. Supplementary driver: Inclusivity.

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.

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.

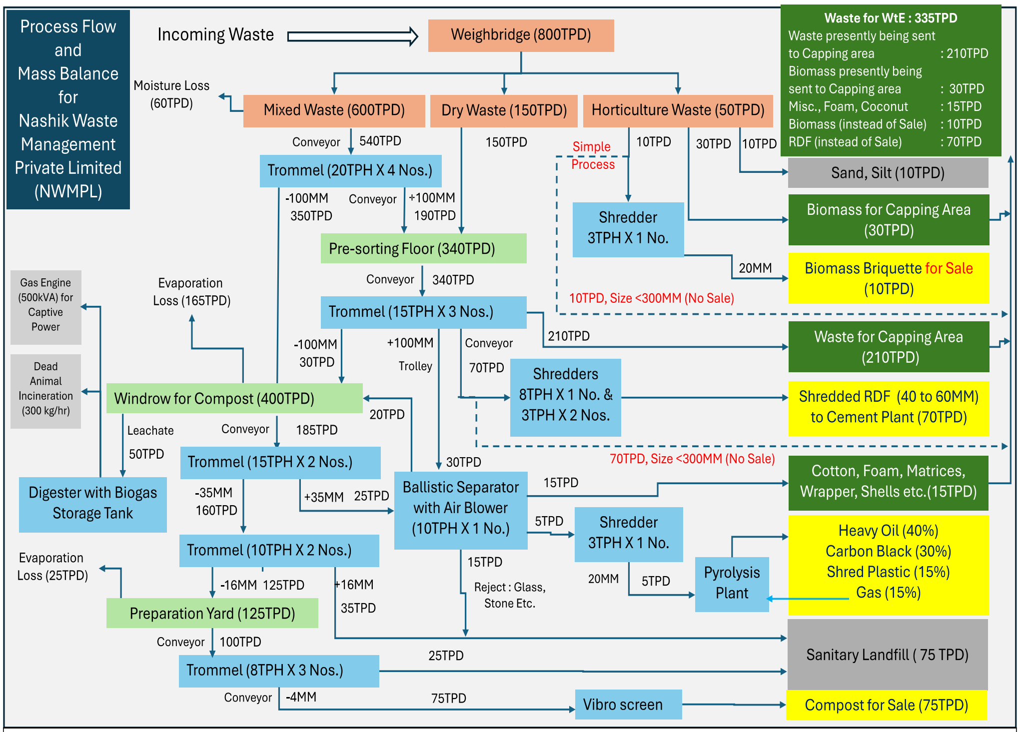
A.3. Location of project activity >>

Country: India
District: Nashik
Village: Pathardi Shivar
Tehsil: Nashik
State: Maharastra
Code: 422010

A.4. Technologies/measures >>

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 under this PoA 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. *Capping of Existing Dump***:** Re-aligning and capping existing dumps to prevent environmental impacts.



Notes : 1) * Necessary Survey for the waste from capping Area to be conducted by NWMPL and results to be provided.
2) The parameters of Acceptable and Prohibited Waste for WtE provided by JFE India are enclosed herewith.
3) Any Waste size for WtE shall be less than 300MM
4) All above information has been prepared solely based on data provided by NWMPL.

Date : 7th January, 2025

Prepared & Checked by :
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WtE Capacity Calculation

Waste presently being sent to Capping area : 210TPD
Biomass presently being sent to Capping area : 30TPD
Misc., Foam, Coconut : 15TPD

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

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 Bioculture 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 Celcius 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.

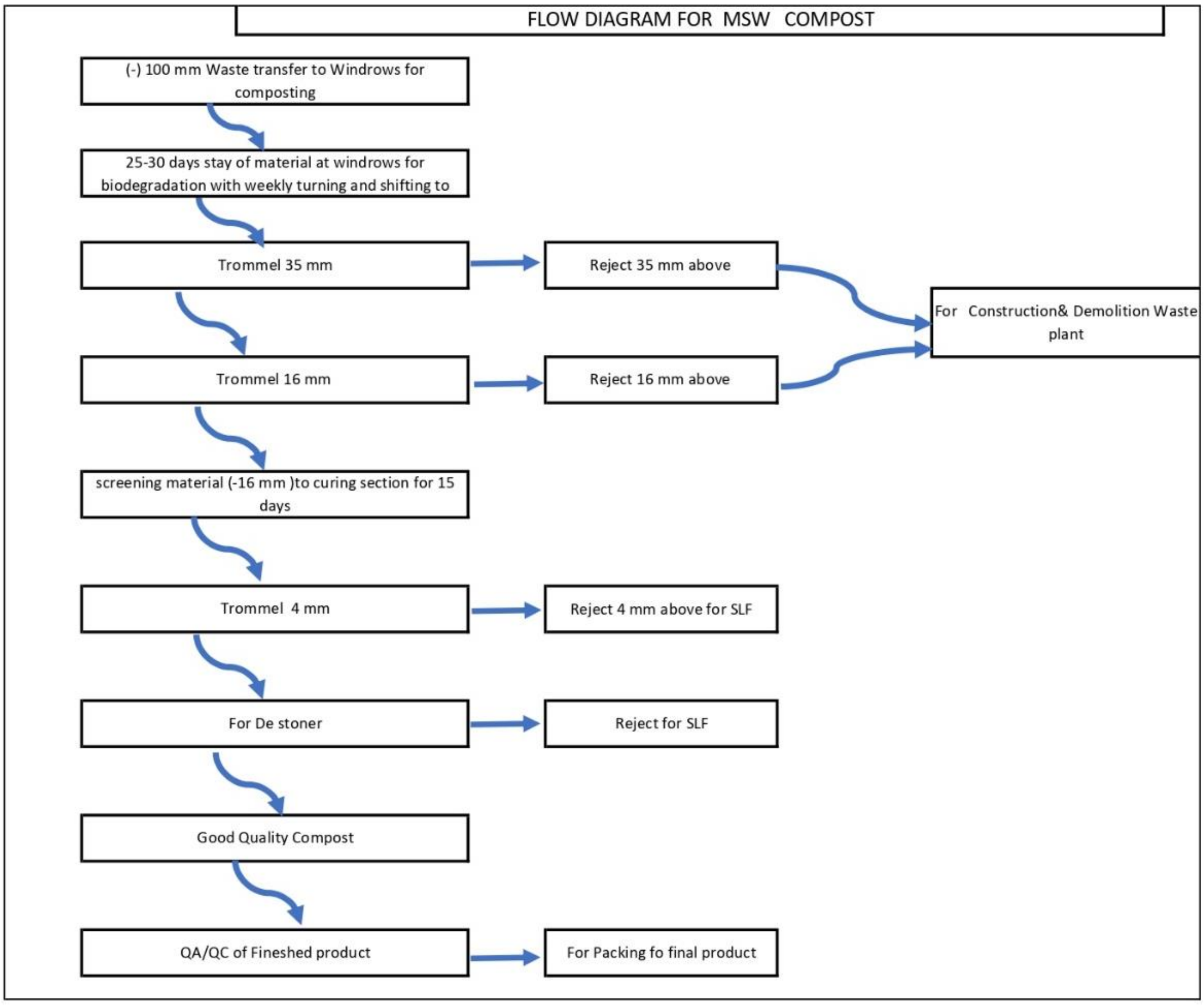


Figure 1: Composting

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)

MSW 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 rdisposal. 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.

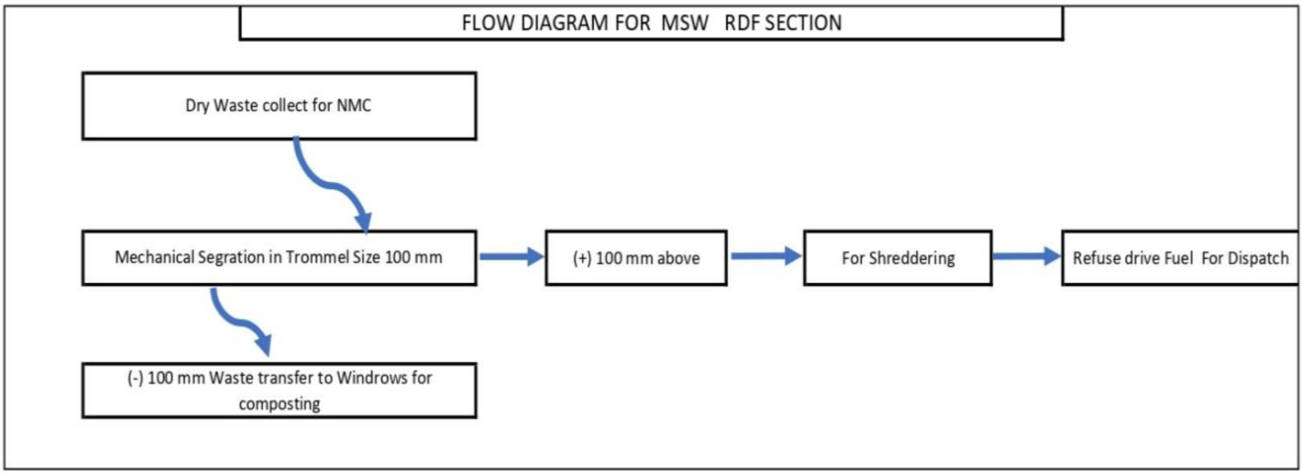


Figure 2 : RDF Production

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
- Pulverizer
- 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 pulverizer through belt conveyor. The organic waste will be then crushed in the pulverizer 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 Upflow 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. Over flow 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 pulverizer 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.

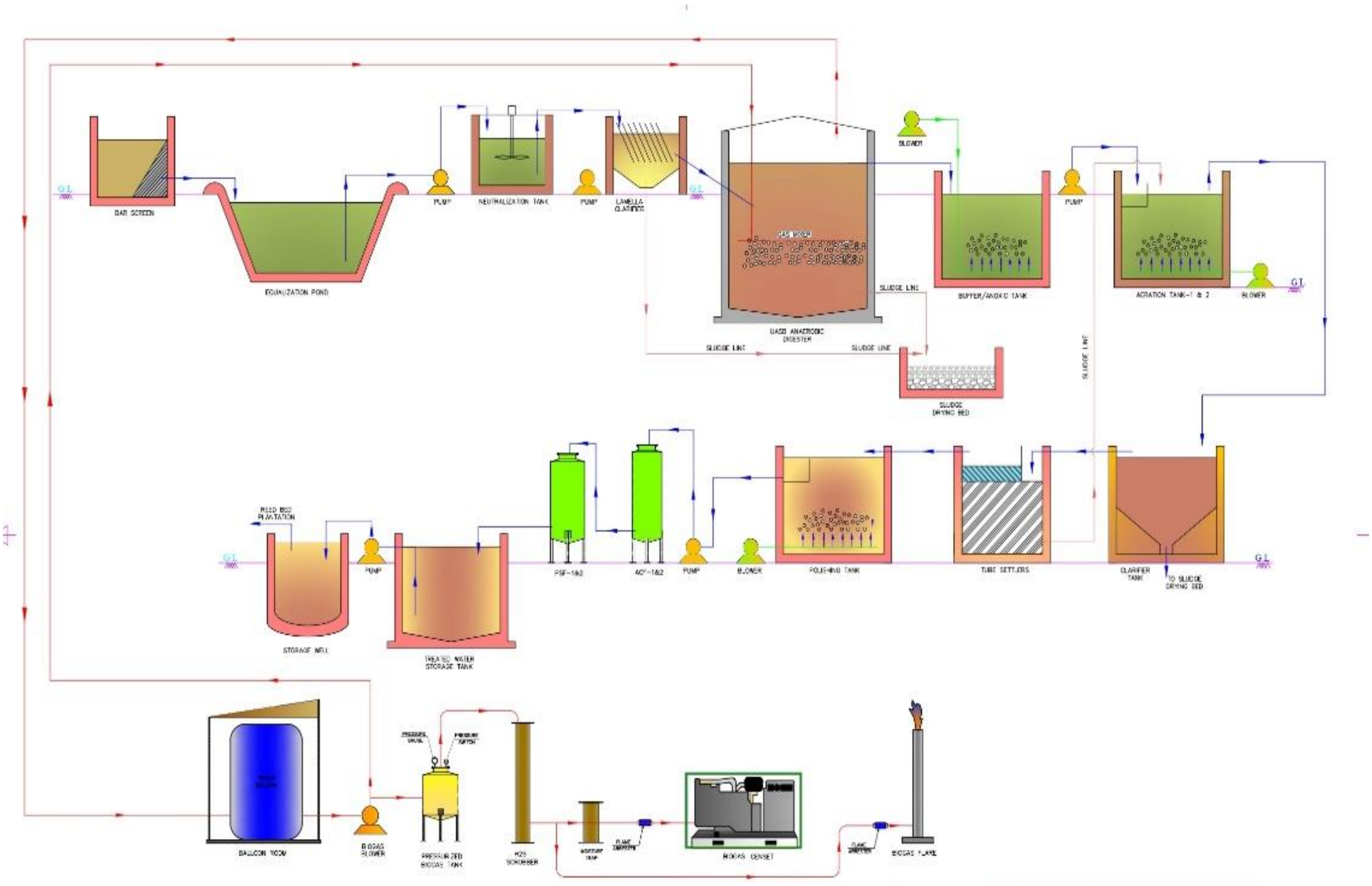


Figure 3: Leachate Treatment Plant/ Biomethanation

4. Biomass Briquetting:

List of Facilities, System and Equipment: A process involving shredding, drying, and compression of biomass material.

- Shredder
- Drying system
- Briquetting machine

Biomass briquettes are a biofuel substitute made of biodegradable green waste with lower emissions of Greenhouse gases and carbon dioxide than traditional fuel sources. This fuel source is used as an alternative for harmful biofuels. Briquettes are used for heating, cooking fuel, and electricity generation usually in developing countries that do not have access to more modern fuel sources. Biomass briquettes have become popular in developed countries due to the accessibility, and eco-friendly impact. The briquettes can be used in the developed countries for producing electricity from steam power by heating water in boilers. The briquettes are fired with coal to create the heat supplied to the boiler. 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 materials, 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.

- Deduster 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 Deduster 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 Aluminum 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 monoblock 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 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.

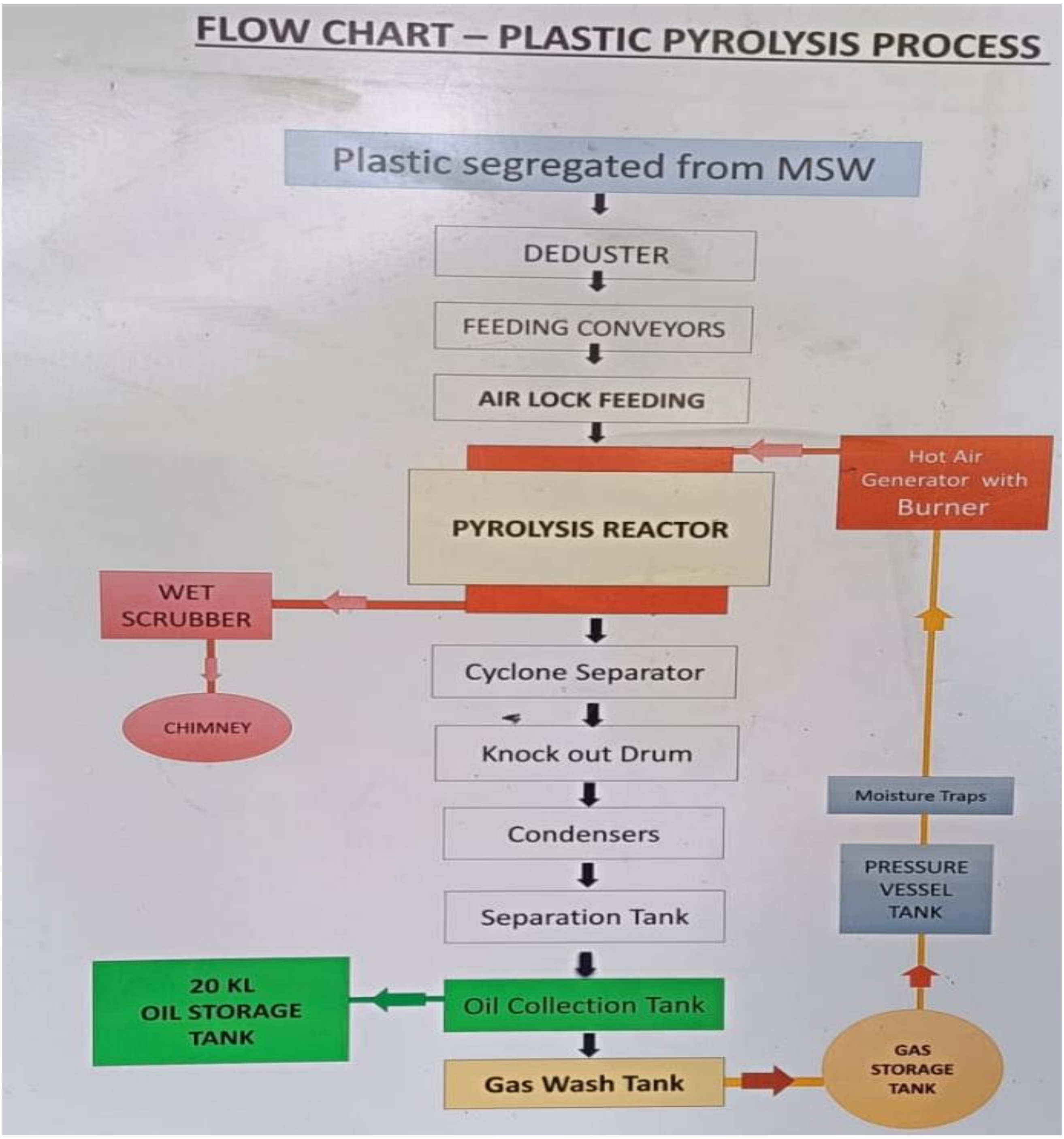


Figure 4: Nashik Plastic to Fuel

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 500ºC -700ºC 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 equipments

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

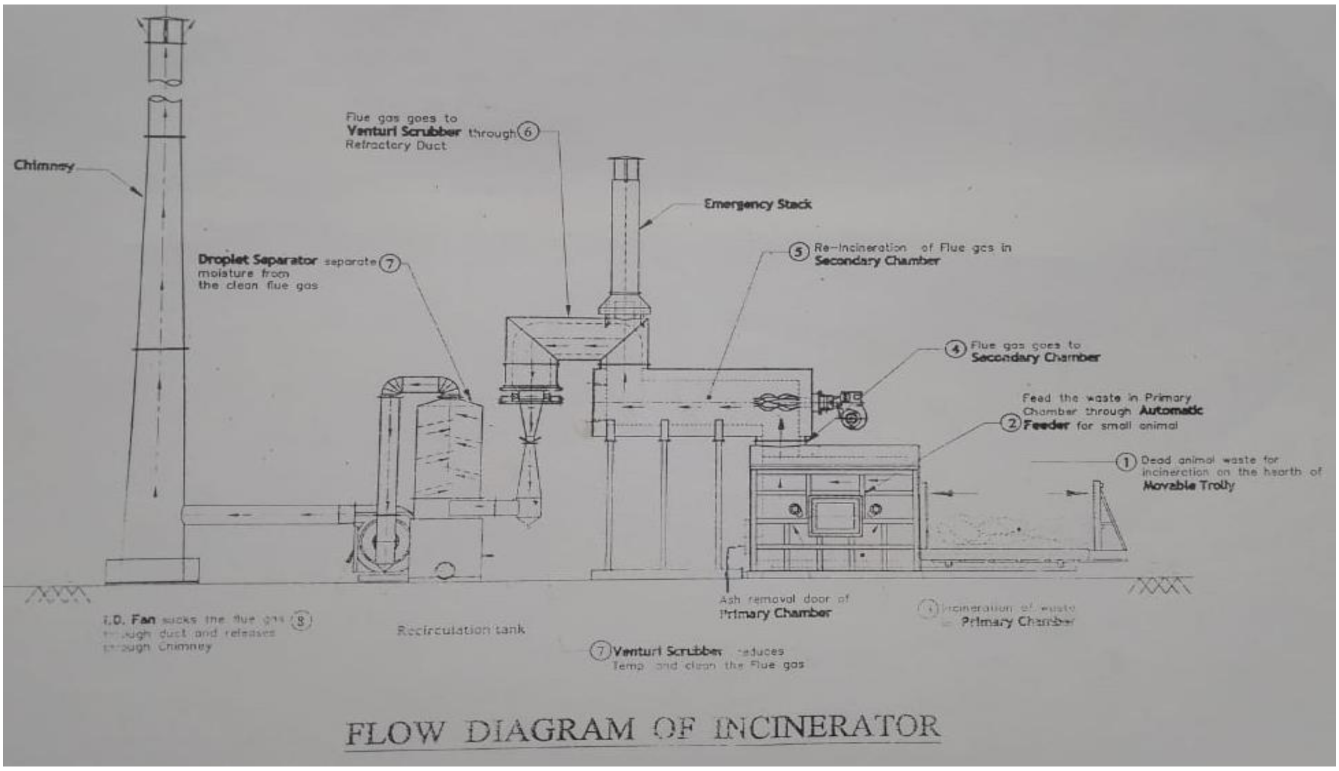


Figure 5: Dead Animal Incineration

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 X 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

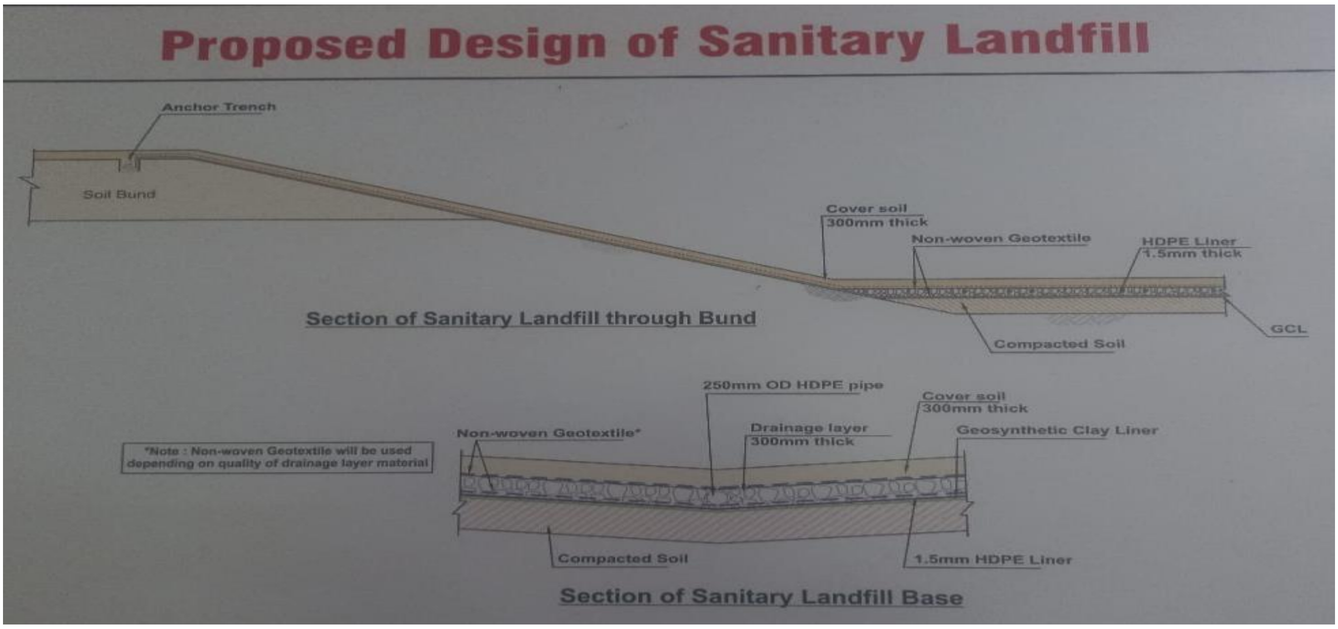


Figure 6 : Reject to Landfill (SLF)

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.

8. Solar Energy

General Description of Solar Photovoltaic technology. The installed Solar Photovoltaic power plant is on grid-tie solar power system.

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 Alluminium 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.

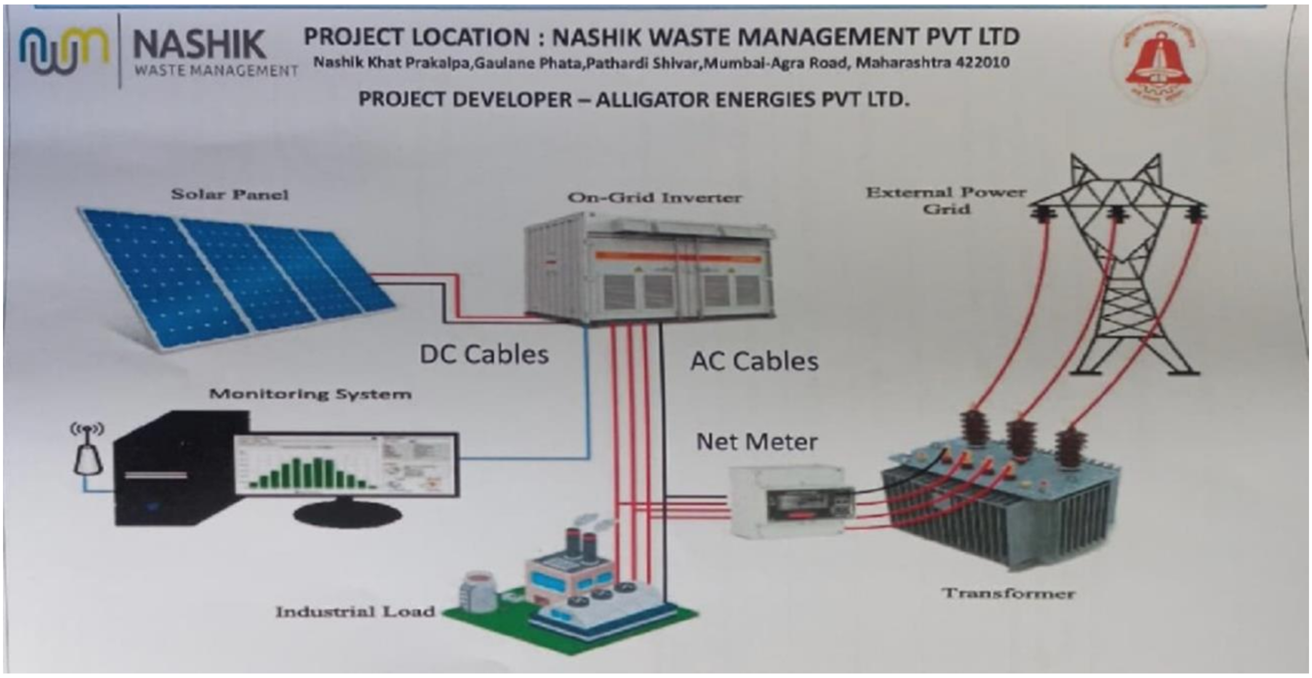


Figure 7: Solar Energy

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 will 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.

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 8: Biomining of Legacy Waste

A.5. Parties and project participants >>

Party (Host)	Participants
INDIA	Nashik Waste Management Pvt. Ltd. (NWMPL)

A.6. Baseline Emissions>>

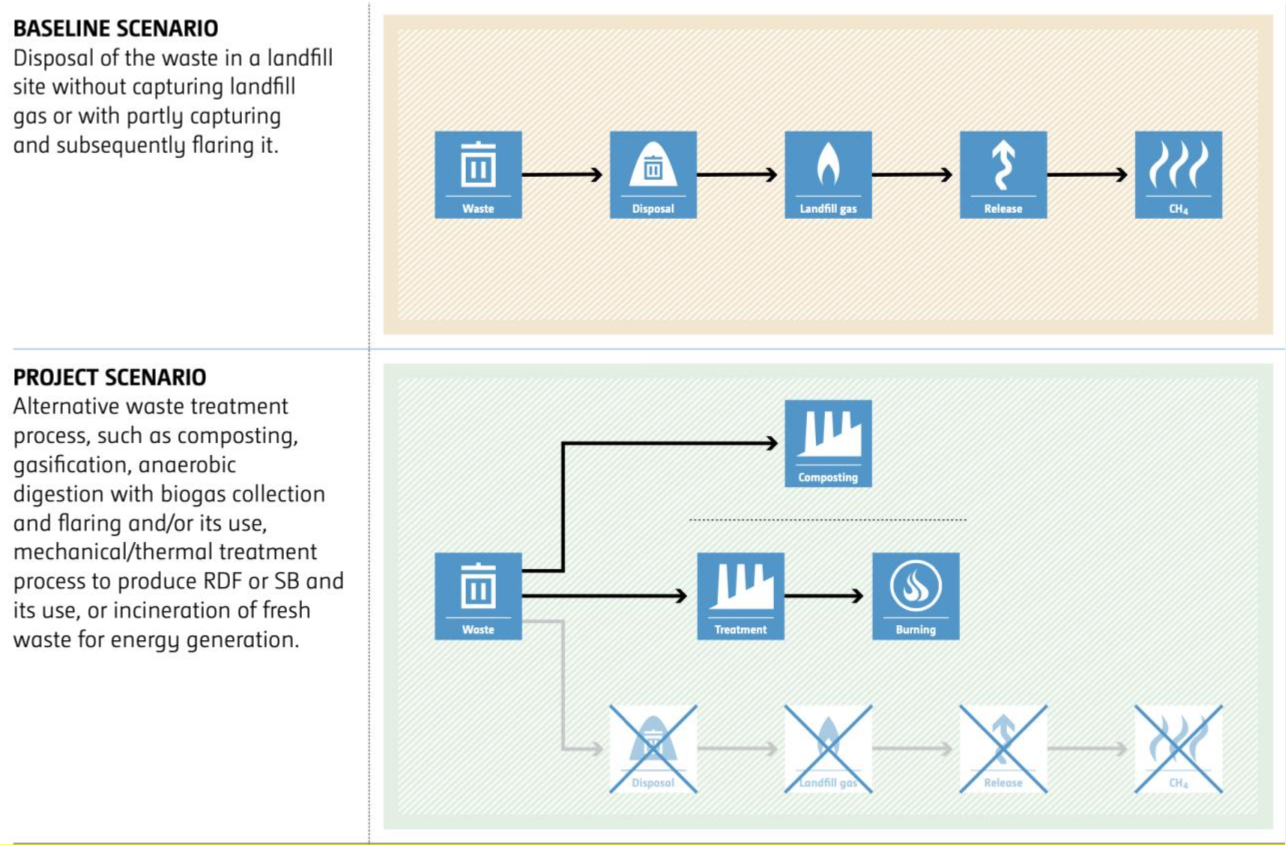
According to the CDM glossary ‘Baseline Scenario’ refers **Baseline For a CDM project activity** (non-A/R) or **CPA** (non-A/R)**,** the scenario for the CDM project activity or CPA that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the CDM project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



The equations for baseline emissions assessments are stated in EB 111, for various technologies or options used for waste treatment like composting, RDF, WtE, etc. As per India’s MSW Rules, a combination of waste treatment technologies known as integrated waste management, is mandated depending on the waste characterization. Biomining is mandated for legacy waste. India’s MSW Rules mandate the use of a (combination) of waste treatment alternative technologies t that are implemented by each CPA. The rate of compliance, documented in the host country, that is India (RATE compliance, t, y) is then used to adjust the baseline emissions calculation, according to equation 1. The PoA DD describes which baseline emission sources apply for each waste treatment option t implemented under the CPA**.**

Baseline emissions are determined as follows:

$$BE_y = \sum_t (BE_{CH4,t,y} + BE_{WW,t,y}) \times (1 - RATE_{compliance,t}) \qquad (1)$$

Where,

BE_y = Baseline emissions in year y (t CO2e)
$BE_{CH4,t,y}$ = 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.

A.7. Debundling>>

This Integrated Municipal Solid Waste Management Activities project is not a debundled 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 B. Application of methodologies and standardized baselines

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

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

TYPE. Not Applicable as this is a Large-Scale Project

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)

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

As per table 1 of applied methodology 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/electricenergy;

Table 1. Methodology key elements

Typical projects	Project activities involve the installation and operation ofnew 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/electricenergy; • Co-composting/anaerobic digestion of wastewater in combination with solid waste.
Type of GHG emissions mitigation action	• Greenhouse gas (GHG) emissions avoidance: CH_4 emissions due to anaerobic decay of organic wasteare 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.

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-composing	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

B.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 CPA	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

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

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

Each CPA 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:

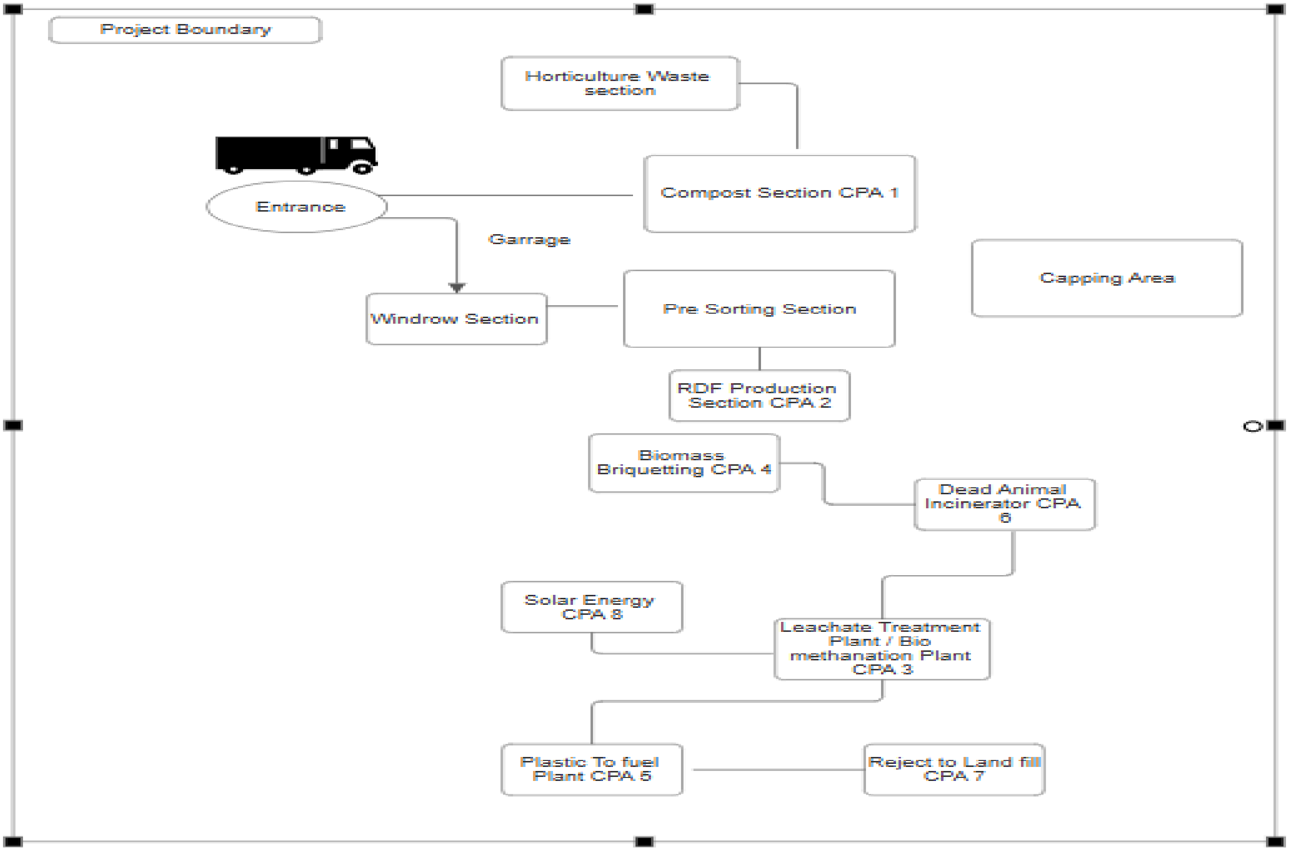


Figure 9: Project Boundary

THE FOLLOWING TABLE DEPICTS GHG SOURCES (INCLUDED AND EXLCUDED)

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_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emission from SWDS	CO_2	No	CO2 emissions from the decomposition of fresh waste are not accounted for
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	Yes	N2O emissions are small compared to CH4 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_2O	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_2O	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_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the waste treatment processes	CO_2	Yes	N2O may be emitted from composting, incineration, syngas produced and RDF/SB combustion

Source		GHG	Included?	Justification/Explanation
		CH_4	Yes	CO2 emissions from incineration, gasification or combustion of fossil-based waste shall be included. CO2 emissions from the decomposition or combustion of fresh waste are not accounted
		N_2O	No	CH4 leakage from the anaerobic digester and incomplete combustion in the flaring process are potential sources of project emissions. CH4 may be emitted from incineration, gasification, composting and RDF/SB combustion
	Emissions from wastewater treatment	CO_2	No	CO2 emissions from the decomposition of fresh waste are not accounted
		CH_4	Yes	CH4 emissions from anaerobic treatment of wastewater are accounted for. Aerobic treatment of wastewater shall not result in CH4 emissions
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small

B.5. Establishment and description of baseline scenario (UCR Standard or Methodology) >>

Baseline emissions:

Baseline emissions are determined as follows:

$$BE_y = \sum_t (BE_{CH4,t,y} + BE_{WW,t,y}) \times (1 - RATE_{compliance,t}) \qquad (1)$$

Where,

BE_y = Baseline emissions in year y (t CO2e)
$BE_{CH4,t,y}$ = 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.

Baseline emissions of methane from the SWDS (BECH4,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:

$$BE_{CH4,SWDS,y} = \O y \times (1 - fy) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_j (W_{j,x} \times DOC_j \times e^{-k_j(y-x)} \times (1 - e^{-k_j})) \qquad (2)$$

Where, for the yearly model,

$BE_{CH4,SWDS,y}$ $PE_{CH4,SWDS,y}$ $LE_{CH4,SWDS,y}$ = Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO2e/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_y = 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_{CH4} = Global Warming Potential of methane

OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste).

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).

J = Type of residual waste or types of waste in the MSW

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

$$BE_{CH4,SWDS,y} = \underbrace{\emptyset y \times (1 - fy) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y}_{\boxed{A}} \times \underbrace{\sum_{x=1}^{y} \sum_j (W_{j,x} \times DOC_j \times e^{-k_j(y-x)} \times (1 - e^{-k_j}))}_{\boxed{B}} \quad (2.1)$$

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

Parameter	SI Unit	Description	Value	
φy	ton/yr or m3/yr	Model correction factor to account for model uncertainties for year y	Default value	1
fy	tC/mass	Weighted average mass fraction of carbon in fuel type i in year y		
$GWPCH4$	Mass unit/volume unit	Weighted average density of fuel type i in year y	Default value	28
OX	GJ/m³, 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
$DOCf,y$	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
$MCFy$		Methane correction factor for year y	Default value	1
Wj,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	
$DOCj$	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 (MCFy)

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

Determining the model correction factor (φy)

The model correction factor (φy) depends on the uncertainty of the parameters used in the FOD model. If project or leakage emissions are being calculated, then φy = φdefault = 1.

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

φy	1
fy	0
1-fy	1
$GWPCH4$	28
OX	0.1
1-OX	0.9
F	0.5
$MCFy$	1
DOCf,default	0.5
A	8.4

Part B:

Determining the amounts of waste types j disposed in the SWDS (Wj,x or Wj,i)

Wj,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 (Wj,x or Wj,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 Wj,x for the yearly model as follows:

$$W_{j,x} = W_x \times p_{j,x} \qquad (3)$$

Where:

$W_{j,x}$ = Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t).

W_x = Total amount of solid waste disposed or prevented from disposal in the SWDS in year x (t).

$p_{j,x}$ = 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 or month i are calculated according to equations (7) and (8), as follows:

$$p_{j,x} = \frac{\sum_{n=1}^{z_x} p_{n,j,x}}{z_x} \tag{4}$$

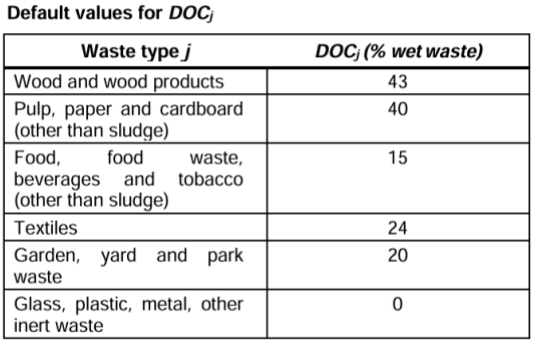
$p_{j,x}$ = Average fraction of the waste type j in the waste in year x (weight fraction).
z_x = Number of samples collected during the year x.
$p_{j,x}$ = Fraction of the waste type j in the sample n collected during the year x (weight Fraction)

Determining the fraction of DOC that decomposes in the SWDS (DOCf,y)

Application A

DOCf,y is given as a default value (DOCf,y = DOCf,default) provided in the section “Data and parameters not monitored” of the PDD.

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 (DOCj) in each waste type is a critical parameter used to estimate carbon emissions. Each waste type has a default DOCj value, as shown in the accompanying table.

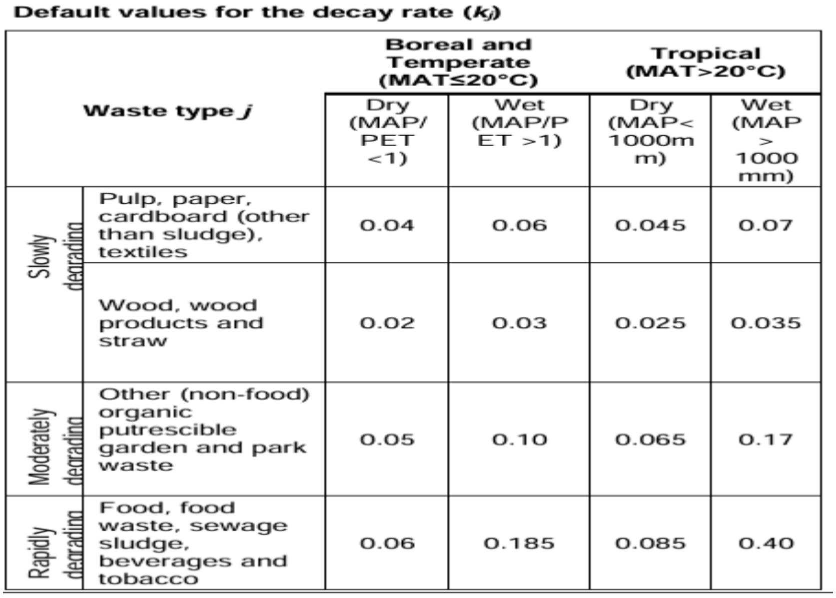


Default values for *DOC*$_j$

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.



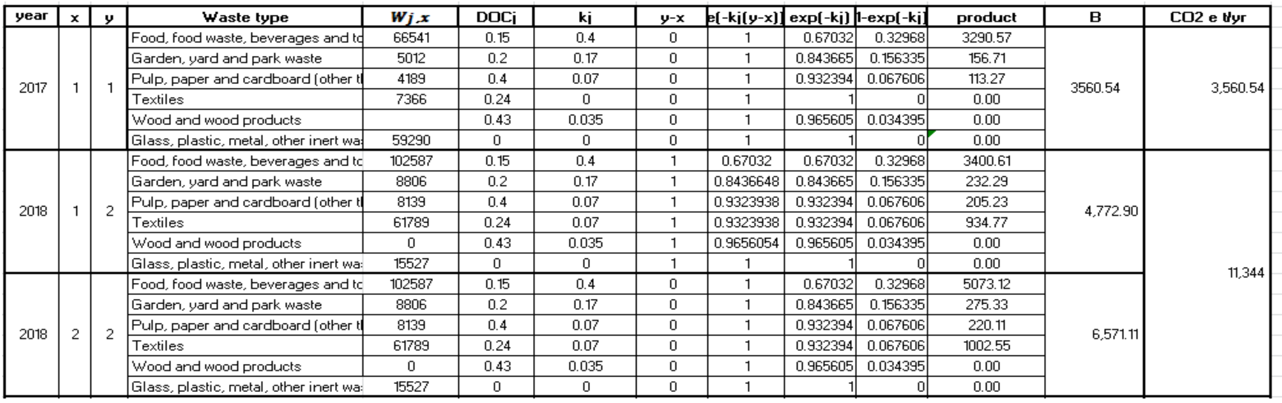
Default values for the decay rate (k_j)

	Waste type *j*	Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	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

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.



year	x	y	Waste type	*Wj,x*	DOCj	kj	y-x	e(-kj(y-x))	exp(-kj)	1-exp(-kj)	product	B	CO2 e t/yr
2017	1	1	Food, food waste, beverages and to	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 t	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 wa	59290	0	0	0	1	1	0	0.00		
2018	1	2	Food, food waste, beverages and to	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 t	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 wa	15527	0	0	1	1	1	0	0.00		
2018	2	2	Food, food waste, beverages and to	102587	0.15	0.4	0	1	0.67032	0.32968	5073.12	6,571.11	
			Garden, yard and park waste	8806	0.2	0.17	0	1	0.843665	0.156335	275.33		
			Pulp, paper and cardboard (other t	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 wa	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 ($BE_{CH4,t,y}$) for 7 years crediting period are accounted to be **11,91,564.28 t CO2 e.**

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

Baseline emissions are determined as the minimum between the amount of methane produced after the implementation of the project activity and the amount of methane calculated using the methane conversion factor method for the estimation of methane emissions from anaerobic lagoons or sludge pits, as follows:

$$BE_{WW,t,y} = \min\{Q_{CH4,y}; BE_{CH4,MCF,y}\} \tag{5}$$

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).

$Q_{CH4,MCF,y}$ = Amount of methane produced from wastewater in year y after the implementation of the project activity (t CO2e).

$BE_{CH4,MCF,y}$ = 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 ($BE_{CH4,MCF,y}$):

$$BE_{CH4,MCF,y} = GWP_{CH4} \times MCF_{BL,y} \times B_0 \times COD_{BL,y} \qquad (6)$$

Where:

$BE_{CH4,MCF,y}$ = Baseline methane emissions determined using the Methane Conversion Factor (t CO2e)
GWP_{CH4} = 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 (CODBL,y x Bo) 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 (tCOD).

The total baseline emissions from organic wastewater (BEWW,t,y) for 7 years crediting period are accounted to be **225 t CO2 e.**

$$BE_y = \sum_t (BE_{CH4,t,y} + BE_{WW,t,y}) \times (1 - RATE_{compliance,t})$$

Compliance rate for the year 2017 is 20.18%.

Baseline emissions of methane from the SWDS ($BE_{CH4,t,y}$) for 7 years crediting period are accounted to be **11,91,564.28 t CO2 e.**

The total baseline emissions from organic wastewater (BEWW,t,y) for 7 years crediting period are accounted to be **225 t CO2 e.**

BE_y = (11,68,278.86 + 258.04) * (1-$RATE_{compliance}$)

Total Baseline emissions as per equation 1 of ACM0022 are **9,51,283.63t CO2 e** for the crediting period of 7 years**.**

Baseline emissions contributed by some other process are:

Biomass briquetting

Project Emissions:

Electricity consumption:

As outlined in Tool 5, "Baseline, project, and/or leakage emissions from electricity consumption and monitoring of electricity generation," Scenario A applies to the sources of electricity consumption for the proposed CDM activity.

Scenario A Description:

Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;
Emissions from electricity consumption include CO2 emissions from the combustion of fossil fuels at any power plants at the site(s) of electricity consumption and, if applicable, at power plants connected physically to the electricity system (grid) from which electricity is consumed.

Calculation Methodology:

Using the generic approach, project, baseline, and/or leakage emissions from electricity consumption are calculated as follows:

$$PE_{EC,y} = \sum_j EC_{P,J,y} \times EF_{EF,j,y} \times (1 - TDL_{j,y}) \qquad (28)$$

$$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 - TDL_{k,y}) \qquad (29)$$

$$LE_{EC,y} = \sum_l EC_{LE,l,y} \times EF_{EF,l,y} \times (1 - TDL_{l,y}) \qquad (30)$$

$PE_{EC,y}$ = Project emissions from electricity consumption in year y (t CO2 / yr)
$BE_{EC,y}$ = Baseline emissions from electricity consumption in year y (t CO2 / yr)
$LE_{EC,y}$ = Leakage emissions from electricity consumption in year y (t CO2 / yr)
$EC_{P,J,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EC_{BL,k,y}$= Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/yr)
$EC_{LE,l,y}$= Net increase in electricity consumption of source l in year y as a result of leakage1 (MWh/yr)
$EF_{EF,j,y}$= Emission factor for electricity generation for source j in year y (t CO2/MWh)
$EF_{EF,k,y}$= Emission factor for electricity generation for source k in year y (t CO2/MWh)
$EF_{EF,l,y}$= Emission factor for electricity generation for source l in year y (t CO2/MWh)
$TDL_{j,y}$= Average technical transmission and distribution losses for providing electricity to source j in year y.
$TDL_{k,y}$ = Average technical transmission and distribution losses for providing electricity to source k in year y.
$TDL_{l,y}$ = Average technical transmission and distribution losses for providing electricity to source l in year y.
j = Sources of electricity consumption in the project.
k = Sources of electricity consumption in the baseline.
l = Leakage sources of electricity consumption.

Electricity Consumption Measurement:

Electricity meters installed at the points of electricity consumption are utilized to directly measure the quantity of electricity consumed by the project's electricity consumption source j in year y. Monthly electricity consumption data is corroborated using the monthly bills provided by the government, ensuring accuracy and transparency in the data collection process.

Emission Factor for Coal-Based Electricity:

Electricity supplied by the national grid is generated predominantly using coal as the primary fuel source. For the CO_2 emission factor of coal used during the period ttt (2017–2024), the following approach is adopted: The emission factor EFCO2,i,t is referenced from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Specifically, values are obtained from Table 1.4, Chapter 1, Volume 2 (Energy), applying the upper limit of uncertainty at a 95% confidence interval to ensure conservative and reliable calculations. The value is 0.4

Transmission and Distribution Losses:

The average technical transmission and distribution losses incurred while delivering electricity to consumption sources j, k, or l in year y are also incorporated into the calculations. This adjustment ensures a more comprehensive estimate of emissions.
A default value of 20% is used as defined in the data and parameters monitored in ACM0022 for
(a) project or leakage electricity consumption sources;
(b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies;

Project emissions:
The project emissions are comprised of emissions from all the processes amounting to **6605 tCO2.**

Fuel combustion:

The following equation estimates the total carbon emissions from fuel consumption across all plant activities over a 7-year period (2017 to 2024). Emissions are calculated by summing the products of the fuel consumption for diesel (or other fuel types) and their respective emission factors.

CO₂ emissions from fossil fuel combustion for a given process j are determined using the quantity of fuel type i combusted and the CO₂ emission coefficient specific to that fuel type, as expressed in the equation below:
The calculation methodology follows the guidelines provided in Tool 13, "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion." This tool outlines standardized procedures for determining project or leakage CO₂ emissions resulting from fossil fuel combustion. It is applicable when emissions are calculated based on the quantity of fuel combusted and its specific properties.

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \qquad (26)$$

Where:

$PE_{FC,j,y}$ = Are the CO2 emissions from fossil fuel combustion in process j during the year y (tCO2/yr)

$FC_{i,j,y}$ = 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)

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

The end user is an SME faced with data gaps due to meter failure and some other reasons unforeseen. Hence, 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 $COEF_{i,y}$, is calculated based on net calorific value and CO2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \qquad (27)$$

Where:

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

$\mathrm{NCV}_{i,y}$ = Is the weighted average net calorific value of the fuel type i in year y

$\mathrm{EF}_{\mathrm{CO2},i,y}$ = 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
Carbon emissions resulting from fuel combustion can be calculated in two steps using the provided equations:
Determine the CO₂ Emission Coefficient for Diesel:

The CO₂ emission coefficient is calculated using Equation 2, which utilizes the default values for the Net Calorific Value (NCVi,y_{i,y}i,y) and the CO₂ Emission Factor (EFCO2,i,y_{CO₂,i,y}CO2,i,y), as specified in the IPCC guidelines.
Calculate CO₂ Emissions:
Once the CO₂ emission coefficient is determined, total CO₂ emissions are calculated using Equation

Weighted Average Net Calorific Value (NCVi,y_{i,y}i,y):

The NCV is obtained from the IPCC default values at the upper limit of uncertainty, with a 95% confidence interval. These values are provided in Table 1.2, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Weighted Average CO₂ Emission Factor (EFCO2,i,y_{CO₂,i,y}CO2,i,y):

The emission factor is derived using IPCC default values at the upper limit of uncertainty, also with a 95% confidence interval. These values can be found in Table 1.4, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines for

National Greenhouse Gas Inventories

The project emissions are comprised of emissions from all the processes amounting to **466 tCO2 e.**

Composting (COMP):

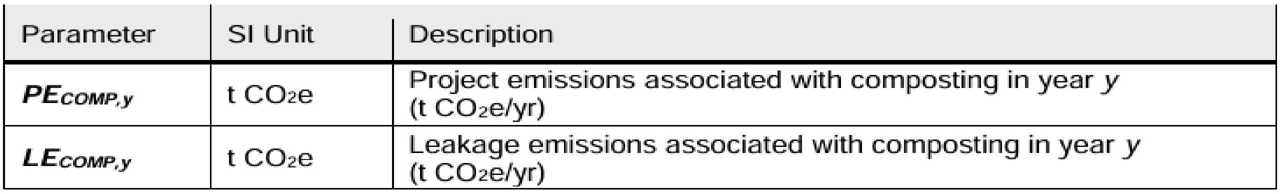
MSW that is received every day is sorted into organic and inorganic waste. The organic waste is pre-sorted and sent to the composting unit.

Methodology for Calculating Composting Emissions:

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 in to project and leakage emissions. Following parameters are obtained using this methodology.



Parameter	SI Unit	Description
$PE_{COMP,y}$	t CO_2e	Project emissions associated with composting in year *y* (t CO_2e/yr)
$LE_{COMP,y}$	t CO_2e	Leakage emissions associated with composting in year *y* (t CO_2e/yr)

Project emissions calculation:

The project emissions will be calculated using the equation 7:

$$PE_{COMP,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{N2O,y} + PE_{RO,y} \qquad (7)$$

$PE_{COMP,y}$ = 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).
$PE_{CH4,y}$ = Project emissions of methane from the composting process in year y (t CO2e/yr)
$PE_{N2O,y}$ = 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 7, $PE_{EC,y}$ and $PE_{FC,y}$ are excluded as they are already calculated later using equation 31 and 32.

Determination of project emissions of methane (PECH4,y)

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

$$PE_{CH4} = Q_y \times EF_{CH4,y} \times GWP_{CH4} \qquad (8)$$

Where:

PE_{CH4} = 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_{CH4} = Emission factor of methane per tonne of waste composted valid for year y (t CH4 / t)
GWP_{CH4} = Global Warming Potential of CH4 (t CO2e / t CH4)

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

Parameter	value
$EF_{CH4,y}$	0.002
GWP_{CH4}	28

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

Global Warming Potential of CH4 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”.

Determination of project emissions of nitrous oxide (PEN2O,y)

For estimating $PE_{N2O,y}$, following equation is used:

$$PE_{N2O,y} = Q_y \times EF_{N2O,y} \times GWP_{N2O} \quad (9)$$

PE_{N2O} = 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_{N2O} = Emission factor of methane per tonne of waste composted valid for year y (t CH4 / t)
GWP_{N2O} = 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
$EF_{N2O,y}$	0.0002
GWP_{N2O}	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 to be **1,07,405.99 t CO2 e** for the period of 7 years**.**

Leachate biomethanation (LB):

The **leachate biomethanation** process involves treating landfill leachate using anaerobic digestion to produce methane (CH_4). 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 flowing steps:

Parameter	SI Unit	Description
$PE_{AD,y}$	t CO_2e	Project emissions associated with the anaerobic digester in year *y* (t CO_2e)
$LE_{AD,y}$	t CO_2e	Leakage emissions associated with the anaerobic digester in year *y* (t CO_2e)

Project emissions calculation:

The project emissions will be calculated using the equation 1:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \quad (16)$$

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 1, $PE_{EC,y}$ and $PE_{FC,y}$ are excluded as they are calculated separately.

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

$$PE_{CH4} = Q_{CH4,y} \times EF_{CH4,default} \times GWP_{CH4} \qquad (17)$$

$Q_{CH4,y}$ - Amount of biogas collected at the digester outlet in year y . The gas flow is measured based on the capacity of the pump delivering the gas.
$EF_{CH4,default}$ - 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.

$PE_{flare,y}$ is calculated using Tool 8. Following equation provides emissions due to flaring based on mass flow measurement of gas in the minute.
However, the at the plant site, annual volumetric gas flow measurement is given for biogas in m3.

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3} \qquad (18)$$

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 CH4)

$F_{CH4,RG,m}$ = 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:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \qquad (19)$$

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.
For simplification, the emissions from flaring are calculated based on annual data instead of minutes. Following equation is used:

$$PE_{flare,y} = BG_{flare,y} \times \omega_{CH4} \times GWP_{CH4} \times (1 - CEF) \qquad (20)$$

Where:

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

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

ω_{CH4} = Fraction of methane in gas generated in digester (0.6)

GWP_{CH4} = Global warming potential of methane (28)

CEF = Combustion efficiency for open flare (0)

Project emissions due to leachate bio-methanation for 7 years are **544.1 tCO2**.

RDF manufacturing (RDF):

Project emissions from RDF manufacturing process:

MSW received every day is sorted into organic and inorganic waste. The inorganic waste is pre-sorted and passed through multiple shredding and trommel segregation units to finally obtain RDF.
The emissions from this process of RDF manufacturing can be obtained using the following equation:

$$PE_{RDF\_SB,y} = PE_{COM,RDF,y} + PE_{EC,RDF,y} + PE_{FC,RDF,y} + PE_{WW,RDF\_SB,y}$$

(10)
Where:

$PE_{RDF\_SB,y}$ = Project emissions associated with RDF/SB in year y (t CO2e).

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

$PE_{EC,RDF\_SB,y}$ = Project emissions from electricity consumption associated with RDF/SB (production and on-site combustion) in year y (t CO2e).

$PE_{FC,RDF\_SB,y}$ = Project emissions from the wastewater treatment associated with RDF/SB (production and on-site combustion) in year y (t CH4).

$PE_{WW,RDF\_SB,y}$ = Project emissions from the wastewater treatment associated with RDF/SB (production and on-site combustion) in year y (t CH4)

Project emissions from fossil fuel consumption associated with

$$PE_{COM,y} = PE_{COM,CO2,c,y} + PE_{COM,CH4,c,y} \qquad (11)$$

Where:

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

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

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

Notice that the above equations 7 and 8 have same components $PE_{COM,i,y}$, $PE_{EC,i,y}$, $PE_{FC,i,y}$, $PE_{ww,i,y}$. From these equations, the terms $PE_{EC,i,y}$, $PE_{FC,i,y}$, and $PE_{ww,i,y}$ are excluded because, carbon emissions from fuel combustion and electricity consumption are calculated in total later using equations 28 and 3. And $PE_{ww,i,y}$ is not applicable because leachate coming from all the processes is collected together and treated by the leachate biomethanation process. Hence, we have to calculate only $PE_{COM,i,y}$ (Project emissions from combustion within the project boundary of fossil waste associated with combustion of RDF). It consists of two sources of emissions. One is CO2 emissions from combustion and the other is CH4 and N2O emissions from combustion.

Project emissions of CO2 from combustion within the project boundary ($PE_{COM\_CO2,c,y}$):
Project emissions of CO_2 from combustion within the project boundary are given by:

$$PE_{COM_{CO2},c,y} = \frac{44}{12} \times FF_{COM,c,y} \times Q_{waste,c,y} \times FFC_{waste,c,y} \qquad (12)$$

$Qwaste$,c,y = Quantity of RDF fed into combustor in year y (t).
Quantity of RDF produced and quantity of RDF sold is obtained from the plant data using weigh balance and quantity of waste combusted is obtained by subtracting these two.
$FFCwas$te,c,y = Fraction of fossil-based carbon in RDF fed into combustor in year y (t C/t).
$FFCOM$,, = Combustion efficiency of combustor c in year y (fraction).

RDF which is used within the boundary is used in dead animal carcass incineration. The carbon emissions are counted in the process of incineration instead of RDF manufacturing, in order to avoid double counting.

Project emissions of CH4 and N2O from combustion within the project boundary ($PE_{COM\_CH4,N2O,c,y}$)

$$PE_{COM,CH4,N2O,c,y} = Q_{waste,c,y} \times (EF_{N2O,t} \times GWP_{N2O} + EF_{CH4,t} \times GWP_{CH4}) \qquad (13)$$

Where:

$PE_{COM,CH4,N2O,c,y}$ = 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).

$GWP_{N2O,t}$ = Global Warming Potential of nitrous oxide (t CO2e/t N2O)

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

Emissions of N2O and CH4 from combustion of RDF/SB are neglected because they are considered very minor.

Baeline emissions: RDF manufacturing does not include baseline emissions.
Project emissions: The project emissions from the RDF manufacturing process are calculated in incineration.

Incineration:

In the incineration process, dead animal carcass is fed to the incinerator. Pyro oil, RDF and shredded biomasss 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:

$$PE_{INC,y} = PE_{COM,INC,y} + PE_{EC,INC,y} + PE_{FC,INC,y} + PE_{WW,INC,y} \qquad (23)$$

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

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

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

$PE_{FC,INC,y}$ = Project emissions from the wastewater treatment associated with incineration in year y (t CH4).

$PE_{WW,INC,y}$ = Project emissions from the wastewater treatment associated with incineration in year y (t CH4)

$$PE_{COM,y} = PE_{COM,CO2,c,y} + PE_{COM,CH4,N2O,c,y} \qquad (24)$$

Where:

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

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

$PE_{COM,CH4,N2O,c,y}$ = Project emissions of CH4 and N2O from combustion within the project boundary associated with combustor c in year y (t CO_2).

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

Project emissions of CO2 from combustion within the project boundary (PECOM_CO2,c,y):

$$PE_{COM,CO_2,c,y} = \frac{44}{12} \times FF_{COM,c,y} \times Q_{waste,c,y} \times FFC_{waste,c,y} \qquad (25)$$

$Q_{waste,y}$ = Quantity of fresh waste (dead animals) fed into incinerator in year y (t)
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:
$Q_{waste,y\,=}$ Number of waste animals incinerated * No. of working hours of incinerator * capacity of incinerator

$FF_{COM,c,y}$ = Fraction of fossil-based carbon in waste fed into incinerator in year y (t C/t).
Source: *Therese Schwarzböcka, Philipp Aschenbrennera, Stefan Spaceka, Sönke Szidatb, Helmut Rechbergera, Johann Fellnera 2017 An alternative method to determine the share of fossil carbon in solid refuse derived fuels– Validation and comparison with three standardized methods.*

$FFC_{waste,y}$ = 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"
Other than dead animals, incinerator also involves burning of pyro oil, shredded biomass and RDF as fuel. In addition, the electricity for heating is supplied through biogas.
Emissions due to Pyro oil combustion are calculated using tool 3- Tool to calculate project or leakage CO2 emissions from fossil fuel combustion.
Emissions saved due to replacement of fossil based energy by biogas are calculated using Tool 5.
Emissions saved due to replacement of coal by shredded biomass are calculated using Tool 3.

Project emissions of CH4 and N2O from combustion within the project boundary (PECOM_CH4,N2O,c,y)

$$PE_{COM,CH4,N2O,c,y} = Q_{waste,c,y} \times (EF_{N2O,t} \times GWP_{N2O} + EF_{CH4,t} \times GWP_{CH4}) \qquad (25)$$

Where:
$PE_{COM,CH4,N2O,c,y}$ = 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).
$GWP_{N2O,t}$ = Global Warming Potential of nitrous oxide (t CO2e/t N2O)
$GWP_{CH4,t}$ = Global Warming Potential of methane valid for the commitment period (t CO2e/t CH4).

Default values for this equation are:

Parameter	N2O	CH4
EF	1.21*60*10^-6	1.21*60*10^-3
GWP	265	28

Source: ACM0022, data and parameters not monitored, table 7
Thereby,
Project emissions due to incineration: **126786.37 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:

Electricity consumption:
No leakage emissions.

Fuel combustion:
No 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,) depend on how the digestate is managed. They include emissions as:

$$LE_{AD,y} = LE_{storage,y} + LE_{COM,y} \qquad (21)$$

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:

$$LE_{storage,y} = F_{SD,CH4,default} \times Q_{CH4,y} \times GWP_{CH4} \qquad (22)$$

Where:
$LE_{storage,y}$ = Leakage emissions associated with storage of digestate in year y (t CO2e)
$F_{SD,CH4,default}$ = Default factor for the methane generation capacity of solid digestate (fraction)
$Q_{CH4,y}$ = Quantity of methane produced in the anaerobic digester in year y (t CH4)
GWP_{CH4} = Global warming potential of CH4 (t CO2/t CH4).

Determination of leakage emissions associated with composting of digestate (LECOMP,y).
$LE_{comp,y}$, shall be calculated using the methodological tool "Project and leakage emissions from composting". The term $PE_{comp,y}$ + $LE_{comp,y}$ the methodological tool "Project and leakage emissions from composting" provides the value for $LE_{comp,y}$ of this tool.

The disgestate is not composted in the present case. Hence, LEcomp,y will be 0.

Leakage emissions are amounted to be **176.39 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:

$$LE_{RDF\_SB,y} = LE_{ENDUSE,RDF_{SB},y} + LE_{SWDS,WBP_{RDF\_SB,y}} \qquad (14)$$

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 ($LE_{ENDUSE,RDF\_SB,y}$):

$$LE_{ENDUSE\_RDF\_SB,y} = Q_{RDF\_SB,COM,y} \times NCV_{RDF_{SB},COM,y} \times EF_{CO2,RDF\_SB,y} \qquad (15)$$

Where:
$LE_{ENDUSE\_RDF\_SB,y}$ = Leakage emissions of CO2 from off-site combustion of RDF/SB in year y (t CO2)
$Q_{RDF\_SB,COM,y}$ = CO2 emissions factor for RDF/SB in year y (t CO2/GJ)
$NCV_{RDF_{SB},COM,y}$= Net calorific value of RDF/SB in year y (GJ/t)

Quantity of RDF/SB exported off-site with potential to be combusted in year y (t)

$EF_{CO2,y}$= 121000 kg/TJ -- IPCC guidelines, Chapter1-Introduction-table 1.4 - Municipal waste (non biomass fraction)
$NCV_{RDF\_SB,y}$= 10 TJ/Gg -- IPCC guidelines, Chapter1-Introduction-table 1.2 – Municipal waste (non biomass fraction)

Leakage emissions are amounted to be **3,21,117.03 tCO2.**

Incineration:
There are no leakage emissions.

Plastic to Fuel (PtoF):
There are no leakage emissions.

Briquetting:
There are no leakage emissions.

Emissions saved:

RDF manufacturing (RDF):

The RDF being produced here is partially utilised in the plant activities and the rest is sold.
RDF is a renewable source which can replace coal as a fuel. In Maharashtra, lignite coal is mostly used as fuel. So the emissions saved due to the use of RDF are calculated as given below:

Tool 3 is used to calculate the emissions due to combustion of fossil fuel
The data for yearly production of RDF in the plant is given below:

Some amount of RDF is used as a fuel in the incineration process. The emissions due the combustion of RDF inside the project boundary are calculated in the incineration process. In order to avoid double counting, these emissions are not calculated in the RDF process.
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:
Mcoal = MRDF *(NCVRDF/NCVcoal)

The emissions due to the given amount of mass of coal replaced by RDF.

Total emissions saved due to use of RDF = 9,60,043.23

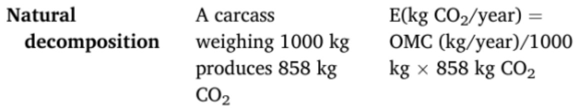
Leachate Biomethanantion:

Carbon emissions saved due to the use of electricity from biogas instead of thermal electricity from the grid are **542.38 t CO2 e.**

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.
The briquettes are considered to be carbon neutral as they are produced from horticulture waste which absorbs the same amount of GHGs as the amount that is emitted on their burning.
However, the briquettes are replacing coal as a fuel, hence, the avoided emissions or carbon credits will be calculated using tool 3.
Thereby, the total emissions saved from briquetting = **1396 t CO2.**
Emissions saved due to briquetting are also because horticulture waste is not left to decompose on the landfill. These emissions amount to 77065 t CO2 e.

Incineration:

The Carbon emissions saved by burning the dead animals instead of letting the dead animal to decompose naturally are calculated with the help of the below given statistics:



Natural decomposition	A carcass weighing 1000 kg produces 858 kg CO_2	E(kg CO_2/year) = OMC (kg/year)/1000 kg × 858 kg CO_2

Source: Pablo Ignacio Plaza, Sergio Agustín LambertucciMitigating 2022. GHG emissions: A global ecosystem service provided by obligate scavenging birds.
Baseline emissions due to natural decomposition of 2733 tons dead animals are 2345.04 t CO2 e.

We use shredded biomass for incineration. Carbon emissions saved due to the us of shredded biomass is 5472.68 t CO2 e.

Plastic to Fuel (PtoF):

Plastic takes more than 100 years to decompose and hence, plastic or inorganic waste when left untreated occupies ample of space. In order to get rid of the space problem i.e to ake space available, the plastic is burnt in general. In the present case, the plastic to fuel process avoids these emissions.

The emissions saved due to the use of plastic to fuel technology instead of burning the plastic waste are 109.551 t CO2 e.
In the process of converting plastic to fuel, pyro oil is produced, the quantity of which is 8762 ltrs. This oil can replace diesel as a fuel in processes such as incineration. Hence the carbon emissions saved will be calculated considering the NCV of diesel. The carbon emissions saved there by will be **58,687.87t CO2 e.**

Solar Energy:
Project Emissions: Since the project activity is a solar PV based power generation project there are no emissions due to the project activity. (AMS-I.D version 18)

Leakage Emissions:
General guidance on leakage in biomass project activities shall be followed to quantify leakages pertaining to the use of biomass residues.

Emissions saved:

Using AMS-I.D. version 18, the total emissions saved due to use of solar energy are **78.97 t CO2 e**.

Emissions reduction:

Hence emission reduction is calculated:

$$Emission\ Reductions$$
$$= Baselin\ emissions - \ Project\ emissions - Leakage\ emissions$$
$$+ Carbon\ emissions\ saved$$

$$= 1031345.60 - \ 241807.47 - \ 315973.82 + \ 1026182.98$$
$$= 2057528.58 - \ 2057566.73$$
$$= 1499785.442\ t\ CO2$$

Emission reductions =1499785.442 tCO_{2eq}

B.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.

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

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

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

In case this PCN document version changes at a later date to include additional details to explain changes to the new version else type
There are no permanent changes from registered PCN monitoring plan and applied methodology

B.9. Monitoring period number and duration>>

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

B.8. Monitoring plan>>

THE FOLLOWING ARE THE TABLES FOR PARAMETERS BEING MONITORED OR USED IN EMISSION REDUCTIONS DETERMINATION

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:	Official studies, reports and certification from municipalauthorities
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:	***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 (see table below) 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 can not 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 participates also have the option to apply the balance method (Appendix 2) to measure FFCj,y
Any comment:	Data and parameters to be monitored in respect of the balance method are shown in the Appendix 2 additionally

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

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 FCCj,y *(see table below)* *Metal and glass contain some carbon of fossil origin. Combustion of significant amounts of glass or metal is not common The project participates also have the option to apply the balance method (Appendix 2) to measure FCCj,y
Any comment:	Data and parameters to be monitored in respect of the balance method are shown in the Appendix 2 additionally

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

Data / Parameter:	***GWP_{CH4}***
Data unit:	t CO_2e/t CH_4
Description:	Global Warming Potential of methane valid for the commitmentperiod (t CO_2e/t CH_4)
Source of data:	IPCC
Value to be applied:	Default value of 25 from IPCC Fourth Assessment Report (AR4). Shall be updated according to any future COP/MOP decisions
Any comment:	-

Data / Parameter:	***GWP_{N2O}***
Data unit:	t CO_2e/t N_2O
Description:	Global Warming Potential of N_2O
Source of data:	IPCC

Value to be applied:	Default value of 298 from IPCC Fourth Assessment Report (AR4). Shall be updated according to any future COP/MOP decisions
Any comment:	-

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 fromwastewater treatment”

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 IPCC2006 guidelines)
Measurement procedures (if any):	-
Any comment:	

Data / Parameter:	***$EF_{CH4,t}$***
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
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 6. For continuous incineration of industrial waste, apply the CH4 emission factors provided in Volume 2, Chapter 2, Stationary Combustion of IPCC 2006 Guidelines. Table 6. CH4 emission factors for combustion

Waste type	**Type of incineration/technology**	**CH4 emission factors (t CH4 / t waste) wet basis**

<table>
<tr><td></td><td>
<table>
<tr><td rowspan="6">MSW</td><td rowspan="2">Continuous incineration</td><td>Stroker</td><td>1.21 X 0.02X10^{-6}</td></tr>
<tr><td>Fluidissed bed</td><td>~0</td></tr>
<tr><td rowspan="2">Semi-continuous incineration</td><td>Stroker</td><td>1.21 X 6X10^{-6}</td></tr>
<tr><td>Fluidissed bed</td><td>1.21X 188X10^{-6}</td></tr>
<tr><td rowspan="2">Batch type incineration</td><td>Stroker</td><td>1.21 X 60X10^{-6}</td></tr>
<tr><td>Fluidissed bed</td><td>1.21X237X10^{-6}</td></tr>
<tr><td colspan="3">Sludge (semi-continous 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>1.21 X560x10^{-6}</td></tr>
</table>
A conservativeness factor of 1.21 has been applied to account for the uncertainty of the IPCC default values
</td></tr>
<tr><td>Any comment:</td><td>Applicable to Option 2 of procedure to estimate PECOM,c,y</td></tr>
</table>

Data / Parameter:	***EF**$_{N2O,t}$*
Data unit:	t N_2O/t waste (wet basis)
Description:	Emission factor for N_2O associated with treatment process *t*
Source of data:	Table 5.6, chapter 5, volume 5 of IPCC 2006 guidelines

<table>
<tr><td>Measurement procedures (if any):</td><td>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>Waste type</th><th>Technology / Management practice</th><th>CH4 emission factors (t N20/ t waste wet basis)</th></tr>
<tr><td>MSW</td><td>Continuous incineration and Semi-continuous incinerators</td><td>1.21 X 50X10-^{3}</td></tr>
<tr><td>MSW</td><td>Batch type incinerators</td><td>1.21 X 60X10^{-3}</td></tr>
<tr><td>Industrial Waste</td><td>All types of incineration</td><td>1.21X 100X10^{-3}</td></tr>
<tr><td>Sludge (except swage sludge)</td><td>All types of incineration</td><td>1.21 X 450x10^{-3}</td></tr>
<tr><td>Sewage Sludge</td><td>Incineration</td><td>1.21X 900X 10^{-3}</td></tr>
</table>
A conservativeness factor of 1.21 has been applied to account for the uncertainty of the IPCC default values</td></tr>
<tr><td>Any comment:</td><td>Applicable to Option 2, of procedure to estimate PECOM,c,y</td></tr>
</table>

Data / Parameter:	***EF**$_{CO2,BL,HG}$*
Data unit:	t CO_2/TJ
Description:	CO_2 emission factor of the fossil fuel type used for heatgeneration by the boiler or air heater in the baseline
Source of data:	The source of data shall be the following, in order of preference: project specific data, country specific data or IPCC defaultvalues. As per guidance from the Board, IPCC default values shall be used only when country or project specific data are notavailable or difficult to obtain
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter:	η_{cogen}
Data unit:	ratio
Description:	Efficiency of the cogeneration plant that would have been usedin the absence of the project activity
Source of data:	Project participants can choose one of the following approaches: Highest of the measured efficiencies of similar plants; Highest of the efficiency values provided by two or more manufacturers for similar plants; or Maximum efficiency of 90 per cent, based on net calorific values
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter:	***$EF_{CO2,BL,CG}$***
Data unit:	t CO_2/MJ
Description:	Emission factor of baseline fossil fuel used in the cogenerationplant, as identified in the baseline scenario identification
Source of data:	The source of data shall be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values shall be used only when country or project specific data are notavailable or difficult to obtain
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter:	***$COD_{out,x}$ $COD_{in,x}$***
Data unit:	tCOD
Description:	COD of the effluent in the period *x.* COD directed to the anaerobic lagoons or sludge pits in theperiod *x* (tCOD)
Source of data:	For existing plants: If there is no effluent: $COD_{out,x} = 0$;If there is effluent: One year of historical data should be used, or If one year data is not available then *x* represents a measurement campaign of at least 10 days to the COD inflow ($COD_{in,x}$) and COD outflow ($COD_{out,x}$) from the lagoon or sludgepit. For Greenfield projects: Use the design COD inflow for COD in and the design effluent COD flow for COD out corresponding to the design features of the lagoon system identified in the procedure for the selection ofthe baseline scenario
Measurement procedures (if any):	For the measurement campaign of at least 10 days: The measurements should be undertaken during a period that is representative for the typical operation conditions of the plant and ambient conditions of the site (temperature)
Any comment:	-

c	***x***
Data unit:	Time
Description:	Representative historical reference period
Source of data:	For existing plants: *x* should represent one year of historical data; If one-year data is not available then *x* represents ameasurement campaign of at least 10 days. For Greenfield projects this parameter is not relevant
Measurement procedures (if any):	-

Any comment:	-

Data / Parameter:	ρ
Data unit:	-
Description:	Discount factor to account for the uncertainty of the use ofhistorical data to determine $COD_{BL,y}$
Source of data:	For existing plants: 1. If one year of historical data is available ρ=1; 2. If a measurement campaign of at least 10 days is available ρ=0.89. For Greenfield projects: ρ=1
Measurement procedures (if any):	The value of 0.89 for the case where there is no one year historical data is to account for the uncertainty range (of 30 per cent to 50 per cent) associated with this approach as comparedto one-year historical data
Any comment:	-

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 (COD)
Source of data:	2006 IPCC Guidelines
Measurement procedures (if any):	No measurement procedures. The default IPCC value for Bo is 0.25 kg CH4/kg COD shall be used. Unless the methodology is used for wastewater containing materials not akin to simple sugars, a CH4 emissions factor different from 0.21 t CH4/tCOD has to be applied
Any comment:	Taking into account the uncertainty of this estimate, project participants should use a value of 0.21 kg CH4/kg COD as a conservative assumption for Bo

Data / Parameter:	***D***
Data unit:	M
Description:	Average depth of the lagoons or sludge pits
Source of data:	For existing plants: conduct measurements. For project activities implemented in Greenfield facilities: As per the baseline lagoon design as identified in Step 1 of the section“Procedure for the identification of the most plausible baseline scenario Identification of alternative scenarios”
Measurement procedures (if any):	Determine the average depths of the whole lagoon/sludge pitunder normal operating conditions
Any comment:	-

Data / Parameter:	***$NCV_{BIOGAS,NG,y}$***
Data unit:	TJ/Nm^3
Description:	Net calorific value of the upgraded biogas sent to the naturalgas network due to the project activity in year *y*
Source of data:	Project participants
Measurement procedures (if any):	Measured directly using an online Heating Value Meter from the gas stream. The measurement must be in volume basis and adjusted to reference conditions
Monitoring frequency:	Continuous
QA/QC procedures:	Calibration shall be according to manufacturer's specifications
Any comment:	Applicable to baseline emissions procedure (D)

Data / Parameter:	***$BIOGAS_{NG,y}$***
Data unit:	Nm^3/yr
Description:	Quantity upgraded biogas sent to the natural gas network dueto the project activity in year *y* (Nm3)
Source of data:	Project participants
Measurement procedures (if any):	Measured by a flow meter and adjusted to reference conditions.Data to be aggregated monthly and yearly
Monitoring frequency:	Continuous (average value in a time interval not greater thanan hour shall be used in the calculations of emission reductions)
QA/QC procedures:	Flow meters shall be subject to a regular maintenance and testing regime to ensure accuracy. Calibration shall be according to manufacturer's specifications
Any comment:	Applicable to procedure (D)

Data / Parameter:	***$EFF_{COM,c,y}$***
Data unit:	Fraction
Description:	Combustion efficiency of combustor *c* in year *y*
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
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:	***$SG_{c,y}$***
Data unit:	m^3/yr
Description:	Volume of stack gas from combustor *c* in year *y*

Source of data:	Project participants
Measurement procedures (if any):	The stack gas flow rate is either directly measured or calculated from other variables where direct monitoring is not feasible. Where there are multiple stacks of the same type, then it is sufficient to monitor one stack of each type. For the case that biogas is combusted, then the stack gas volume flow rate may be estimated by summing the inlet biogas and air flow rates and adjusting for stack temperature. Direct measurement of the air inlet flow rate shall be made using a flow meter
Monitoring frequency:	Continuous or periodic (at least quarterly)
QA/QC procedures:	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Where laboratory work is outsourced, one which follows rigorous standards shall be selected
Any comment:	-

Data / Parameter:	$C_{N2O,SG,c,y}$
Data unit:	t N_2O/Nm^3
Description:	Concentration of N_2O in stack gas from combustor *c* in year *y*
Source of data:	Project participants
Measurement procedures (if any):	-
Monitoring frequency:	At least every three months
QA/QC procedures:	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Where laboratory work is outsourced, one which follows rigorous standards shall be selected
Any comment:	More frequent sampling is encouraged

Data / Parameter:	$C_{CH4,SG,c,y}$
Data unit:	t CH_4/Nm^3
Description:	Concentration of CH_4 in stack gas from combustor *c* in year *y*
Source of data:	Project participants
Measurement procedures (if any):	-
Monitoring frequency:	At least every three months
QA/QC procedures:	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Where laboratory work is outsourced, one which follows rigorous standards shall be selected
Any comment:	More frequent sampling is encouraged

Data / Parameter:	$Q_{waste,c,y}$
Data unit:	T
Description:	Quantity of fresh waste or RDF/SB fed into combustor *c* inyear *y*
Source of data:	Project participants
Measurement procedures (if any):	Measured with calibrated scales or load cells
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	-
Any comment:	Parameter required for procedure to calculate projectemissions from combustion within the project boundary

Data / Parameter:	$p_{n,j,y}$
Data unit:	Weight fraction
Description:	Fraction of waste type *j* in the sample *n* collected during theyear *y*
Source of data:	Sample measurements by project participants
Measurement procedures (if any):	-
Monitoring frequency:	A minimum of three samples shall be undertaken every three months with the mean value valid for year *y*
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	z_y
Data unit:	-
Description:	Number of samples collected during the year *y*
Source of data:	Project participants
Measurement procedures (if any):	-
Monitoring frequency:	Continuously, aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EC_{t,y}$
Data unit:	MWh
Description:	Electricity consumption of electricity generated in an on-site fossil fuel fired power plant or from the grid as a result of the alternative waste treatment process *t* in year *y*
Source of data:	Electricity meter

Measurement procedures (if any):	Sources of consumption shall include the operation of the alternative waste treatment process, on-site processing or management of the feedstock or products associated with the treatment process and on-site combustion activity. Electricity consumption shall be monitored for all activities included in the project boundary, associated with the treatment process, as illustrated in Appendix 1
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. The readings will be double checked against invoices when available
Any comment:	This parameter is required for calculating project emissions from electricity consumption due to waste treatment under the project activity process t (PEEC,t,y) using the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” ECt,y excludes consumption of any electricity generated by the project activity. In case of consumption of electricity generated by the project by RDF/SB combustion or incineration, then emissions associated with combustion of fossil carbon content of the waste are accounted for in the procedure “Project emissions from combustion”, and do not need to be accounted for again in the procedure “Project emissions from electricity use”

Data / Parameter:	$EG_{t,y}$
Data unit:	MWh
Description:	Electricity generated by the alternative waste treatment process *t* and exported to the grid or displacing fossil fuel fired power- only and/or cogeneration captive energy generation in year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	-
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:	$EG_{INC,y}$
Data unit:	GJ
Description:	Amount of electricity generated by incineration during the year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	Electricity generation needs to be converted to thermal energy (1 MWh = 3.6 GJ)
Monitoring frequency:	Continuous, aggregate annually
QA/QC procedures:	-
Any comment:	This parameter will be used to assess that the fraction of energy generated by fossil fuel is no more than 50 per cent of the total

	energy generated in the incinerator

Data / Parameter:	$HG_{PJ,y}$
Data unit:	TJ
Description:	Quantity of heat supplied by the project activity displacing baseline heat generation by a fossil fuel boiler or air heater in year *y* (TJ)
Source of data:	Steam meter
Measurement procedures (if any):	In case of steam meter: the enthalpy of steam and feed water will be determined at measured temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter. In case of hot air: the temperature, pressure and mass flow rate will be measured
Monitoring frequency:	Monthly, aggregated yearly
QA/QC procedures:	In case of monitoring of steam, it will be calibrated for pressure and temperature of steam at regular intervals. The meter shall be subject to regular maintenance and testing to ensure accuracy
Any comment:	The dedicated quantity of thermal energy generated for heat supply or cogeneration by the project activity if included

Data / Parameter:	$HG_{INC,y}$
Data unit:	GJ
Description:	Quantity of thermal energy generated by incineration in year *y*
Source of data:	Steam meter
Measurement procedures (if any):	In case of steam meter: the enthalpy of steam and feed water will be determined at measured temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter. In case of hot air: the temperature, pressure and mass flow rate will be measured
Monitoring frequency:	Annually
QA/QC procedures:	In case of monitoring of steam, it will be calibrated for pressure and temperature of steam at regular intervals. The meter shall be subject to regular maintenance and testing to ensure accuracy
Any comment:	This parameter will be used to assess that the fraction of energy generated by fossil fuel is no more than 50 per cent of the total energy generated in the incinerator

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 should be kept at the project site. They shall contain customer contact details, physical location of delivery, type, amount (in tons) and purpose of RDF/SB (use as fuel or as material in furniture, etc.). A list of customers and delivered SD amount shall be kept at the project site
Monitoring frequency:	Weekly
QA/QC procedures:	-
Any comment:	See procedure to calculate leakage emissions associated with RDF/SB for further information

Data / Parameter:	**Temperature of the thermal treatment process**
Data unit:	degrees Celsius
Description:	The thermal treatment process (dehydration) occurs under controlled conditions (up to 300 degrees Celsius)
Source of data:	Project site
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$Q_{export,RDF\_SB,y}$
Data unit:	T
Description:	Quantity of RDF/SB exported outside the project boundary thatis considered to decay anaerobically in year *y*
Source of data:	Project participants
Measurement procedures (if any):	Weighbridge. All RDF/SB for which documented evidence is not available that it is combusted, or used for fertilizer of furniture manufacture
Monitoring frequency:	Annually
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Any comment:	-

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
Monitoring frequency:	Annually
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Any comment:	-

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:	Measured value by flow meter
Measurement procedures (if any):	-
Monitoring frequency:	Monthly, aggregated annually
QA/QC procedures:	The monitoring instruments will be subject to regular maintenance and testing to ensure accuracy
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:	**$P_{COD,y}$**
Data unit:	$tCOD/m^3$
Description:	COD of the wastewater discharge generated by the project activity in year *y*
Source of data:	Measured value by purity meter or COD meter
Measurement procedures (if any):	-
Monitoring frequency:	Monthly and averaged annually
QA/QC procedures:	The monitoring instruments will be subject to regular maintenance and testing to ensure accuracy
Any comment:	If the wastewater discharge is treated aerobically, emissions are assumed to be zero, and hence this parameter does not need to be monitored

Data / Parameter:	**$EG_{INC,FF,y}$**
Data unit:	GJ
Description:	Energy generated by auxiliary fossil fuel added in the incinerator
Source of data:	Project site
Measurement procedures (if any):	This parameter will be estimated multiplying the amount of auxiliary fossil fuel added in the incinerator to the net calorific value of this auxiliary fossil fuel
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	This parameter will be used to assess that the fraction of energy generated by fossil fuel is no more than 50 per cent of the total energy generated in the incinerator. $EG_{INC,FF,y} < 0.50 \times (HG_{INC,y} + EG_{INC,y})$

Data / Parameter:	**$EF_{CO2,RDF\_SB,y}$**
Data unit:	$t\ CO_2/GJ$
Description:	Weighted average CO_2 emission factor for RDF/SB in year *y*
Source of data:	$EF_{CO2,RDF\_SB,y}$ is zero for biomass residues, otherwise determine

<table>
<tr><td></td><td>from one of the following sources:
<table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>(a) Measurements by the project participants</td><td>This is the preferred data source</td></tr><tr><td>(b) 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</td><td>If (a) is not available</td></tr></table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a): Measurements shall be undertaken in line with nationalor international fuel standards</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a): the CO2 emission factor shall be obtained for each shipment of RDF/SB exported from the project site for which there is documented evidence that it will be combusted, from which weighted average annual values shall be calculated.
For (b): any future revision of the IPCC Guidelines shall be taken into account</td></tr>
<tr><td>QA/QC procedures:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>This parameter is required for the procedure to calculate leakage emissions for the combustion of RDF/SB outside the project boundary</td></tr>
</table>

Data / Parameter:	$NCV_{RDF\_SB,y}$
Data unit:	GJ/mass or volume units
Description:	Weighted average net calorific value of RDF/SB in year y
Source of data:	Measurements by the project participants
Measurement procedures (if any):	Measurement is not required for RDF/SB produced wholly from biomass residues, otherwise measurements shall be undertaken in line with national or international fuel standards
Monitoring frequency:	The NCV shall be obtained for each shipment of RDF/SB exported from the project site for which there is documented evidence that it will be combusted, from which weighted average annual values shall be calculated
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 / Parameter:	$F_{PJ,AD,m}$
Data unit:	m^3
Description:	Quantity of wastewater or sludge that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (m^3)
Source of data:	Measured
Measurement procedures (if any):	-

Monitoring frequency:	Parameter monitored continuously but aggregated monthly and annually for calculations
QA/QC procedures:	-
Any comment:	In case of Scenario 1, if the solid materials are also treated in the baseline and project scenario, the $F_{PJ,dig,m}$ does not account the amount of solid materials treated or separated from the wastewater stream in the anaerobic digester, if applicable

Data / Parameter:	$COD_{AD,m}$
Data unit:	t COD/m³
Description:	Chemical oxygen demand in the wastewater or sludge that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month *m*
Source of data:	Measurements
Measurement procedures (if any):	Measure the COD according to national or international standards. If COD is measured more than once per month, the average value of the measurements should be used
Monitoring frequency:	Regularly, calculate average monthly and annual values
QA/QC procedures:	-
Any comment:	In case of Scenario 1, if the solid materials are also treated in the baseline and project scenario, the $w_{COD,dig,m}$ is not calculated for the solid materials treated or separated from the wastewaterstream in the anaerobic digester, if applicable

Data / Parameter:	$T_{2,m}$
Data unit:	K
Description:	Average temperature at the project site in month *m*
Source of data:	Measurement in the project site, or national or regional weather statistics
Measurement procedures (if any):	In case that project participants decide to measure temperaturein the project site: The temperature sensor must be housed in a ventilatedradiation shield to protect the sensor from thermal radiation
Monitoring frequency:	Continuously, aggregated in monthly average values
QA/QC procedures:	In case that project participants decide to measure temperaturein the project site: Uncertainty of the measurements provided by temperaturesensor supplier should be discounted from the readings
Any comment:	-

Data / Parameter:	$EF_{grid,,y}$
Data unit:	t CO_2e/kWh
Description:	CO_2 emission factor of the grid electricity in year *y*
Source of data	-
Measurement procedures (if any):	As per the requirements in “Tool to calculate the emission factor for an electricity system”

Monitoring frequency:	-
Any comment:	-

Data / Parameter:	***$EG_{PJ,facility,y}$***
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Source of data	Electricity meter(s)
Measurement procedures (if any):	This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid. In case it is calculated then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit to the grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	-

Data / Parameter:	***$EG_{PJ,add,y}$***
Data unit:	MWh
Description:	Quantity of net electricity generation supplied to the grid in year y by the project plant/unit that has been added under the project activity
Source of data	Electricity meter(s)
Measurement procedures (if any):	If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts). This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid. In case it is calculated then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit to the grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	Applicable to wind, solar, wave, tidal or biomass power plants/units.

Data / Parameter:	**-**
Data unit:	Tonne
Description:	Quantity of biomass consumed in year *y*
Source of data	Project activity site

Measurement procedures (if any):	Use mass or volume based measurements. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity of biomass shall be measured continuously or in batches. If more than one type of biomass fuel is consumed, each shall be monitored separately. Cross-check: Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g. with sales/receipts) and stock changes. Check the consistency of measurements ex post with annual data on energy generation, fossil fuels and biomass used and the efficiency of energy generation as determined ex ante
Monitoring frequency:	Continuously and estimate using annual energy/mass balance
Any comment:	-

c	**-**
Data unit:	%
Description:	Moisture content of the biomass (wet basis)
Source of data	Project activity site
Measurement procedures (if any):	On-site measurements. Ex ante estimates should be provided in the PDD and used during the crediting period. In case of dry biomass, monitoring of this parameter is not necessary
Monitoring frequency:	The moisture content of biomass of homogeneous quality shall be determined ex ante. The weighted average should be calculated and used in the calculations
Any comment:	-

Data / Parameter:	**-**
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of biomass type *k*
Source of data	Project activity site
Measurement procedures (if any):	Measurement in laboratories according to relevant national/international standards. Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period. Measure the NCV based on dry biomass. Check the consistency of the measurements by comparing the measurement results with relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements
Monitoring frequency:	Determine once in the first year of the crediting period
Any comment:	-

Data / Parameter:	$\sigma_{historical}$

Data unit:	MWh
Description:	Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data	Calculated from data used to establish $EG_{historical}$
Measurement procedures (if any):	Calculated from data used to establish $EG_{historical}$ Parameter to be calculated as the standard deviation of the annual generation data used to calculate $EG_{historical}$ for retrofit or replacement project activities
Monitoring frequency:	-
Any comment:	-