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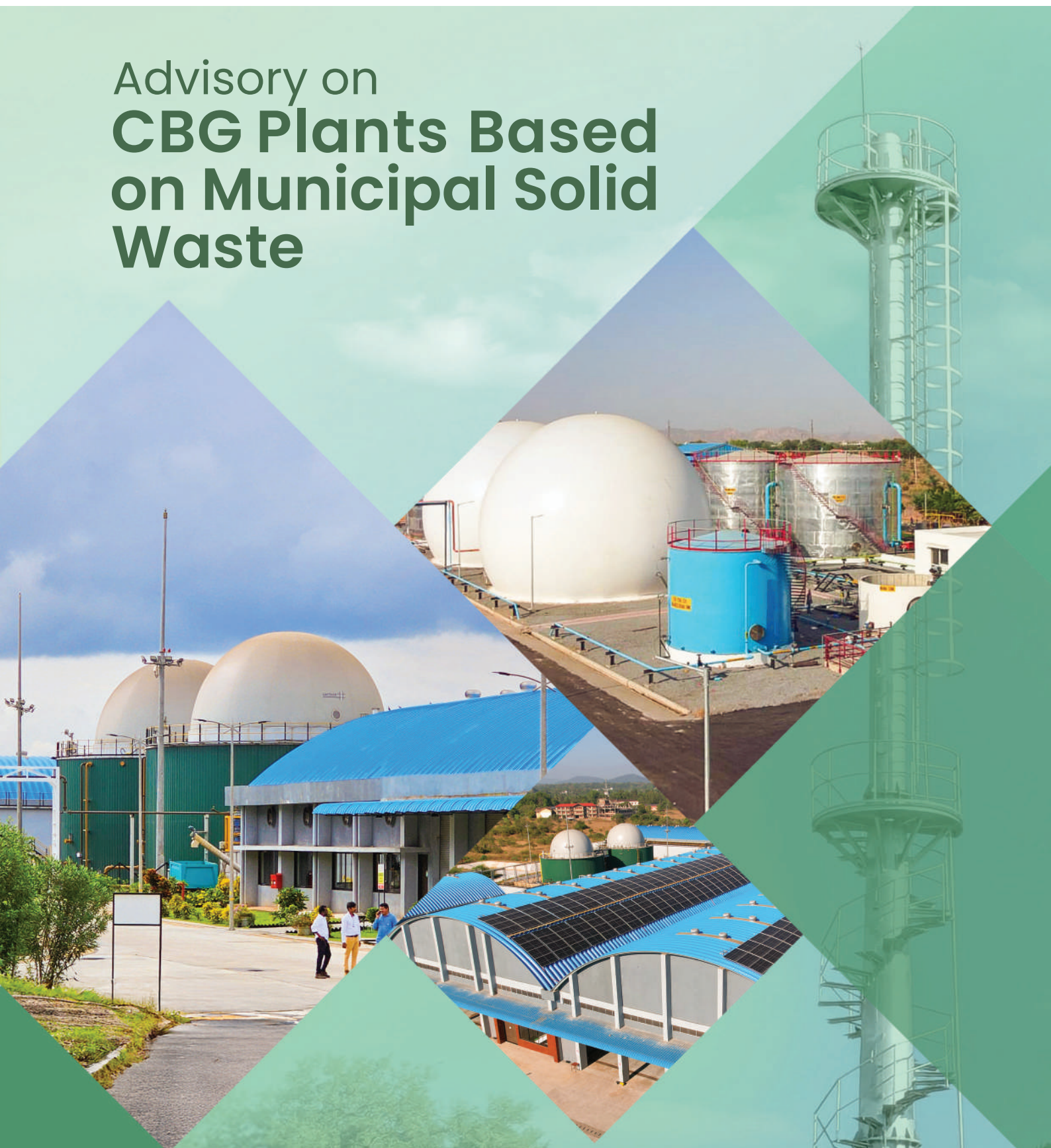


Ministry of Housing  
and Urban Affairs  
Government of India



on the basis of a decision  
by the German Bundestag

# Advisory on CBG Plants Based on Municipal Solid Waste



Ministry of Housing and Urban Affairs, Government of India  
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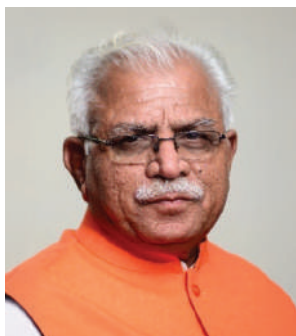
July 2025



“शहर के कचरे और पशुधन से गोबरधन,  
फिर गोबरधन से स्वच्छ ईंधन, फिर स्वच्छ ईंधन से  
ऊर्जा धन, यह शृंखला जीवन धन का निर्माण करती है।”

– Hon'ble Prime Minister at the inauguration  
of Indore CBG Plant in February 2022

श्री मनोहर लाल  
Sh. Manohar Lal



आवासन और शहरी कार्य  
एवं ऊर्जा मंत्री  
भारत सरकार

Minister of Housing & Urban  
Affairs, and Power  
Government of India

## MESSAGE

India is at the forefront of sustainable urban transformation driven by commitment to environmental responsibility and circular economy principles. India generates approximately 1,60,000 metric tonnes (MT) of municipal solid waste (MSW) daily, of which nearly 80% is now being processed, a significant leap from just 18% in 2014 – an outcome under the Swachh Bharat Mission (SBM-U).

While a significant portion of wet waste is being processed through composting, biomethanation presents a more efficient, scalable, and cost-effective alternative by converting organic waste into clean energy (Compressed Biogas) and nutrient-rich organic manure.

India has pledged to reduce emission intensity of its economy by 45% from 2005 levels by 2030 under its Nationally Determined Contribution (NDC). In this context, biomethanation emerges as a game-changer in India's journey toward emission intensity reduction, sustainable urban waste management, offering a scientifically proven, financially viable, and environmentally responsible solution.

The Global Biofuels Alliance (GBA) launched by India in 2023 during its G20 Presidency aims to accelerate the adoption of biofuels worldwide. The Ethanol Blending Roadmap of India (30% by 2030) along with the GOBARDHAN (Galvanizing Organic Bio-Agro Resources Dhan) programme are pillars of the country's biofuels strategy. This Advisory is a comprehensive knowledge product for Urban Local Bodies (ULBs), policymakers, and industry stakeholders, providing technical, financial, and operational guidance to implement biomethanation projects.

Under Swachh Bharat Mission 2.0, the focus is on promoting scientific waste management with high priority on waste to CBG projects. Additionally, initiatives like SATAT (Sustainable Alternative Towards Affordable Transportation) and the National Bio-Energy Policy provide strategic incentives to expand CBG production.

I encourage all stakeholders—municipal bodies, technology providers, private entrepreneurs, and research institutions to leverage this advisory to accelerate Waste to CBG adoption across India. Together, we can drive the country toward a future where waste is not a burden but a valuable resource, ensuring cleaner cities, energy security, and a healthier environment for future generations.

New Delhi, July 2025

मनोहर लाल  
(Manohar Lal)

श्री तोखन साहू  
Sh. Tokhan Sahu



राज्य मंत्री, आवास एवं  
शहरी कार्य मंत्रालय  
भारत सरकार  
Minister of State, Ministry  
of Housing & Urban Affairs  
Government of India

## MESSAGE

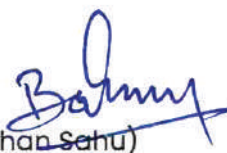
Under the Swachh Bharat Mission (SBM) 2.0, the Ministry of Housing & Urban Affairs (MoHUA) has launched an ambitious national programme to ensure the scientific processing of all municipal solid waste (MSW) generated across the country. Biomethanation has emerged as an efficient and sustainable technology for treating the biodegradable fraction of MSW while generating revenue through the sale of Compressed Biogas (CBG) and Fermented Organic Manure (FOM).

CBG is a purified form of biogas with a composition and energy potential comparable to fossil fuel-based natural gas. It is produced from agricultural residues, animal dung, food waste, and MSW. In a significant policy move, the Government of India has mandated blending CBG into Compressed Natural Gas (CNG) for transport and Piped Natural Gas (PNG) for domestic and industrial use. The CBG Blending Obligation (CBO) is expected to drive investment and facilitate the establishment of 750 CBG projects by 2028-29.

This advisory is being published at a crucial moment, addressing the national imperative to accelerate the development of CBG projects. It serves as a comprehensive guide, introducing the CBG conversion process from MSW, covering its design and engineering aspects, and detailing the performance of existing operational plants. Developed with technical support from GIZ India and leading sector experts, this advisory will assist cities in systematically planning and implementing CBG projects.

I extend my best wishes on the release of this advisory and encourage city officials and other stakeholders to utilise it in advancing sustainable waste management solutions.

New Delhi, July 2025

  
(Tokhan Sahu)

श्री श्रीनिवास आर कटिकिथला  
Sh. Srinivas R Katikithala, IAS



सचिव, आवास एवं  
शहरी कार्य मंत्रालय  
भारत सरकार

Secretary, Ministry  
of Housing & Urban Affairs  
Government of India

## FOREWORD

The Ministry of Housing and Urban Affairs (MoHUA), Government of India, is implementing the Swachh Bharat Mission – Urban 2.0 with the objective of achieving Garbage-Free Cities. As part of its commitment to sustainable urban waste management, SBM has introduced multiple initiatives to promote advanced technology for converting the organic fraction of municipal solid waste (MSW) into compressed biogas (CBG).

Unprocessed and ill-processed organic waste is a major source of methane emissions, making its scientific treatment essential for environmental sustainability. Source segregation and conversion of organic waste into CBG offers multiple benefits, including energy recovery, enhanced soil health, promotion of a circular economy, and reduced dependence on imported fossil fuels.

The successful implementation of CBG projects in India is being achieved through a whole-of-government approach including measures by multiple Ministries, State Governments and ULBs. Source segregation by citizens and Bulk Waste Generators (BWGs) is the starting step in ensuring project efficiency. Government has introduced drivers such as assured offtake of CBG and Market Development Assistance (MDA) for Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (FOM) which ensure the viability of these projects. Several CBG plants in India, developed under the Public-Private Partnership (PPP) model, have provided valuable insights for future advancements. This advisory on setting up CBG plants using biodegradable municipal solid waste is based on learnings consolidated from a national study of CBG plants conducted by GIZ India, with a specific focus on MSW's organic fraction as the primary feedstock.

It is designed to support State Governments, Urban Local Bodies (ULBs), private sector entrepreneurs, and other key stakeholders in setting up CBG plants for producing high-quality biogas projects.

I hope this knowledge resource will serve as a valuable guide for urban administrators, many of whom continue to face challenges in implementing CBG projects and will enable them to fully realise the benefits of scientific management of organic waste.

New Delhi, July 2025

(Srinivas R Katikithala)

डॉ. जूली रिविएर  
Dr. Julie Reviere  
Country Director  
GIZ-India



## MESSAGE

Building on the long-standing partnership between our two countries, GIZ has worked with the Government of India for over six decades to promote sustainable economic, ecological, and social development.

Indo-German cooperation reflects our shared responsibility to protect the planet and foster inclusive growth that leaves no one behind. It is firmly grounded in global commitments such as the Paris Agreement and the Sustainable Development Goals (SDGs).

To advance these joint goals, both countries signed the Indo-German Green and Sustainable Development Partnership (GSDP) in May 2022. Circular Economy and Waste Management are among the key priorities under this partnership, making the topic of Compressed Biogas (CBG) particularly relevant to our shared agenda.

This *Advisory on Compressed Biogas (CBG) Plants Based on Municipal Solid Waste*, developed in partnership with the Indian Ministry of Housing and Urban Affairs (MoHUA), serves as a comprehensive knowledge resource to support the rapid deployment of CBG projects across India.

This publication was jointly developed under the technical cooperation projects *Waste Solutions for a Circular Economy in India* and *Management of Organic Waste in India*, commissioned by the Federal Ministry for Economic Affairs and Energy (BMWE) and the European Union. It was co-created in close collaboration with experts from MoHUA and other stakeholders.

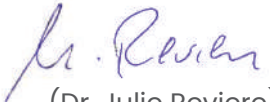
This document stands as a strong example of Indo-German cooperation in action and reflects both countries' continued commitment to the objectives of the Green and Sustainable Development Partnership.

Together, we set the foundation for scalable and sustainable waste-to-energy solutions that support India's circular economy ambitions and highlight the potential of meaningful international collaboration.

I hope this publication proves valuable to policy makers, practitioners, and all those engaged in shaping sustainable urban development.

I wish you an insightful and inspiring read.

New Delhi, July 2025

  
(Dr. Julie Reviere)

श्रीमती रुपा मिश्रा  
Smt. Roopa Mishra, IAS



संयुक्त सचिव, आवास एवं  
शहरी कार्य मंत्रालय  
भारत सरकार

Joint Secretary, Ministry  
of Housing & Urban Affairs  
Government of India

## PREFACE

India is at a critical juncture in its journey toward sustainable urban development and environmental stewardship. The organic fraction of the 160,000 TPD of Municipal Solid Waste (MSW) generated in India offers an opportunity to generate around 1.75 million tonnes of CBG by 2030, 3.5 million tonnes by 2035, and 8.5 million tonnes by 2050. However, to achieve this potential there is a need for collective and consistent efforts from all stakeholders.

While there are several national policies and programmes like GOBARDhan, SATAT, SBM, providing capital subsidies, support in access to land, offtake of products, etc. there is a need for more focused support at state level. States including Andhra Pradesh, Bihar, Gujarat, Haryana, Madhya Pradesh and Uttar Pradesh have launched state level bio-energy policies. Introduction of more such state level policies can be instrumental in accelerating adoption of CBG.

Further, there is a need for creating awareness and building capacities at the ULB level so that adequate support can be provided for CBG project implementation. ULBs have a key role to play in terms of ensuring source segregation of waste, providing land for setting up of CBG projects, mobilising waste from Bulk Waste Generators (BWGs) and alternative sources, establishing collection and transport systems and supporting in offtake arrangements.

The success of this endeavour depends on convergence of policy, technology, financing, and public participation. Urban Local Bodies must take the lead in ensuring source segregation and creating an enabling ecosystem, while the private sector must step in with innovation, investment, and awareness building.

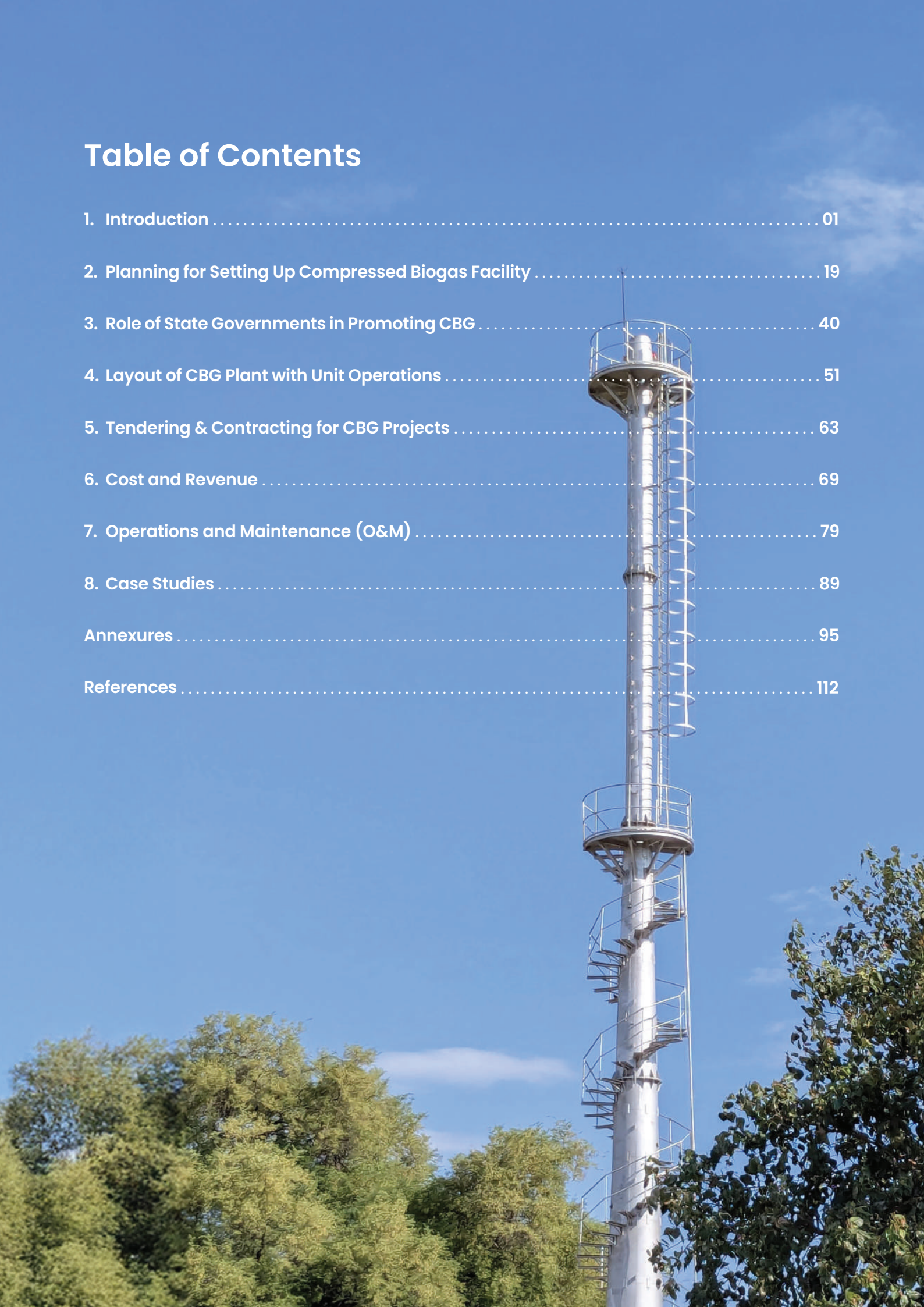
To support stakeholders in accessing key information related to planning and implementation of CBG projects, this advisory has been prepared as a joint initiative by MoHUA and GIZ. I would like to congratulate the teams from MoHUA, GIZ and private sector stakeholders involved in development of this advisory. I am confident that this advisory will help develop state and city level roadmaps to achieve the CBG potential leading to a clean, circular, and energy-secure future for our country.

New Delhi, July 2025

  
(Roopa Mishra)

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# 01 Introduction



The world generates around 2 billion tonnes of Municipal Solid Waste (MSW) which is expected to increase to 3.40 billion tonnes by 2050. Around 50% of the waste fractions are organic in nature. In case the organic fraction of waste is dumped in landfills, it leads to harmful greenhouse gas (GHG) emissions and can contribute to local air, water and soil pollution. An estimated 1.6 billion tonnes of carbon dioxide equivalent (CO<sub>2</sub>eq) greenhouse gas emissions were generated from solid waste management in 2016. This is about 5% of global emissions. Without improvements in the sector, solid waste related emissions are anticipated to increase to 2.6 billion tonnes of CO<sub>2</sub>eq by 2050.<sup>1</sup>

The Compressed Biogas (CBG) production from the organic fraction of MSW is rapidly gaining global recognition as a sustainable waste management and climate change mitigation solution. Thermal combustion technologies based waste to energy projects have limitations in terms of processing organic fraction of MSW due to low calorific value and high moisture content. Further combustion technologies are also being discouraged as it reduces incentives to decrease waste generation and move towards a zero-waste and low-carbon society.<sup>2</sup>

According to the Global Bioenergy Statistics 2024<sup>3</sup>, released by the World Biogas Association, 40 billion cubic metres of biogas were produced globally. The total potential is 1 trillion cubic metres per year, which is equivalent to 25% of the natural gas consumption.<sup>4</sup> Therefore, countries worldwide are adopting biomethanation as a key strategy in their energy transition and waste management frameworks. In line with these global trends, the Government of India has undertaken significant efforts to promote CBG through enabling policies, blending mandates, financial support, and flagship programmes, such as GOBARdhan and SATAT. CBG holds immense potential not only for enhancing energy security and reducing greenhouse gas emissions but also for addressing the challenges of urban solid waste management. Within the Indian context, CBG offers a practical and scalable solution for treating the organic fraction of Municipal Solid Waste (MSW), directly supporting the goals of Swachh Bharat Mission Urban 2.0 (SBM-U 2.0), which mandates 100% source segregation and scientific processing of waste by 2026. In this backdrop, a need was felt—based on extensive inputs from cities, states, and sector experts—for a concise and focused advisory document on biomethanation and CBG production.

This advisory aims to provide structured technical, operational, and financial guidance to Urban Local Bodies (ULBs), elected representatives, and private sector stakeholders involved in planning, implementing, and managing biomethanation facilities. It outlines key considerations for decision-making, offers clarity on capital and operational expenditures, and assessment of long-term sustainability. To aid practical understanding, the advisory also presents case studies from across India, highlighting successful models with proven technical and financial viability. As CBG represents a convergence point for India's ambitions in clean energy, waste valorisation, rural livelihood generation, and climate resilience, this advisory serves as a strategic tool to help scale CBG initiatives across the country in a systematic and outcome-oriented manner.

<sup>1</sup> *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*, World Bank.

<sup>2</sup> *Global Waste Management Outlook 2024*, UNEP.

<sup>3</sup> *Global Bioenergy Statistics Report*, World Bioenergy Association.

<sup>4</sup> *Outlook for Biogas and Biomethane*, IEA.



# 1.1 What is Compressed Biogas (CBG)?

Compressed Biogas (CBG) is a renewable fuel derived from the purification and compression of biogas, which is generated through the anaerobic digestion of organic materials. These materials include agricultural residues, cattle dung, organic fraction of municipal solid waste (OFMSW), food waste, industrial sludge, and sewage treatment plant (STP) waste. The anaerobic digestion process involves the microbial breakdown of biodegradable matter in the absence of oxygen, resulting in a raw gas composed primarily of methane ( $\text{CH}_4$ ) and carbon dioxide ( $\text{CO}_2$ ). To be converted into CBG, the raw biogas undergoes an upgrading process in which impurities such as  $\text{CO}_2$ , hydrogen sulphide ( $\text{H}_2\text{S}$ ), ammonia, siloxanes, and water vapour are removed. The purified gas, which has a methane content exceeding 90%, is then compressed at high pressure (typically 220–250 bar) to form CBG. The final product has similar calorific value and combustion properties of Compressed Natural Gas (CNG), making it suitable for use as an automotive fuel and as a substitute for fossil-based natural gas in industrial and domestic applications.

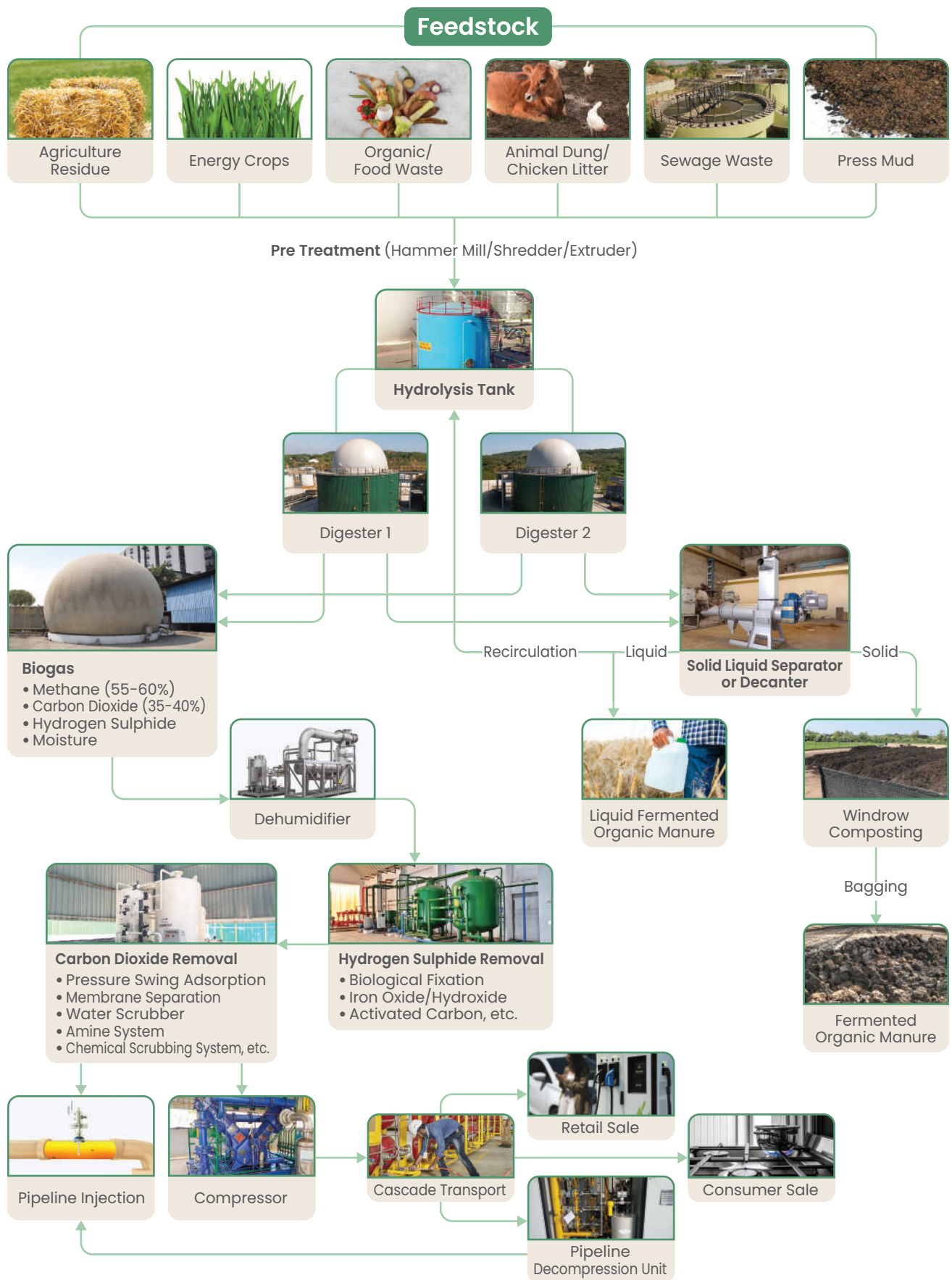
CBG is governed by the quality specifications laid down in IS 16087:2016, ensuring its suitability for safe use in engines and distribution systems. The process of CBG production also generates valuable by-products, such as Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (LFOM), which are nutrient-rich biofertilisers that help improve soil health and reduce dependency on chemical fertilisers. The composition of CBG and related gases is compared below:

## CBG contributes to:

- **GHG mitigation:** Captures methane from organic waste, reducing emissions.
- **Energy diversification:** Offers a decentralised, renewable fuel from local waste.
- **Waste valorisation:** Transforms agri-residue and MSW into energy and biofertiliser.
- **Air quality improvement:** Minimises emissions from stubble burning and dumping.
- **Rural–urban synergy:** Links waste management, agriculture, and energy sectors.

- **CBG supports** global commitments like the **Paris Agreement**.
- **CBG adheres to UN SDGs**, especially: SDG 7, SDG 11 and SDG 13.





**Figure–Flow chart of CBG Production from various feedstocks**

## 1.2 Global Perspective on Source Segregation of Municipal Solid Waste and Use of Organic Fraction of MSW for CBG Production

Source segregation of Municipal Solid Waste is mandatory in the European Union, Japan, South Korea and selected cities in the United States of America. In Germany, particularly, citizens are mandated to do four-way segregation.<sup>5</sup> The general segregation system followed in most German cities is given below in comparison to the Indian Waste Segregation mandate:

| Type of waste                            | Bins/bags colour | Germany                                                                            | Indian waste segregation system | India                                                                                |
|------------------------------------------|------------------|------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------------------------------|
| Paper & cardboard                        | Blue             |   | Blue-Dry waste                  |   |
| Packaging waste (plastic, metal, etc.)   | Yellow           |   | Blue-Dry waste                  |   |
| Residual waste (diapers, ceramics, etc.) | Black/Grey       |   | Red/Black-Domestic hazardous    |   |
| Organic waste                            | Brown/Green      |  | Green-Wet waste                 |  |

**Figure**–General Segregation System followed in Germany and India

Germany has banned landfilling of untreated organic waste; the ban was put in place in mid 2005. As per the Federal Statistical Office of Germany,<sup>6</sup> in 2020 around 13.65 million tonnes of biodegradable waste collected from households, commercial establishments and industries were treated in composting plants (54%) and biomethanation plants (46%). The Berlin City Cleaning company<sup>7</sup> or BSR (Berliner Stadtreinigung) processes more than 60% of organic waste from Berlin households annually in a biogas plant. The biogas produced is cleaned, processed, concentrated and fed into the city gas network as biomethane.

| Type of waste                            | Bins/bags colour | Italy                                                                               | Bins/bags colour                | Austria                                                                               |
|------------------------------------------|------------------|-------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------|
| Paper & cardboard                        | White/Blue       |  | Red                             |  |
| Packaging waste (plastic, metal, etc.)   | Yellow           |  | Yellow (plastic), Blue (metals) |  |
| Residual waste (diapers, ceramics, etc.) | Grey             |  | Black                           |  |
| Organic waste                            | Brown/Green      |  | Brown/Green                     |  |

**Figure**–General Segregation System followed in Italy and Austria

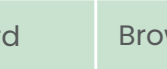
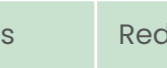
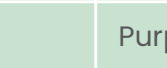
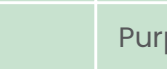
<sup>5</sup> Waste Management in Germany 2023, BMUV.

<sup>6</sup> Federal Statistical Office of Germany.

<sup>7</sup> Berliner Stadtreinigungsbetriebe.

The Italian government mandates source segregation of municipal waste into key streams, such as organic waste, paper, plastic and metal packaging, glass, and residual waste. While bin colours may vary by municipality, national legislation requires local authorities to ensure separate collection systems, with efforts underway to harmonise segregation practices across regions.

The Austrian government strictly enforces source segregation laws through federal and municipal regulations. Households are legally required to separate waste into fractions like paper, plastics, metals, glass, organic, and residual waste, typically using standardised colour-coded bins. Non-compliance can lead to penalties, supporting Austria's high recycling rates.

| Type of waste     | Bins/<br>bags colour | Denmark                                                                             | Type of waste  | Bins/<br>bags colour | Denmark                                                                              |
|-------------------|----------------------|-------------------------------------------------------------------------------------|----------------|----------------------|--------------------------------------------------------------------------------------|
| Paper & cardboard | Light Blue           |    | Cardboard      | Brown                |    |
| Beverage carton   | Yellow               |    | Hazardous      | Red                  |    |
| Metal             | Grey                 |    | Residual waste | Black                |    |
| Organic waste     | Green                |   | Textile        | Purple/Red           |   |
| Glass             | Blue                 |  | Plastic        | Purple/Pink          |  |

**Figure**–General Segregation System followed in Denmark

Denmark has mandated 10-way waste segregation across all municipalities since July 2021. To promote harmonisation, Denmark (along with other Nordic countries) uses standardised colour-coded pictograms for bins and bags. These are part of the Nordic Pictogram System developed by the Nordic Council of Ministers.

Currently, around 3.5 MT (million tonnes of oil equivalent) of biomethane is produced worldwide. Most of the production lies in European and North American markets, with some countries such as Denmark and Sweden boasting more than 10% share of biogas/biomethane in total gas sales. Countries outside Europe and North America are catching up quickly, with the number of upgrading facilities in Brazil, China, and India tripling since 2015.

In 2024, the Ministry of Environment, South Korea, announced a strategy to activate biogas production and use it to achieve national carbon neutrality, focusing on organic waste resources such as livestock manure and food and beverage waste.<sup>8</sup> South Korea plans to produce a maximum of 500 million Nm<sup>3</sup>/year of biogas and process 5.57 million tonnes/year of organic waste by 2026. Currently, more than 100 biogas facilities are operating nationwide, producing around 370 million Nm<sup>3</sup>/year of biogas.<sup>9</sup>

<sup>8</sup> *Envilience Asia.*

<sup>9</sup> *Asian Development on the Horizon, Biogas Community.*



Japan is also actively promoting biogas. The Ministry of Environment oversees the circular-biomass strategies. In 2022, Ministry of Environment, Japan, launched the Basic Plan for the Promotion of Biomass Utilisation, committing to utilising about 80% of domestically produced biomass (including food and municipal waste) by 2030. There are ~100 biogas generation projects in Japan.<sup>10</sup>

A report by the International Energy Agency estimates that nearly 600 Mtoe of biogas could be produced sustainably from currently available resources.<sup>11</sup> Developing economies currently account for two-thirds of the global potential, with developing countries in Asia holding around 30%, and Central and South America another 20%.

## Global Technological Advancements

The Continuous Stirred Tank Reactor (CSTR) technology has been widely used for the conversion of organic feed into biogas worldwide. However, Dry Anaerobic Digestion (Dry AD) is getting more attention across several countries as a sustainable solution for managing organic waste, especially municipal solid waste (MSW) and the organic fraction of municipal solid waste (OFMSW) due to its high yield of biogas and lower production of LFOM, which remains a challenge to evacuate in urban areas. Countries like the USA, Germany, Italy, and Austria have taken the lead by setting standards for input material quality and pathogen reduction, ensuring safe and efficient processing of municipal bio-waste. Italy and Austria have integrated dry AD into their regional waste-to-energy strategies, deploying the technology widely to treat OFMSW as part of broader circular economy goals.

Amongst the widely adopted Dry AD technologies in Europe is the horizontal plug flow digester, a proven method especially suited for high-solids organic waste streams. Another Dry AD method which is becoming popular in Europe is Dry-Fermentation AD (tunnel based, batch operated) technology, which offers significant advantages over conventional wet digestion technologies. These include reduced water and energy consumption, lower lifecycle costs due to minimal mechanical components, and higher process stability across diverse feedstock types. The technology is inherently more tolerant of impurities and operational shocks, making it suitable for Indian MSW where waste characterisation can vary widely.

In view of advancements of technology happening across the globe to improve biogas yield from OFMSW, India should also explore Dry AD over the conventional CSTR, which will generate lower liquid FOM and higher yield, leading to a sustainable economic model. The details of both the technologies are discussed in detail in Chapter 2.

<sup>10</sup> *Annual Report on Energy for FY4 of Reiwa, Agency for Natural Resources and Energy.*

<sup>11</sup> *Sustainable supply potential and costs, IEA.*

## 1.3 India's Biofuel vision and Strategic Initiatives

India's Biofuel vision is aimed at promoting the production of biofuels from multiple feedstocks, leading to reduction in the import of petroleum products. This will give an impetus to the Prime Minister's vision of India becoming 'energy independent' by 2047. With a vast feedstock potential, a strong policy push, and increasing private sector participation, India envisions becoming a global hub for biofuel production and innovation.

The Global Biofuels Alliance (GBA), launched by India in 2023 during its G20 Presidency, underscores India's leadership in the global clean energy dialogue and provides momentum to its national biofuels programme. This multilateral platform, led by India, the United States, and Brazil, aims to accelerate the adoption of biofuels worldwide through collaboration, technology sharing, and harmonisation of standards.

India's National Bio-Energy Programme, Ethanol Blending Roadmap (20% by 2025-26), the GOBARDhan (Galvanizing Organic Bio-Agro Resources Dhan) programme, and the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative form the pillars of the country's biofuels strategy. Among the biofuel options, CBG has gained prominence as a renewable fuel that aligns environmental goals with economic and energy security objectives.

### I. National Policy on Biofuels (2018, amended 2022)

The National Policy on Biofuels serves as the overarching strategy for the development and adoption of bio-based energy in India. The policy distinguishes between Basic Biofuels—such as 1G bioethanol and biodiesel—and Advanced Biofuels, which include 2G ethanol, drop-in fuels from MSW, algae-based 3G fuels, and Compressed Biogas (CBG). The 2022 amendment further broadens the scope of feedstocks eligible for CBG production and provides clear direction for scaling up CBG as a clean automotive and industrial fuel. The policy supports a blending target of up to 5% CBG in the piped natural gas (PNG) network, in addition to 20% ethanol in petrol, and 5% biodiesel in diesel by 2030. These targets position CBG as a key enabler of energy diversification and decarbonisation in India's fuel mix, especially given the country's abundant organic waste resources.

### II. Auto Fuel Vision and Policy 2022

This policy outlines India's strategy for transitioning to cleaner transportation fuels by reducing dependence on conventional fossil fuels. It encourages the adoption of alternative fuels, such as CNG, LPG, electricity, and hydrogen. CBG, due to its methane-rich composition and interchangeability with CNG, is recognised as a credible and environment-friendly substitute. The policy provides a framework for tax incentives, subsidies, and R&D promotion for low-emission vehicles and fuel supply systems. By incorporating CBG into the future fuel mix, it supports reduced tailpipe emissions, improved urban air quality, and resilience against global fossil fuel price volatility.

### III. Blending Mandate – CBG Blending Obligation (CBO)

To create a sustained demand for Compressed Biogas (CBG) and integrate it into mainstream fuel supply chains, the Government of India has introduced a phased blending mandate known as the CBG Blending Obligation (CBO). This mandate applies to City Gas Distribution (CGD) networks, covering both the transport (CNG) and domestic (PNG) segments. Under the policy, blending remains voluntary until FY 2024-25, after which it becomes mandatory, starting at 1% in FY 2025-26, increasing to 3% in 2026-27, 4% in 2027-28, and ultimately reaching 5% from FY 2028-29 onwards. This phased approach is designed to ensure a stable market for CBG producers, diversify fuel sources for CGD companies, and stimulate long-term private sector investment in biogas infrastructure while reducing the import of LNG.

#### Government of India Policy Initiatives

| CBG Blending Obligations (CBO), CBO will be voluntary till 2024-25      |                                                                          |                                                                |                                                                       |                                                       |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------|
| CBG Blending Obligations                                                |                                                                          |                                                                |                                                                       |                                                       |
| 2025-26<br>1%                                                           | 2026-27<br>3%                                                            | 2027-28<br>4%                                                  | 2028-29<br>5%                                                         |                                                       |
| Policy Initiatives (As on 01.07.2025)                                   |                                                                          |                                                                |                                                                       |                                                       |
| MNRE<br>Capital subsidies: up to INR 10 Cr for 12 TPD CBG Plant         | Dept. of Fertilizer<br>FOM Market Development Assistance: INR 1500/tonne | MoHUA SBM (U) 2.0<br>Grants of up to 25%-100% of project CapEX | MoP&NG<br>Development of Pipeline Infrastructure on CBG: Subsidy @50% | MoP&NG<br>Biomass Aggregation Machinery: Subsidy @50% |
| CBG included in priority sector lending by RBI                          |                                                                          |                                                                |                                                                       |                                                       |
| FOM & LFOM included in FCO                                              |                                                                          |                                                                |                                                                       |                                                       |
| CBG Plants conditionally under "White Category" for pollution clearance |                                                                          |                                                                |                                                                       |                                                       |



## 1.4 Government of India's Programmes on CBG

To reduce dependency on fossil fuel imports and to have a cleaner environment, the Government of India is promoting biogas through the following programmes in the true spirit of circularity:

- i. **Swachh Bharat Mission (Urban) 2.0:** Focuses on 100% source segregation, scientific processing of municipal solid waste, remediation of legacy dumpsites, and sustainable sanitation infrastructure.

**Financial Support:** ULBs may avail grants of up to 25%-50% of project CAPEX for SWM infrastructure depending on city size.<sup>12</sup> Additionally, VGF on PPP projects may be availed as part of central government support as per the DEA, Ministry of Finance.<sup>13</sup>

- ii. **Ministry of Petroleum and Natural Gas's (MoPNG) CBG-CGD synchronisation scheme 2021-ongoing:** Aligns CBG production with CGD networks, ensuring uniform pricing and streamlined distribution.<sup>14</sup> The direct pipeline infrastructure scheme:<sup>15</sup> Assists development of infrastructure for transporting CBG through pipelines to the City Gas Distribution networks and the Gas Pipeline Network.

**Financial Support:** For CGD Network: Up to 50 km, INR 0.075 Cr/km (MDPE) and INR 0.5 Cr/km (Steel) or 50% of project cost, whichever is lower. Between 50-75 km, per km rates are also defined. Maximum financial support up to INR 28.75. Additional information attached as Annexure 4.

For Gas Pipeline Network (Trunk Pipeline Network) [scheme under approval]: Up to 50 km, INR 0.075 Cr/km (MDPE) to INR 0.75 Cr/km (Steel) or 50% of project cost, whichever is lower. Between 50-75 km, per km rates are also proposed.

- iii. **Sustainable Alternative Towards Affordable Transportation (SATAT) 2018-ongoing:** Encourages the establishment of 5,000 CBG plants. The initiative promotes entrepreneurship and creates market linkages for CBG with Oil and Gas Marketing Companies (OGMCs), guaranteeing the offtake of CBG to be produced.

**Financial Support:** Guaranteed CBG purchase agreements with PSU oil companies (e.g., IOCL), including a 15-year commercial agreement. Pricing at INR 72/kg + Compression charge (INR 8/kg) in case of cascades or (INR 2/kg) in case of pipeline injection (applicable from 01.06.2025 to 31.10.2025).

<sup>12</sup> Swachh Bharat Mission (Urban) 2.0.

<sup>13</sup> Viability Gap Funding Scheme, Department of Economic Affairs.

<sup>14</sup> Synchronisation Scheme, GAIL.

<sup>15</sup> Direct Pipeline Infrastructure.



- iv. **GOBARDhan Scheme (Galvanizing Organic Bio-Agro Resources Dhan) 2018-ongoing:** Focuses on converting cattle dung and agricultural residues into biogas and CBG. A unified portal connects stakeholders with resources and market opportunities.<sup>16</sup>

**Financial Support:** For rural, provides CAPEX assistance up to INR 50 lakh for community and cluster-based plants and viability gap funding under convergence with MNRE or SBM (U) 2.0.

- v. **Waste to Energy Programme of MNRE for FY 2021-22 to 2025-26:** Supports waste-to-energy projects that produce biogas, CBG, or power.

**Financial Support:** CFA of Bio-CNG/Enriched Biogas/Compressed Biogas (CBG). For new plants: INR 4.0 crore per 4,800 kg/day capacity, and for existing plants: INR 3.0 crore per 4,800 kg/day (capped at INR 10 crore per project).<sup>17</sup> Additional information attached as Annexure 5.

- vi. **Market Development Assistance (MDA) for Organic Fertilisers for FY 2023-24 to 2025-26:** Provides financial assistance of up to INR 1500 per tonne for organic fertilisers derived from biogas slurry.<sup>18</sup> Additional information attached as Annexure 7.

## Other Enablers

- i. **Ministry of Road Transport and Highways' (MoRTH) notification on CNG-CBG equivalence in automobile fuel under section 3 (A):** This allows CBG as an approved fuel for motor vehicles, provided it meets BIS standards. This aligns CBG with conventional CNG for automotive use.<sup>19</sup>

- ii. **Priority Sector for lending by the RBI and the Banks:** Enables easier access to loans up to INR 100 crore for renewable energy projects, including CBG plants.<sup>20</sup>

- iii. **Other enablers such as carbon financing at item 5 under (I) GHG mitigation activities:** Recognises compressed biogas under international carbon credit trading mechanisms, enabling projects to participate in carbon markets.<sup>21</sup>

**Financial Support:** Projects can monetise emission reductions through the sale of carbon credits under Article 6.2 and voluntary carbon markets, creating performance-based revenue to offset OPEX.

<sup>16</sup> GOBARDhan, Department of Drinking Water and Sanitation.

<sup>17</sup> Waste to Energy Programme, Ministry of New and Renewable Energy.

<sup>18</sup> Policy on Promotion of Organic Fertilisers, Government of India.

<sup>19</sup> Ministry of Roads and Transport Notification, Government of India.

<sup>20</sup> Master Directions – Priority Sector Lending (PSL) – Targets and Classification, Reserve Bank of India.

<sup>21</sup> Office Memorandum, Ministry of Environment, Forest and Climate Change.

## 1.5 India's Strategic Push Towards CBG – “GOBARDhan” & “SATAT” Initiative

The **Galvanizing Organic Bio-Agro Resources Dhan (GOBARDhan)** initiative, launched by the Government of India in 2018, is an integrated “waste to wealth” initiative of the Government of India. The scheme encourages convergence with other government programmes like SATAT, unlocking both technical assistance and financial support, including viability gap funding and capital subsidies. It aims to convert cattle dung, agricultural residue, kitchen waste, and organic biomass into biogas, CBG, and organic manure.<sup>22</sup>

A unified GOBARDhan portal was launched to integrate data, streamline stakeholder coordination, track progress, and enable entrepreneurs to access information on land availability, scheme incentives, feedstock, and bankable models.

The Sustainable Alternative Towards Affordable Transportation (SATAT) initiative, launched by the Government of India in 2018, represents a pivotal move in the country's shift towards clean, affordable, and domestically sourced transport fuels. SATAT aims to promote the production and use of Compressed Biogas (CBG) as a green alternative to fossil fuels, especially in the automotive sector. The initiative targets the establishment of 5,000 CBG plants nationwide, with an annual production goal of 15 million metric tonnes (MMT) of CBG.

In addition, these plants are expected to generate 50 MMTPA of organic manure, contributing to the circular economy through the productive use of co-products. At full scale, SATAT has the potential to mitigate around 50 MMT of CO<sub>2</sub> emissions annually, reduce LNG import dependence by saving approximately USD 9 billion per year, and produce 30 MMTPA of biogenic CO<sub>2</sub>, which can be utilised for e-fuels or in the beverage and industrial sectors.

The initiative also allows CBG producers to participate in carbon markets, both through India's Carbon Credit Trading Scheme (CCTS) and under international mechanisms, such as Article 6.2 of the Paris Agreement. Economically, SATAT is expected to drive USD 60 billion in investment for plant setup and another USD 5 billion for gas distribution infrastructure, while creating nearly 200,000 direct jobs and supporting millions of indirect employment opportunities.

At scale, GOBARDhan can significantly reduce methane emissions from unmanaged organic waste and livestock dung, which are major contributors to India's greenhouse gas profile. It helps mitigate health risks associated with open defecation, untreated animal waste, and biomass burning. By enabling clean energy generation from bio-waste, the initiative directly contributes to India's Nationally Determined Contributions (NDCs) under the Paris Agreement and aligns with SDGs 6, 7, 11, 12, and 13.

<sup>22</sup> GOBARDhan, Department of Drinking Water and Sanitation.



## Biogas potential of various feedstocks in India

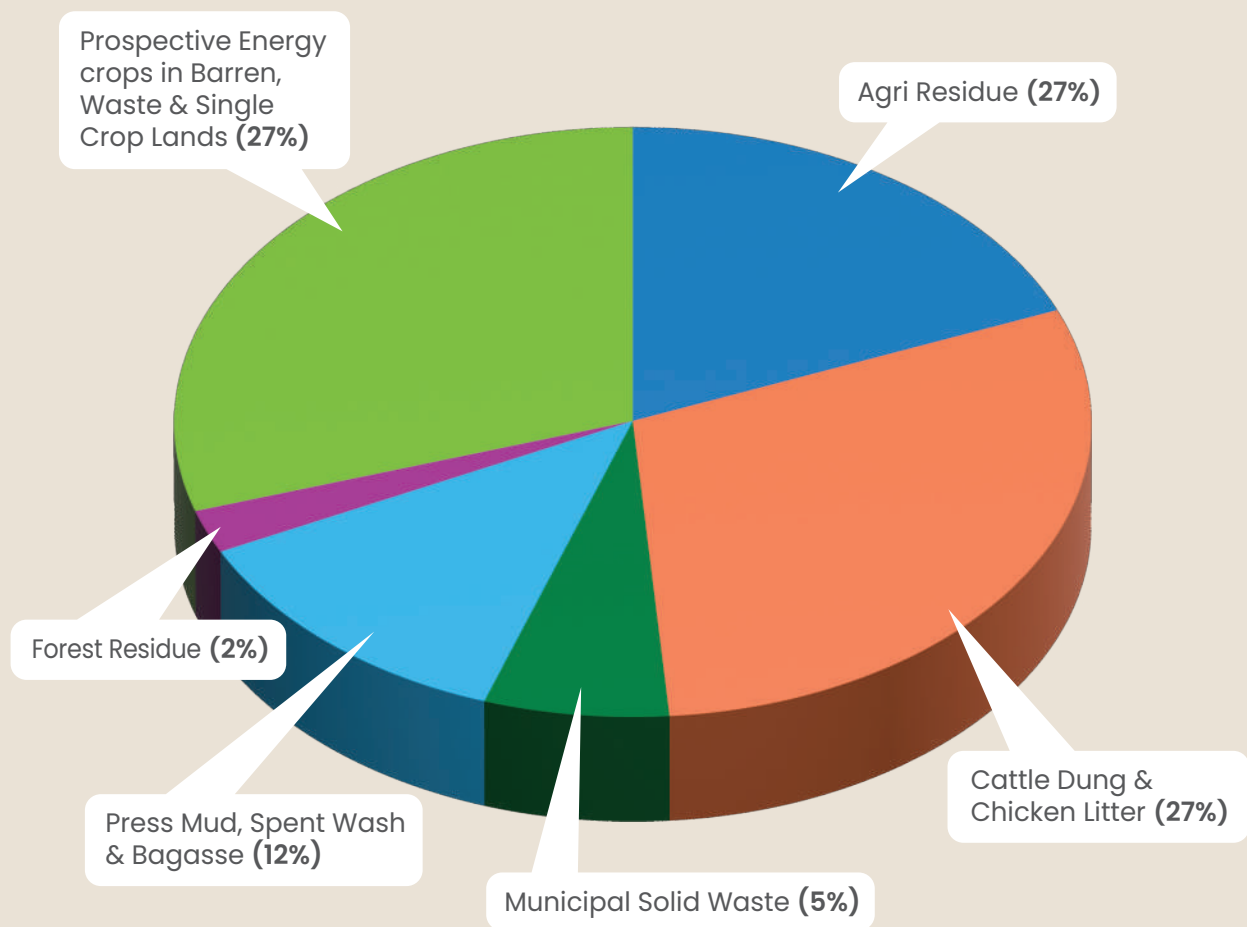
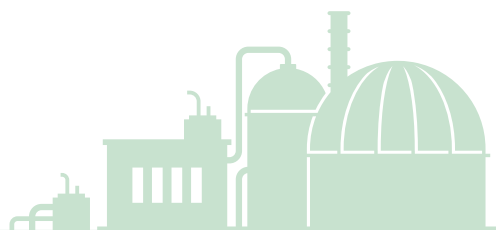


Figure-Biogas potential of various feedstocks in India (Derived from the SATAT programme)



## 1.6 Integrating CBG in City Waste Systems – An SBM 2.0 Mandate

The Government of India has made solid waste management a national priority through initiatives like the Swachh Bharat Mission Urban (SBM-U) and its second phase, SBM (U) 2.0, launched in 2021 with a vision for all Indian cities to become “Garbage Free” by 2026.

A core strategy under SBM-U 2.0 is to promote scientific and sustainable management of biodegradable waste, and CBG production through biomethanation plays a central role in achieving this. With a mandate for 100% source segregation and processing of wet waste in all Urban Local Bodies (ULBs), the mission encourages cities to develop City Solid Waste Action Plans (CSWAPs) that include setting up CBG plants to handle food waste and other organic fractions from households, commercial establishments, and bulk generators.

CBG aligns with and advances the following key national mandates and policies:

- **Swachh Bharat Mission (Urban) 2.0** officially endorses biomethanation as a scalable technology, especially for cities with population over 3 lakh.
- **Solid Waste Management (SWM) Rules 2016 and Draft 2024** mandate scientific management of source segregated organic fraction of MSW and promote biomethanation or composting.
- **Public-Private Partnership (PPP) models** are being actively explored for CBG infrastructure development, supported by viability gap funding, grants, and demand assurance mechanisms.

By integrating **CBG generation into city-level waste systems**, India is not only addressing its growing waste crisis but also generating clean energy, reducing landfill dependency, creating green jobs, and building climate-resilient urban infrastructure.

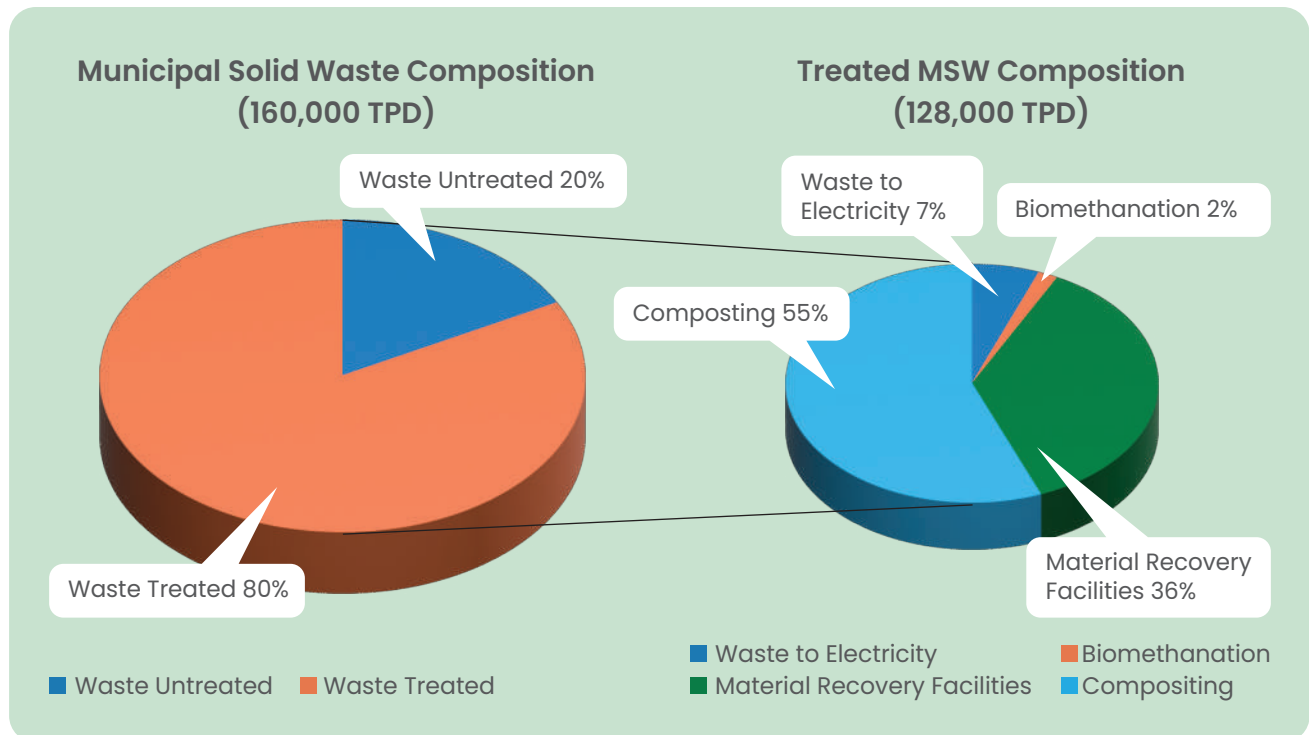
## 1.7 MSW Generation in India

India generates ~58 million tonnes of MSW every year, which translates to 200–550 grams per person per day. The waste generation is higher in larger cities and lower in smaller cities as follows:

| S. No. | ULB Population Class | Typical Per Capita Waste Generation (in grams) |
|--------|----------------------|------------------------------------------------|
| 1.     | >10 lakh             | 550                                            |
| 2.     | 1 to 10 lakh         | 450                                            |
| 3.     | <1 lakh              | 300                                            |

**Figure–**Capita Waste Generation by ULB Population Class

As a result of the continued efforts under the SBM, notable progress has been made towards scientific management of Solid Waste. Out of the total generated MSW of 160,000 tonnes per day, around 80% is being treated. MSW designed processing capacity stood at a reported 205,000 TPD (~130% of estimated waste generation, i.e., ~150,000 TPD).<sup>23</sup> Of this, ~112,000 TPD (55%) was in the form of composting. Other approaches, namely, Biomethanation (3500 TPD), Waste to Electricity (14,200 TPD), and Material Recovery Facilities (75,000 TPD) accounted for the remaining 45% share. The operational efficiency of these plants is in the range of 50%–60%, i.e., 100,000 to 120,000 TPD.



**Figure–Municipal Solid Waste Treatment and Composition in India (As per Swachhatam Portal, MoHUA)**

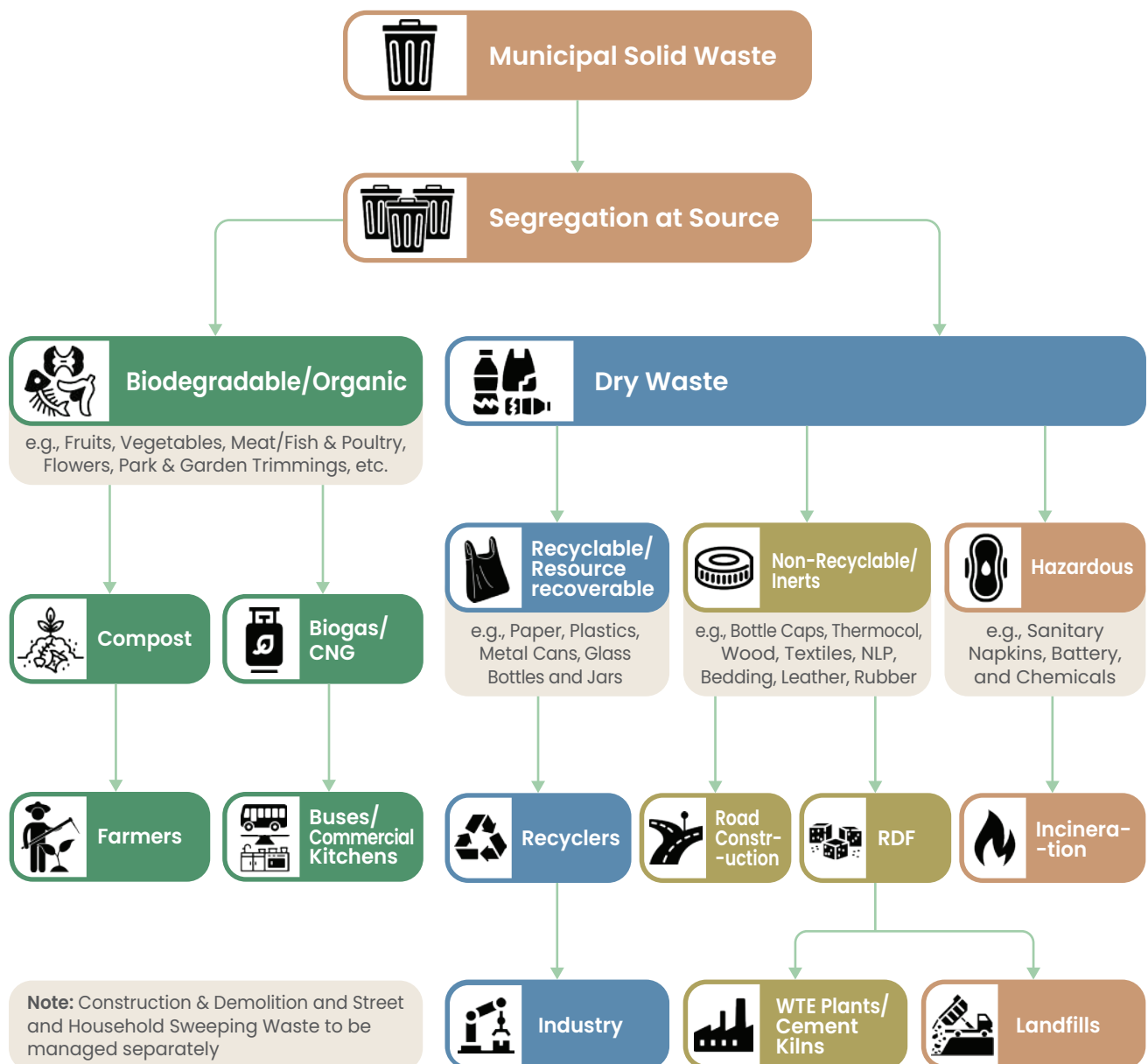
The Manual on Solid Waste Management 2016 by CPHEEO highlights biomethanation as a scalable technology for MSW processing. It recommends industrial-scale operations with real-time monitoring to ensure compliance and efficiency. Biomethanation also enables the utilisation of agricultural residues and sewage sludge, along with the source segregated MSW, creating additional revenue streams while addressing broader environmental concerns.

In this context and in the prevailing market situation, the alternative process of generating biogas from the source segregated organic fraction of MSW processing through digestion presents a better alternative to composting. The anaerobic digestion of wet/organic waste, called biomethanation, has several advantages over conventional composting, including higher additional revenue from the sale of biogas, lesser land requirement, and reduced timeframe for waste processing. Therefore, SBM-U is focusing on promoting biomethanation as a technology for the treatment of the source segregated organic fraction of MSW.

<sup>23</sup> Swachhatam Portal, MoHUA.

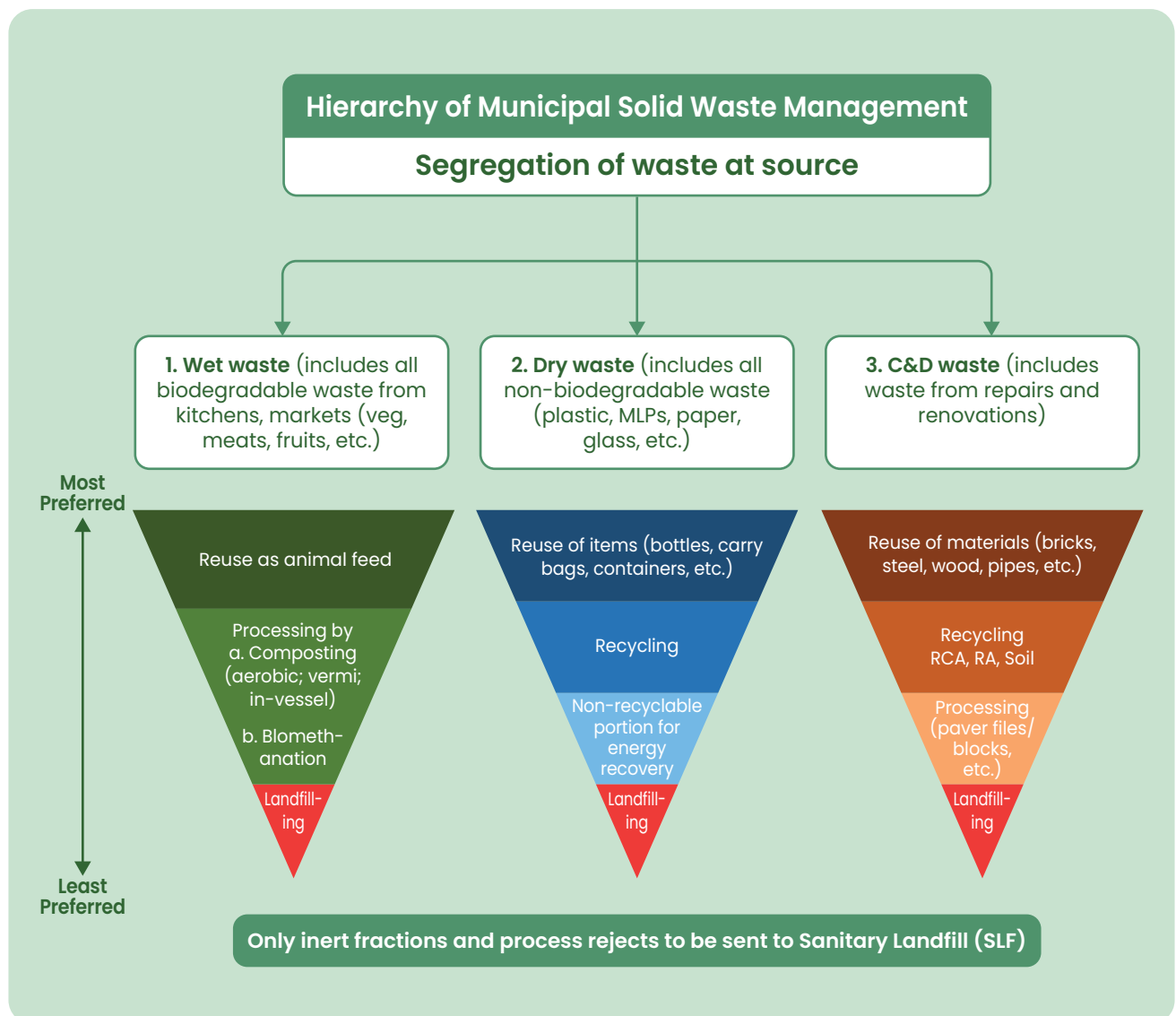
As a transition measure, cities with population over 5 lakh, will generate at least 100 TPD of organic fraction of MSW, should prioritise setting up of CBG plants. No further investment in new composting plant should be taken up. The existing composting plants can operate till the end of life as per contract agreement.

The process flow of Municipal Solid Waste is important to understand. Here is a figure that illustrates a clear flow of MSW from generation to disposal:



**Figure**–Process Flow of MSWM as per SBM (U) 2.0 guidelines

The hierarchy of waste defines the most preferred to the least preferred methods of handling municipal solid waste as follows:



**Figure–Hierarchy of MSWM as per SBM (U) 2.0 guidelines**

From the above hierarchy, biomethanation is coming up as a preferred process to treat wet waste. By adopting the right mix of technology and evacuation of finished products, each ULB can be an energy generator in the form of CBG and also manufacturer of organic manure, which is essential for soil health improvement, especially by raising organic carbon.



## Estimated CBG Potential from MSW — Current and Future

India generates ~58 million tonnes of MSW every year. Considering approximately 50% as organic waste, ~1.2 million tonnes of CBG can be generated from organic fraction of MSW. By 2030, India is projected to generate ~165 million tonnes of MSW. As per the forecast available, in 2050, India will generate ~436 million tonnes of MSW, which will have the potential to produce around 8.5 million tonnes of CBG, which will replace equivalent quantity of imported natural gas. This will also save over 25 million tonnes of CO<sub>2</sub>eq emissions, leading to cleaner cities and contributing substantially towards the achievement of the Net Zero emissions target.

| Year | Estimated MSW Generation (MTPA) | Estimated CBG Potential (MMTPA) |
|------|---------------------------------|---------------------------------|
| 2024 | 58                              | ~1.2                            |
| 2030 | 165                             | ~3.4                            |
| 2050 | 436                             | ~8.5                            |

*Figure—Projected MSW Generation and CBG Potential in India (2024–2050)*

## Allied Benefits of CBG Promotion

- 1. Job Creation:** A robust CBG ecosystem generates employment across the value chain — biomass collection, plant construction, operations, and manure marketing, particularly in rural and peri-urban areas.
- 2. Soil Rejuvenation through Biofertilisers:** Solid and Liquid Fermented Organic Manure (FOM and LFOM) produced as co-products of CBG Plants have significant organic carbon as well as other macro and micronutrients, which can rejuvenate the soil and also substitute the import of chemical fertilisers in the long run.
- 3. Additional Farmer Income:** Farmers benefit from new income streams by supplying crop residues, animal waste, and other biomass to CBG plants, aligning with rural development goals.

## Conclusion

CBG represents a convergence of India's goals on clean energy, sustainable waste management, rural empowerment, and climate resilience. With strong institutional support, enabling policies, and entrepreneurial participation, CBG has the potential to transform India's urban and rural landscapes. This advisory aims to provide stakeholders with a practical, structured, and forward-looking guide to develop and scale CBG from MSW, driving India towards a green energy hub while thriving to operate sustainable cities of international standards.

02

# Planning for Setting Up Compressed Biogas Facility



Establishing Compressed Biogas (CBG) plants requires careful planning and robust technical and operational strategies to ensure long-term commercial viability. Factors such as variable waste quantity and quality, segregation issues, high capital and maintenance costs, technological suitability, and uncertain offtake arrangements often pose significant challenges. Hence, Urban Local Bodies (ULBs) must conduct a detailed due diligence before initiating such projects.

Before proceeding with any CBG project, ULBs must undertake a comprehensive assessment across key domains — demographic (waste generation trends and patterns), technological (compatibility with local waste characteristics), spatial (availability and suitability of land), infrastructural {access to utilities, roads, City Gas Distribution (CGD)/Biogas Gathering Station (BGS), Sewage Treatment Plant (STP), and other utilities}, environmental (including buffer requirements), regulatory (compliance with CPCB, SPCB, and local norms), and administrative (institutional coordination and long-term ownership). This multidimensional assessment will help in identifying site-specific constraints and enablers, ensuring that the proposed facility is both technically feasible and economically sustainable.



**Picture**–Biogas Plant, Goa, India

# Stepwise Planning Recommendations for ULBs

## STEP 1: QUANTITY OF WET WASTE



ULBs generating 100 TPD organic waste should plan a CBG plant for efficient waste processing and clean energy generation.

Smaller ULBs can cluster and include waste from markets, dairies, canteens, and *gaushalas* to ensure viable CBG plant operations.

## STEP 2: QUALITY OF WET WASTE

Ensure over 90% segregation of wet waste to maximise biogas yield, reduce contamination, and enhance plant efficiency and sustainability.

Make it mandatory for Bulk Waste Generators to supply segregated organic waste to CBG plants and enforce strict segregation.



## STEP 3: COLLECTION & TRANSPORTATION VEHICLES



Transport segregated organic waste using covered, partitioned vehicles to prevent contamination and maintain feedstock quality for CBG production.

Identify and integrate organic waste from all potential sources to ensure consistent and adequate feedstock supply to the CBG plant.

## STEP 4: TECHNOLOGY SELECTION

Right selection of technology (Wet-AD or Dry-AD) for the conversion of OFMSW to CBG.



## STEP 5: LAND SELECTION



Identify 4-5 acres of land for a 100 TPD CBG plant, ensuring compliance with site selection and environmental norms.

Choose a location which is optimally placed between CGD pipelines, Biogas Gathering Stations (BGS), STPs, and major BWGs to reduce infrastructure costs.

If city land is unavailable, consider peri-urban areas or use surplus land at existing composting facilities for the CBG plant.

## STEP 6: CONTRACTING AND FINANCING OPTIONS

Adopt suitable PPP models like DBFOT based on project size, ensuring developers have a minimum 3 years of O&M experience.

Leverage central and state schemes, such as MNRE's Waste-to-Energy Programme and SBM for capital and viability gap funding support.

Align with MoPNG's CGD and GPO Synchronisation Scheme to ensure seamless CBG offtake and integration into the Gas Pipeline Network (Trunk Pipeline Network).



## STEP 7: OFFTAKE MECHANISM



Synchronise CBG offtake through CGD pipelines or GPO trunk pipelines via Biogas Gathering Stations (BGS) for grid injection.

Where pipelines are not feasible, opt for bottling and cascade transportation to gas stations or open market distribution.

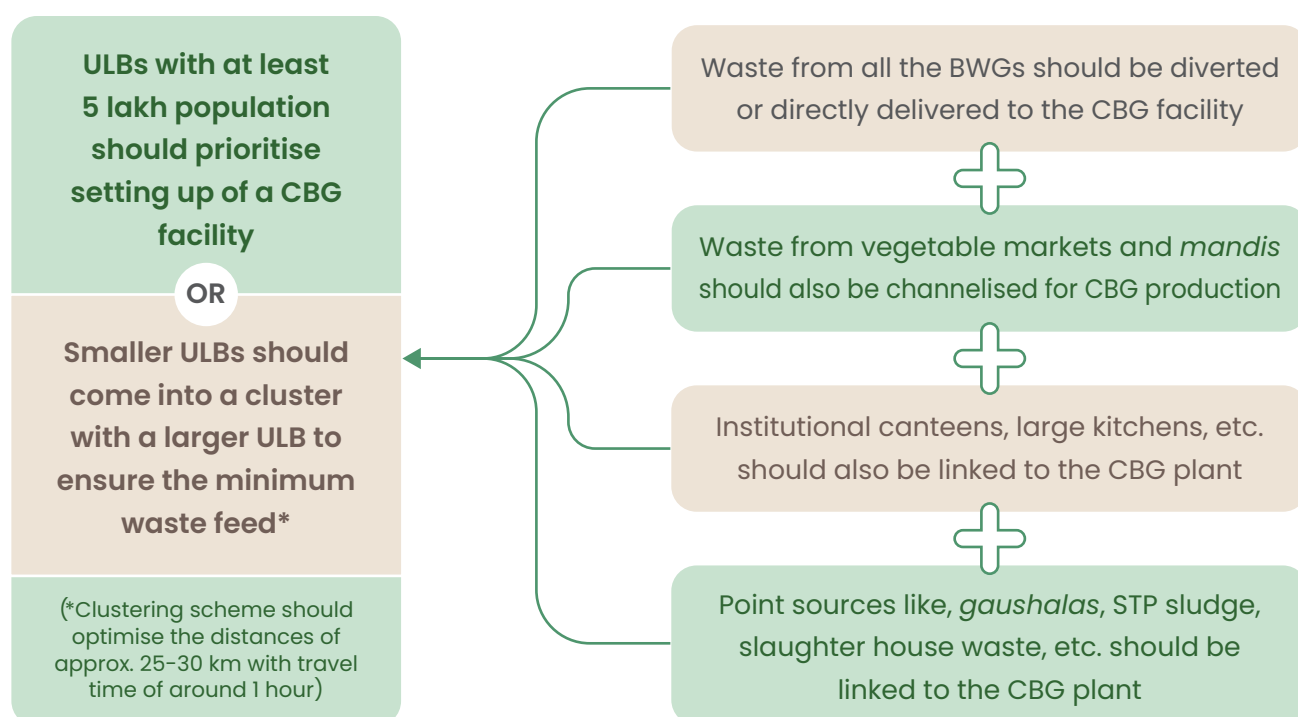
Facilitate sale of FOM/LFOM by linking with Market Development Assistance (MDA) schemes to support offtake and distribution.

## 2.1 Assuring Minimum Waste Quantities

To ensure the commercial and operational viability of CBG plants, ULBs must focus on securing a consistent and adequate supply of organic feedstock. Based on performance insights from operational CBG facilities, a minimum of 100 TPD (tonnes per day) of source segregated organic waste is generally required to achieve feasible plant operations and financial sustainability.

Accordingly, ULBs with more than 5 lakh population and generating at least 100 TPD of organic fraction of municipal solid waste (OFMSW) should actively plan for the development of such facilities. In case of less waste availability, they should look for the feasibility of channelising waste from different sources. For example, smaller ULBs or those with lower daily waste generation may adopt a cluster-based approach with a larger ULB. Clustering with nearby ULBs can help collectively meet the 100 TPD threshold and even more waste quantities, significantly increasing the CBG plant's viability.

Additionally, ULBs should prioritise the channelisation of organic waste from key bulk waste generators, starting with hotels and institutions, followed by vegetable and fruit markets, canteens, community kitchens, and similar sources. These facilities generate high-quality, largely uncontaminated organic waste and can significantly enhance the daily feedstock availability for CBG plants.



**Figure**–Ensuring maximum Waste Feed for CBG Facility



By adopting such collaborative and integrated waste supply strategies, ULBs can ensure the long-term viability and efficiency of CBG facilities, contributing to sustainable waste management and local green energy generation.

*SBM (Urban) 2.0 Operational Guidelines also recommends clustering of large Urban Local Bodies (ULBs) with adjoining smaller ULBs and peri-urban areas to enhance the overall viability of waste management systems. This approach for the pooling of waste resources can be applied to the organic fraction to ensure a consistent feedstock supply for Compressed Biogas (CBG) plants. Such collaboration not only improves the economic and operational feasibility of CBG projects but also supports efficient infrastructure use and shared logistics.*

## 2.2 Assuring Quality of Waste for CBG Plants

While securing a minimum waste quantity is critical for the viability of Compressed Biogas (CBG) plants, ensuring consistent quality of feedstock is equally essential for optimising gas yield, protecting plant equipment, and maintaining operational efficiency. Urban Local Bodies (ULBs) play a pivotal role in maintaining the integrity and purity of organic waste reaching the CBG facility.

To begin with, ULBs must ensure that over 90% source segregation is achieved at the household level. However, achieving this target requires more than operational enforcement – it demands sustained public participation. Therefore, ULBs must implement mass awareness and behaviour change campaigns, aimed at educating citizens about the importance of waste segregation, especially the separation of organic waste at source. Regular outreach through community engagement, IEC (Information, Education & Communication) activities, digital platforms, and local leaders is essential to instil the habit of correct segregation.



**Picture**–IEC activity on source segregation of MSW in Bengaluru

Strict regulatory measures must be implemented for Bulk Waste Generators (BWGs), including hotels, hostels, restaurants, canteens, and community kitchens, requiring them to supply only clean, segregated organic waste to the CBG facility. ULBs should establish a monitoring system with routine checks to ensure compliance and penalise violations that affect feedstock quality.

To enhance the methane yield and digestion performance, ULBs may consider co-digestion strategies by blending organic waste with high-yield organic supplements, such as animal dung from urban dairies and *gaushalas*, or sludge from Sewage Treatment Plants (STPs). These materials can be mixed in appropriate proportions with OFMSW to enrich the feedstock, stabilise the digestion process, and improve overall gas output.

By adopting these practices, ULBs can assure a high-quality organic feed stream, which is essential for sustainable and efficient CBG plant operations.

| Animal Dung                                                                                                                                                                                                | Sewage Sludge (STP Sludge)                                                                                                                                                                                                    | Slaughterhouse Waste (Non-hazardous Portions)                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Cattle dung from urban dairies and <i>gaushalas</i> is a high-quality feedstock.</li> <li>Readily available, rich in volatile solids and microbial load.</li> </ul> | <ul style="list-style-type: none"> <li>Sludge from Sewage Treatment Plants (STPs) offers a consistent source of organic matter.</li> <li>Should be pre-treated, if needed, and handled as per environmental norms.</li> </ul> | <ul style="list-style-type: none"> <li>High in protein and fat content; offers high methane potential.</li> <li>Should be used with caution due to odour, pathogen, and regulatory considerations.</li> </ul> |

**Figure**–Co-digestion options for Organic Waste Fraction with other Wastes<sup>24</sup>

## 2.3 Collection & Transportation of Organic Waste

Ensuring the quality of organic waste delivered to the CBG plant depends significantly on the collection and transportation stage. Improper handling or contamination during this phase can severely affect biogas yields and damage processing equipment. ULBs must, therefore, implement the following precautions:

<sup>24</sup>• *Reviewing the Anaerobic Digestion of Food Waste.*

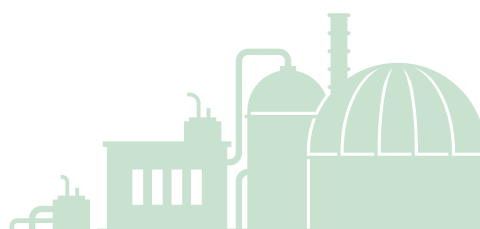
- *Anaerobic co-digestion of sewage sludge with other organic wastes.*
- *Anaerobic co-digestion of fruit and vegetable waste.*
- *Food waste co-digestion with slaughterhouse waste and sewage sludge.*



- **Public Awareness and Behaviour Change:** ULBs should conduct continuous and targeted IEC campaigns to sensitise citizens and institutions about the importance of source segregation and its role in the success of CBG projects. These campaigns should use local languages and be tailored to different audiences — households, bulk waste generators, and market associations. Street plays, posters, public announcements, and digital outreach can be leveraged to encourage responsible waste practices.
- **Route Mapping for Organic Waste:** Once ULBs have identified and finalised the key sources for organic waste supply, they must ensure proper route planning for its collection and transportation. This includes scheduling optimal collection timings, defining efficient vehicle routes, and establishing monitoring mechanisms to ensure timely, uncontaminated, and consistent delivery of organic waste to the CBG plant.
- **Dedicated Collection Systems:** Adopt dedicated systems for door-to-door collection of organic waste using colour-coded or labelled bins. Sensitise sanitation workers through regular capacity-building efforts and equip them with SOPs for segregated handling of waste, leading to successful channelisation of segregated waste to the CBG plant.
- **Covered, Partitioned Vehicles:** Transport the collected segregated organic waste in covered, leak-proof, and partitioned vehicles to avoid cross-contamination with dry or hazardous waste. This preserves the moisture content and calorific value of the feedstock.
- **Non-Compacting Collection Vehicles:** Vehicles used for transporting organic waste should be non-compacting in nature, as compactors can densify the organic material and increase leachate generation.



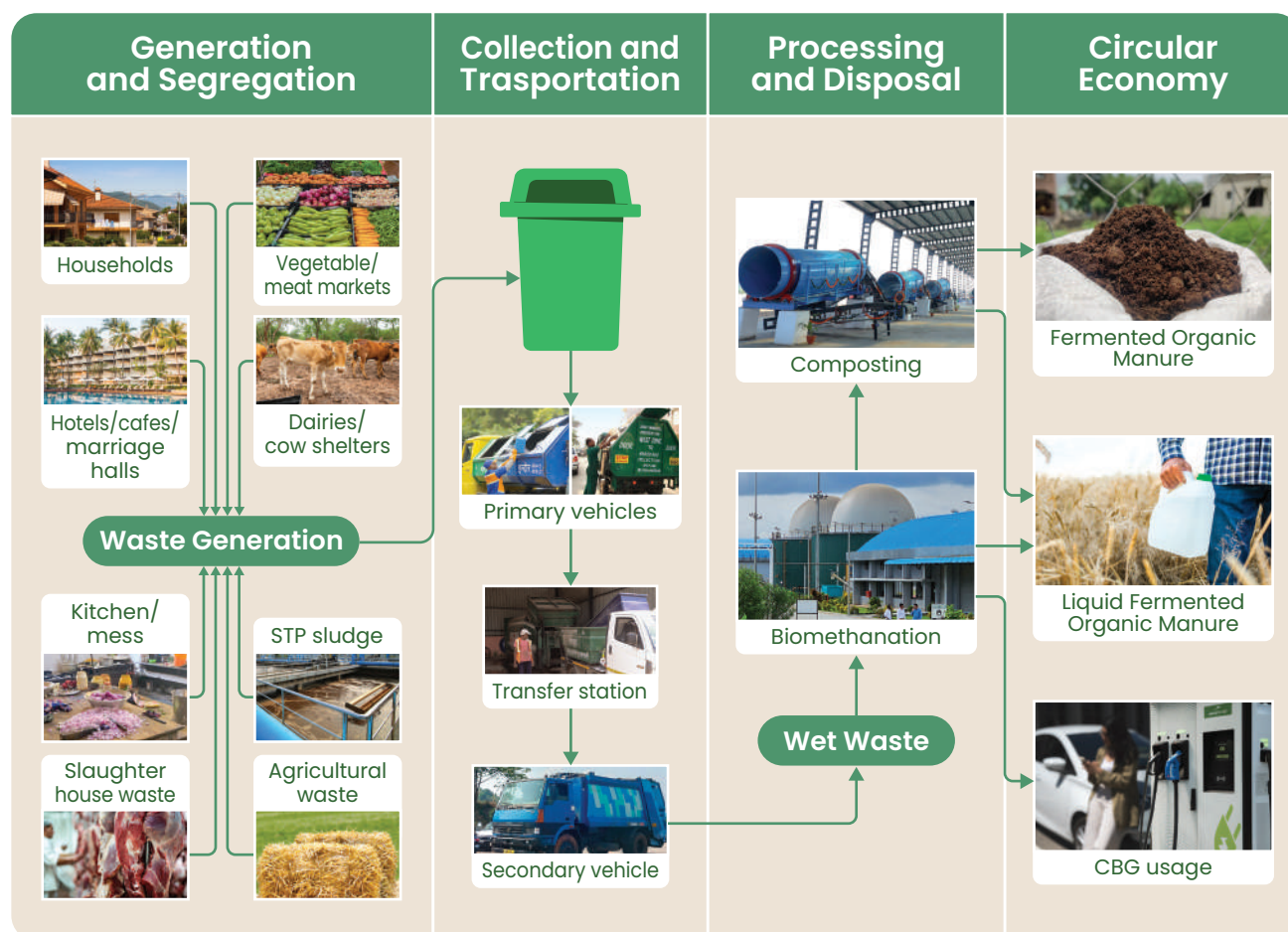
**Picture**—Partitioned vehicles for transportation of source segregated Wet and Dry fractions





**Picture**–Partitioned vehicles for transportation of source segregated Wet and Dry fractions

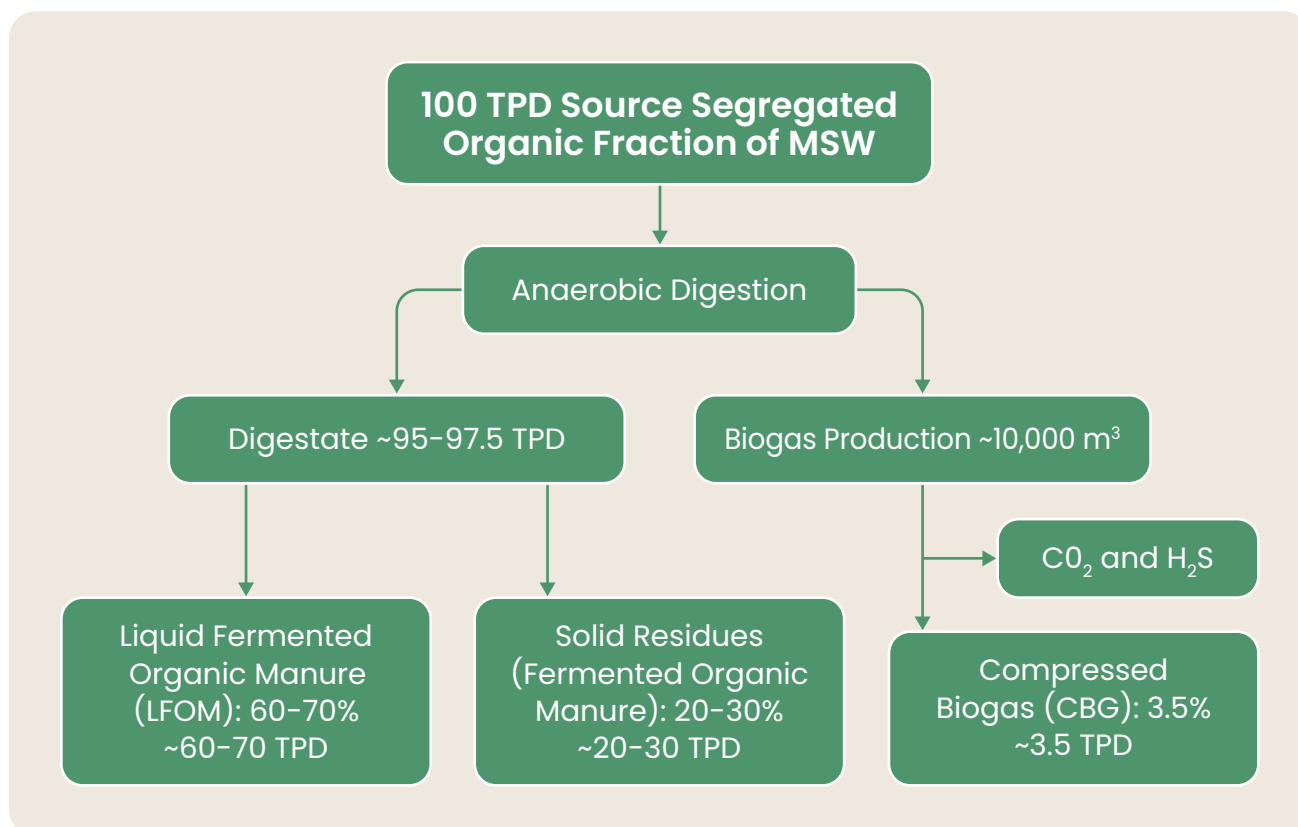
By ensuring these precautions, ULBs can significantly improve the quality and consistency of feedstock, which directly enhances the operational efficiency, gas yield, and sustainability of the CBG plant.



**Figure**–Value Chain Flowchart of Organic Fraction of MSW from generation to CBG

## 2.4 Understanding Biogas Yield and Mass Balance

Biogas yield out of the processing of 100 tonnes of source segregated organic fraction of MSW, together with its mass balance, is given below:<sup>25</sup>



**Figure**—Illustration of Biogas yield out of processing of 100 tonnes of wet-waste

### Compressed Biogas Production

The anaerobic digestion of 100 TPD of source segregated organic fraction of MSW waste typically yields approximately 3.5 TPD (~3.5%) of Compressed Biogas (CBG) after removing impurities, depending on the composition of the waste and the conditions of the digestion process.

### Fermented Organic Manure (FOM)

In addition to CBG & liquid manure, there will be solid residues also known as Fermented Organic Manure (FOM) that can be used as a soil amendment. FOM accounts for 20-30% of the original mass. Specification of FOM is detailed in Annexure-2

<sup>25</sup> *Anaerobic digestion for bioenergy from agro-residues and other solid wastes - An overview of science, technology and sustainability.*





*Picture-Solar sludge dryer at Goa for preparation of FOM*

## **Liquid Fermented Organic Manure (LFOM)**

After the anaerobic digestion process, the remaining material is known as digestate, which can be further processed into liquid fermented organic manure. Approximately 60-70% of the initial mass of source segregated organic fraction of MSW can be converted into liquid organic manure. Specification of FOM is detailed in Annexure-2.



*Picture-LFOM collection at Surat*

## 2.5 Technology Selection

Compressed Biogas (CBG) can be produced using two main anaerobic digestion technologies – Wet Anaerobic Digestion (typically Continuous Stirred Tank Reactor or CSTR) and Dry Anaerobic Digestion (Dry AD). CSTR operates with diluted slurry (8–12% total solids) and is well-established in India for treating source segregated municipal solid waste. On the other hand, Dry AD technologies, such as Horizontal Plug Flow Digesters and Tunnel-Based Plug Flow Digesters are batch processes and gaining traction globally due to their higher biogas yield, lower water requirement, and reduced generation of liquid effluent (LFOM). Each technology has specific requirements, advantages, and limitations based on feedstock characteristics and site conditions. ULBs should take due care while selecting the appropriate technology to ensure long-term operational and financial viability.

### 2.5.1 Continuous Stirred Tank Reactor (CSTR)

The Continuous Stirred Tank Reactor (CSTR) is one of the most widely adopted anaerobic digestion technologies for processing source segregated organic municipal solid waste (OFMSW) in India. Owing to its adaptability to variable feedstock and ability to operate in wet digestion conditions, CSTRs are well-suited for Indian waste profiles. These reactors provide stable gas production through continuous mixing and are compatible with both mesophilic and thermophilic temperature regimes. The compatibility of CSTR digesters especially offers natural advantage on mesophilic range in Indian ambient conditions. CSTR systems have been successfully implemented in cities such as Indore, Pune, and Chennai, and are promoted under government initiatives like SATAT and the Swachh Bharat Mission (Urban).

#### Key Highlights of CSTR

- Proven track record in Indian cities.
- Handles feedstock variability effectively.
- Endorsed under SATAT and SBM (U).
- Suitable for medium to large-scale applications.
- Mesophilic range supports ambient temp condition.
- Supports circular economy through energy recovery and nutrient recycling.

#### Technical Parameters

| Parameter            | Specification/Range                     |
|----------------------|-----------------------------------------|
| Input Waste Type     | Source segregated organic MSW (OFMSW)   |
| Pre-treatment        | Shredding, pulping, dilution with water |
| Total Solids (TS)    | 8–12%                                   |
| Volatile Solids (VS) | >70% of TS                              |

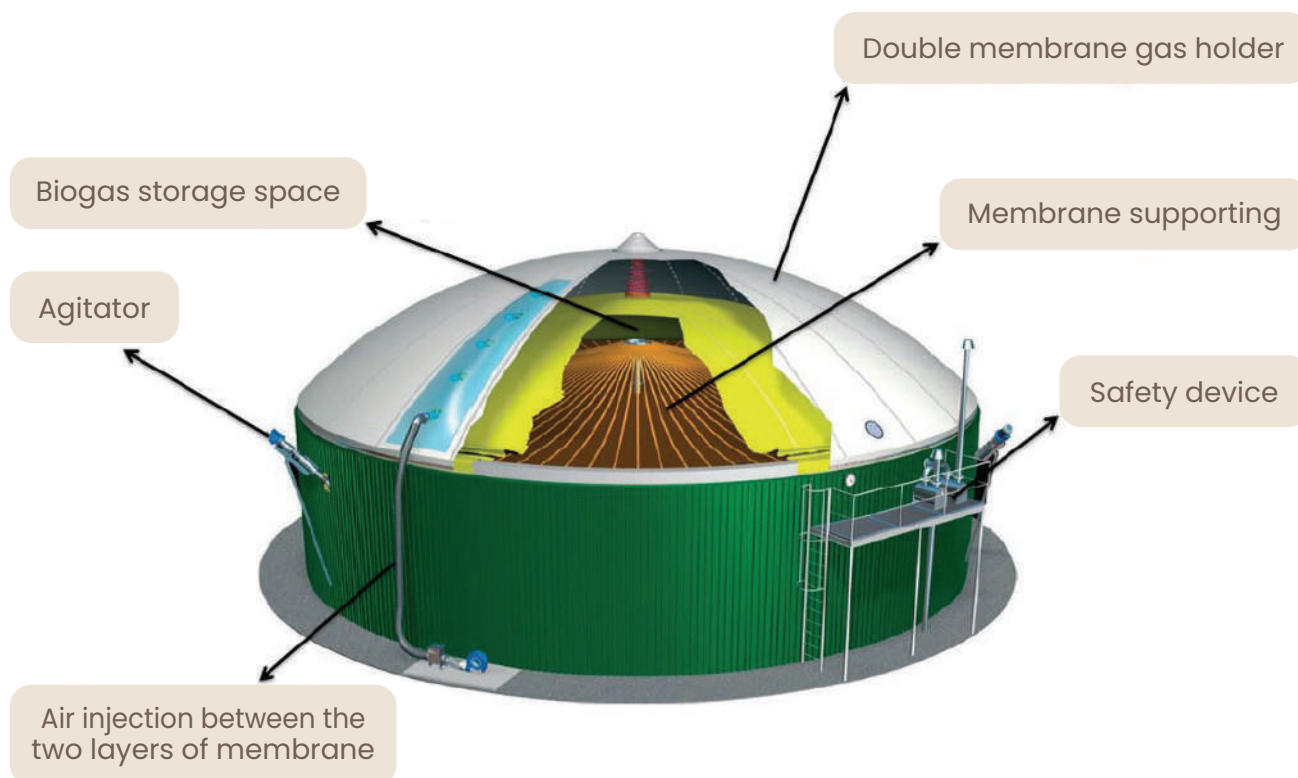
| Parameter                | Specification/Range                         |
|--------------------------|---------------------------------------------|
| Temperature Range        | 35–40°C (Mesophilic)/50–55°C (Thermophilic) |
| pH Range                 | 6.8–7.4                                     |
| Hydraulic Retention Time | 25–35 days                                  |
| Reactor Mixing           | Mechanical or hydraulic                     |
| Biogas Yield             | 100–150 Nm <sup>3</sup> /tonne OFMSW        |
| Methane Content          | 55–65%                                      |
| Water Requirement        | ~1 m <sup>3</sup> per tonne of waste        |
| Digestate Output         | Slurry form; usable as FOM/LFOM             |

## Process Flow of CSTR for MSW–Based Anaerobic Digestion

The CSTR-based anaerobic digestion process for municipal solid waste (MSW) begins with the reception of source segregated organic waste. This waste is pre-processed to remove inerts and recyclables through manual or mechanical means, followed by shredding, pulping, and dilution to form a uniform slurry. The prepared slurry is then fed into the Continuous Stirred Tank Reactor (CSTR), where it undergoes controlled mesophilic or thermophilic digestion for 25–35 days. This results in the generation of biogas, which can be upgraded to Compressed Biogas (CBG) and used for energy applications, such as vehicle fuel or industrial gas.

The post-digestion process involves separating the digestate into solid and liquid fractions. The solid portion is processed into compost or Fermented Organic Manure (FOM), while the liquid (LFOM) can be recycled or safely treated. To ensure environmental safety, the facility also includes systems for leachate collection, odour control using enclosures and bio-filters, and overall environmental management. This integrated process provides a sustainable pathway for cities to manage organic waste while generating renewable energy and valuable by-products.





**Figure**–Representative image of Green Energy Network CSTR<sup>26</sup>

## Operational plants on CSTR

**Indore CBG Plant:** The Indore Municipal Corporation partnered with a private developer to set up a 550 TPD plant processing segregated organic MSW using wet AD via CSTR. The plant produces approx. 15 TPD of CBG, which is used by city buses and municipal vehicles. Digestate is converted into organic compost and sold to farmers.

**Pune CBG Plant:** In Pune, a 300 TPD segregated organic waste plant is being operated at 140 TPD, using CSTR technology. This plant is one of the first generation plants under SATAT, supplying CBG to municipality for running their vehicles.

<sup>26</sup> Green Energy Network.



### 2.5.2 Horizontal Plug Flow Digesters (HPFD)

The Horizontal Plug Flow Digester (HPFD) is a dry anaerobic digestion (AD) technology optimised for treating high-solids organic waste, particularly source segregated organic fraction of municipal solid waste (OFMSW), with a total solids content of 20–35%. This system is well-suited for Indian urban conditions where water availability is limited and consistent organic feedstock is available. In HPFD systems, the feedstock moves gradually in a “plug” motion through a horizontal, enclosed reactor, enabling efficient staged digestion under thermophilic or mesophilic conditions. With lower water and energy requirements, high methane yields, and a compact modular layout, the HPFD is an ideal solution for decentralised CBG projects in urban and semi-urban settings.

#### Key Highlights of HPFD

- Dry digestion system suited for high solids (20–35%) organic waste.
- Low water use and minimal dilution required.
- Staged, unidirectional flow ensures stable digestion and better gas yields.
- Compact footprint with modular scalability for urban and semi-urban areas.
- Lower O&M costs due to fewer internal moving parts.
- High biogas yield (120–160 Nm<sup>3</sup>/tonne OFMSW) with high methane content.
- Better odour control and energy efficiency due to enclosed insulated design.

#### Technical Parameters

| Parameter             | Requirement/Specification                                  |
|-----------------------|------------------------------------------------------------|
| Input Waste Type      | Source segregated OFMSW                                    |
| Pre-treatment         | Shredding, inert removal, size homogenisation              |
| Total Solids (TS)     | 20%–35%                                                    |
| Volatile Solids (VS)  | >70% of TS                                                 |
| Dilution Requirement  | Very low (<10%) or none                                    |
| Retention Time (HRT)  | 25–40 days                                                 |
| Temperature Range     | Thermophilic (50–55°C) preferred; mesophilic also feasible |
| pH Range              | 7.0–7.5                                                    |
| Biogas Yield          | 120–160 Nm <sup>3</sup> /tonne of OFMSW                    |
| Mixing                | Occasional mechanical stirring (optional)                  |
| Digestate Output      | High-solid compostable fraction                            |
| Reactor Configuration | Horizontal plug flow, modular, or channel-based            |

## Process Flow of HPFD for MSW with Dry AD

The anaerobic digestion process using a Horizontal Plug Flow Digester (HPFD) for MSW begins with the reception and pre-treatment of source segregated organic waste, where inerts are removed and the feedstock is shredded, pulped (if necessary), and homogenised. The prepared high-solid feed (typically with 20-35% total solids) is then loaded into the horizontal plug flow reactor, maintaining a unidirectional movement with minimal back-mixing. Within the digester, thermophilic or mesophilic conditions are maintained, allowing a retention time of 25-40 days for optimal digestion and consistent biogas generation. The biogas collected from the reactor's headspace can either be used directly for electricity generation or upgraded to compressed biogas (CBG) for use as vehicle fuel or injection into the gas grid. The resulting digestate is then extracted – solid fractions are composted or dried, while liquid leachate is recycled or treated through an Effluent Treatment Plant (ETP), ensuring environmentally compliant waste management.



Figure–TTV – Plug Flow Digester<sup>27</sup>

### Operational plants on Horizontal Plug Flow Digester

**1. Thöni High Solid Plug-Flow Digester** – Güstrow, Germany processes ~300 TPD of organic waste (biowaste, food scraps) using high-solid plug-flow digestion. The plant operates under thermophilic conditions, achieving methane yields >60%. The biogas is upgraded to biomethane and fed into the national gas grid. Digestate is turned into certified compost.

Key Takeaway: Demonstrates long-term stability (>15 years operation) with minimal internal maintenance due to the absence of high-wear internal parts.

**2. Villeneuve-sur-Lot**, France facility treats 140 TPD of organic household waste using a dry plug flow digester. The system is integrated with a composting unit and achieves >95% organic matter degradation. About 1.2 million Nm<sup>3</sup> of biogas is produced annually, largely used for heating and electricity.

Key Takeaway: Validated European best practice for urban bio-waste integration using plug flow configuration.

<sup>27</sup> Theoni.

### 2.5.3 Tunnel-based Plug Flow Digester (TPFD)– Dry Fermentation

Tunnel-based Plug Flow Digesters represent an advanced form of Dry Anaerobic Digestion (Dry AD), designed to handle high-solid organic municipal solid waste (MSW) with total solids (TS) content above 25%. This batch-operated, tunnel-based system eliminates the need for dilution and internal mechanical agitation, making it highly suitable for Indian waste streams that are heterogeneous and moisture-variable. Operated under thermophilic conditions (50–55°C), the technology ensures efficient biogas generation and compost production with minimal operational overhead, supporting decentralised and space-efficient implementation models. The process integrates membrane-based CBG upgradation and windrow composting for digestate management, aligning well with national schemes, such as SATAT and GOBARdhan.

#### Key Highlights of TPFD

- Treats OFMSW with >25% TS without dilution or slurry formation.
- Offers decentralised batch-operated, scalable and modular deployment with minimal mechanical complexity.
- Low O&M and Energy Footprint with water and energy usage.
- Produces compostable digestate and high-purity CBG ( $\geq 95\% \text{ CH}_4$ ).
- $\text{CO}_2$ , as a by-product, can also be commercially utilised.

#### Technical Parameters

| Parameter                    | Specification                                      |
|------------------------------|----------------------------------------------------|
| Input Waste                  | Source segregated OFMSW, agri/market/kitchen waste |
| TS in Feedstock              | $\geq 25\%$                                        |
| VS Content                   | $> 70\%$ of TS                                     |
| HRT                          | 25–35 days                                         |
| Temperature Regime           | Thermophilic (50–55°C)                             |
| pH Range                     | 7.0–7.5                                            |
| Biogas Yield                 | 90–135 $\text{Nm}^3/\text{tonne OFMSW}$            |
| Methane Content (Raw Biogas) | 50–55%                                             |
| CBG Output                   | 4–4.5% of feedstock (mass basis)                   |
| Digestate Output             | ~30–35% of feedstock, compostable                  |
| Mixing                       | None; plug flow and gravity-driven batch retention |

## Principles of Process Flow of TPFD for MSW with Dry AD Fermentation

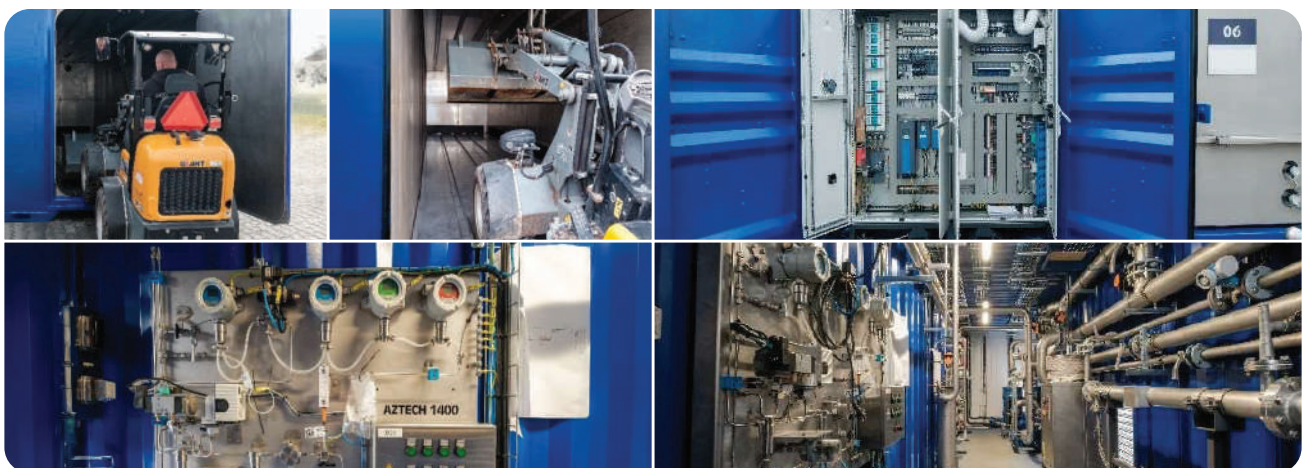
The process begins with the reception and pre-treatment of segregated organic fraction of municipal solid waste (OFMSW) delivered by the ULB or collection and transportation (C&T) contractors. The waste undergoes mechanical trommel screening, yielding over 92% organic content, followed by the removal of inerts and ferrous/non-ferrous metals. It is then shredded and homogenised without requiring dilution. The prepared feedstock, with total solids (TS) exceeding 25%, is batch-loaded into enclosed, insulated tunnel reactors. These reactors are inoculated with percolate from previous batches to initiate digestion.

Biogas is uniformly extracted through a spigot floor system, ensuring complete gas recovery during the 25–35 day retention under thermophilic conditions. The collected biogas is then purified using membrane separation to achieve methane content above 95%, yielding Compressed Biogas (CBG) equivalent to approximately 4–4.5% of the feedstock weight. The upgraded gas is suitable for offtake by Oil Marketing Companies (OMCs), industries, or for bottling.

The remaining solid digestate, comprising 30–40% of the input mass, is transferred for aerobic windrow composting, with compost output reaching around 30–35% of feedstock weight. Leachate from the process is managed through integration with aerobic tunnels, and the fully enclosed plant operations are equipped with biofilters to control odours and vector nuisance.



*Picture-Representative Image of Transportable Biogas Plant (TBG)*



*Picture-Representative Image of Components of TBG*

## Plant under construction based on TPFD

**Nagpur City:** Nagpur is implementing India's first Tunnel-Based Plug Flow Anaerobic Digestion project under a 30-year Public-Private Partnership (PPP) model. This innovative system processes high-solids organic waste (>25% TS) without dilution, operating under thermophilic batch conditions with minimal mechanical complexity.

### Project Snapshot:

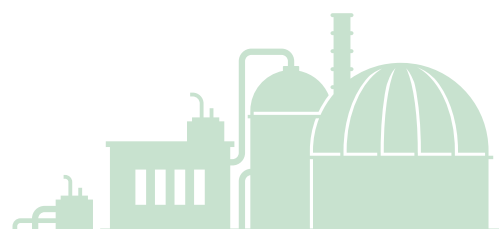
- Waste Processing: 1000 ± 20% TPD
- CBG Output: 29 TPD (~14,500 kg LPG/day)
- Compost Output: 235 TPD
- Financial Closure: Achieved in September 2023
- Expected COD: November 2025
- Land: Secured
- Stakeholders: ULB, private concessionaire, and technical partners

This modular dry digestion system offers low O&M costs, high biogas yield, and reduced leachate, with minimal water use and strong odour control. The model demonstrates strong financial viability, with a favourable return on capital in larger plant capacities, especially under assured offtake of CBG and compost.

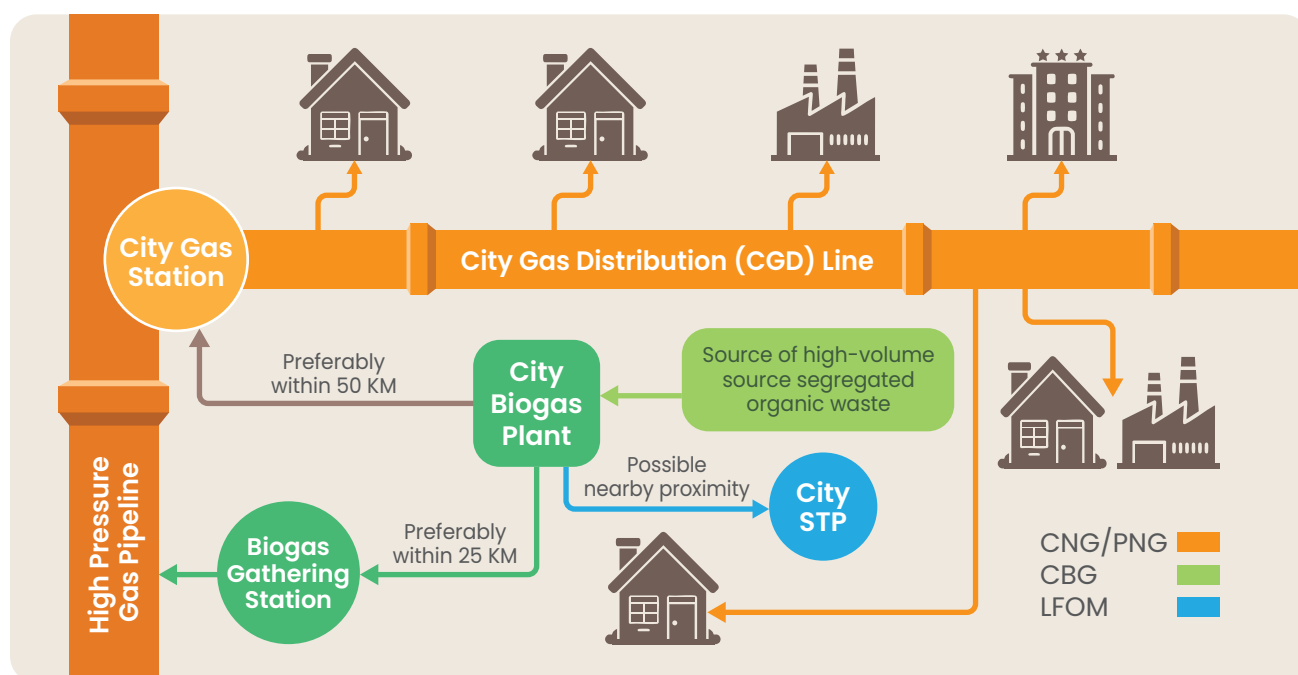
**Source:** Based on technical submissions from project developers "KEVA Green Energy (2024)."

## 2.6 Site Selection Criteria

Proper site selection is critical to ensure the operational efficiency, economic viability, and environmental compliance of Compressed Biogas (CBG) facilities. The land identified must be free from legal disputes or encumbrances. Ideally, the site layout should consider proximity to key enablers, such as nearby injection infrastructure like City Gas Distribution (CGD) or Biogas Gathering Stations (BGS), reliable organic waste sources, proximity to Sewage Treatment Plant (STP) for LFOM disposal, and offtake points for Fermented Organic Manure (FOM). While it may not always be possible to locate the CBG plant near all of these elements simultaneously, Urban Local Bodies (ULBs) should aim to optimise the location and minimise distances wherever feasible, to ensure smooth logistics, cost efficiency, and compliance with recommended siting criteria.



Following image illustrates an ideal placement for a CBG Plant:



**Figure**–Ideal placement for a CBG Plant

## A. Injection into the City Gas Distribution (CGD) Network

The site selection should prioritise locations near to the CGD networks, because if the plant is located within a 50 km radius of an authorised CGD pipeline, it qualifies for capital subsidies under government-supported schemes, such as SATAT.<sup>28</sup> The CBG must meet the prescribed BIS standards (IS 16087:2016) for gas quality, including calorific value, pressure, water vapour, and H<sub>2</sub>S limits before injection into the grid. Suitable metering, odourisation, and gas conditioning units must be installed to enable pipeline compatibility.

The composition of CBG and CNG is compared below:

| Characteristics                     | Requirement/<br>Concentration Range | Requirement/<br>Concentration Range      |
|-------------------------------------|-------------------------------------|------------------------------------------|
|                                     | CBG (IS 16087:2016)                 | CNG (IS 15958:2012)                      |
| Methane (CH <sub>4</sub> ), minimum | 90%                                 | 90%                                      |
| Other HCs (Max)                     | –                                   | 10%                                      |
| Carbon Dioxide, maximum             | 4%                                  | 3.5% (CO <sub>2</sub> & N <sub>2</sub> ) |
| Total Sulphur, maximum              | 20 mg/m <sup>3</sup>                | 20 mg/m <sup>3</sup>                     |
| Moisture, maximum                   | 5 mg/m <sup>3</sup>                 | 5 mg/m <sup>3</sup>                      |
| O <sub>2</sub> , maximum            | 0.5%                                | 0.5%                                     |

Additional specification of Biogas is provided in Annexure-1

<sup>28</sup> Office Memorandum, Ministry of Petroleum and Natural Gas.

## **B. Supply to a Biogas Gathering Station (BGS) – Proposed Concept**

Alternatively, the plant may also supply CBG to a Biogas Gathering Station within 25 km, particularly in regions where direct CGD connectivity is limited. This model is inspired by oil & gas midstream infrastructure and allows aggregation of CBG from multiple small and medium scale CBG plants. The BGS ensures uniformity in gas pressure, quality compliance, and consolidated metering before injecting the CBG into the high-pressure trunk pipeline. Co-locating multiple feed-in points within a shorter radius minimises logistics costs and maximises subsidy eligibility.

## **C. Proximity to the High-Volume Organic Waste Sources**

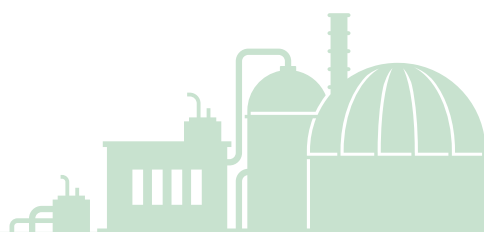
Another key criterion for selecting the location of a CBG facility is its proximity to high-volume sources of segregated organic waste. If a single bulk generator or a cluster of generators can contribute over 40–50% of the plant's input capacity, it is advisable to situate the facility close to such sources. This helps reduce transportation costs and associated carbon emissions, while ensuring a steady and cost-efficient supply of feedstock.

## **D. Distance from STPs**

An essential co-located infrastructure element is the Sewage Treatment Plant (STP). The STP's presence is critical for the disposal and potential valorisation of the Liquid Fermented Organic Manure (LFOM), a by-product of anaerobic digestion. LFOM is nutrient-rich but has to be managed carefully to avoid environmental contamination. The STP enables either co-treatment of LFOM with municipal sewage or facilitates its controlled discharge as per CPCB/SPCB norms. Proximity to an STP ensures environmental compliance and supports a circular economy by allowing the recovery of treated water and nutrients. Sale of Liquid Fermented Organic Manure (LFOM) is typically not considered feasible due to the long distances between plant sites and agricultural areas. In such cases, it is recommended that LFOM be diverted to the nearest Sewage Treatment Plant (STP) for co-treatment or safe disposal.

## **E. Offtake of FOM:**

The offtake of Fermented Organic Manure (FOM) can be effectively planned within urban and peri-urban areas. ULBs should identify and leverage potential demand centres, such as municipal parks, horticulture departments, nurseries, residential welfare associations (RWAs), rooftop gardens, and agri-input shops. FOM may also be routed through fertiliser marketing companies or utilised in municipal greening initiatives. Planning of offtake should prioritise proximity to usage points to minimise transport costs and ensure regular movement of material.



### The integrated site planning approach enables:

- **Improved economic viability** by utilising subsidies linked to CGD and BGS proximity.
- **Reliable revenue generation** through planned and localised offtake of FOM.
- **Environmental compliance** by ensuring safe LFOM disposal via nearby STPs.
- **Scalable operations** through decentralised CBG plants connected to aggregated injection points.
- **Technical consistency** by meeting BIS pipeline-grade standards for CBG injection into the grid.

## Land Area Requirement

The following table provides the minimum land area requirement for CBG plants, having capacities ranging from 100–500 TPD. Keeping in view the lifespan of 25 years of the CBG plant, ULBs must plan capacity expansion of the CBG plant over the years as waste input quantity increases. **A 30–50% of additional land must be planned/allocated to accommodate the future expansions.**

| Tentative land area requirements for different capacities of CBG plants |                   |
|-------------------------------------------------------------------------|-------------------|
| Feedstock quantity (TPD)                                                | Land area (acres) |
| 100                                                                     | 4–5               |
| 200                                                                     | 6–7               |
| 500                                                                     | 13–15             |

**Figure**–Land required for CBG plant (estimated based on survey of operators, TCS-GIZ 2022)



03

# Role of State Governments in Promoting CBG



While the Central Government provides the overarching policy direction and financial support for Compressed Biogas (CBG) initiatives under missions such as SBM (Urban) 2.0, SATAT, and GOBARdhan, State Governments serve as the critical enablers for on-ground implementation. Urban Local Bodies (ULBs) are the designated implementing agencies, but it is the States that play a pivotal role in facilitating land acquisition, clearances, co-financing, and convergence across departments. State Government leadership is essential for aligning CBG projects with broader urban development, renewable energy, and waste management objectives.

By formulating dedicated policies, offering land, supporting infrastructure, and capital subsidies, and streamlining regulatory procedures, States can accelerate project approvals, improve investor confidence, and promote sustainable infrastructure. Several progressive States have already introduced bioenergy policies that support CBG production from municipal and agricultural wastes. Moving forward, all States must adopt a proactive role, not only as policy-makers but also as coordinators and ecosystem builders, to ensure that every ULB is adequately supported to develop viable and scalable CBG projects.

This chapter outlines the various responsibilities of State Governments in supporting CBG initiatives, including mapping the potential, policy incentives, financial facilitation, cluster-based project planning, and monitoring mechanisms. It also highlights how States can strengthen ULB capacities and ensure alignment with broader environmental and energy transition goals.

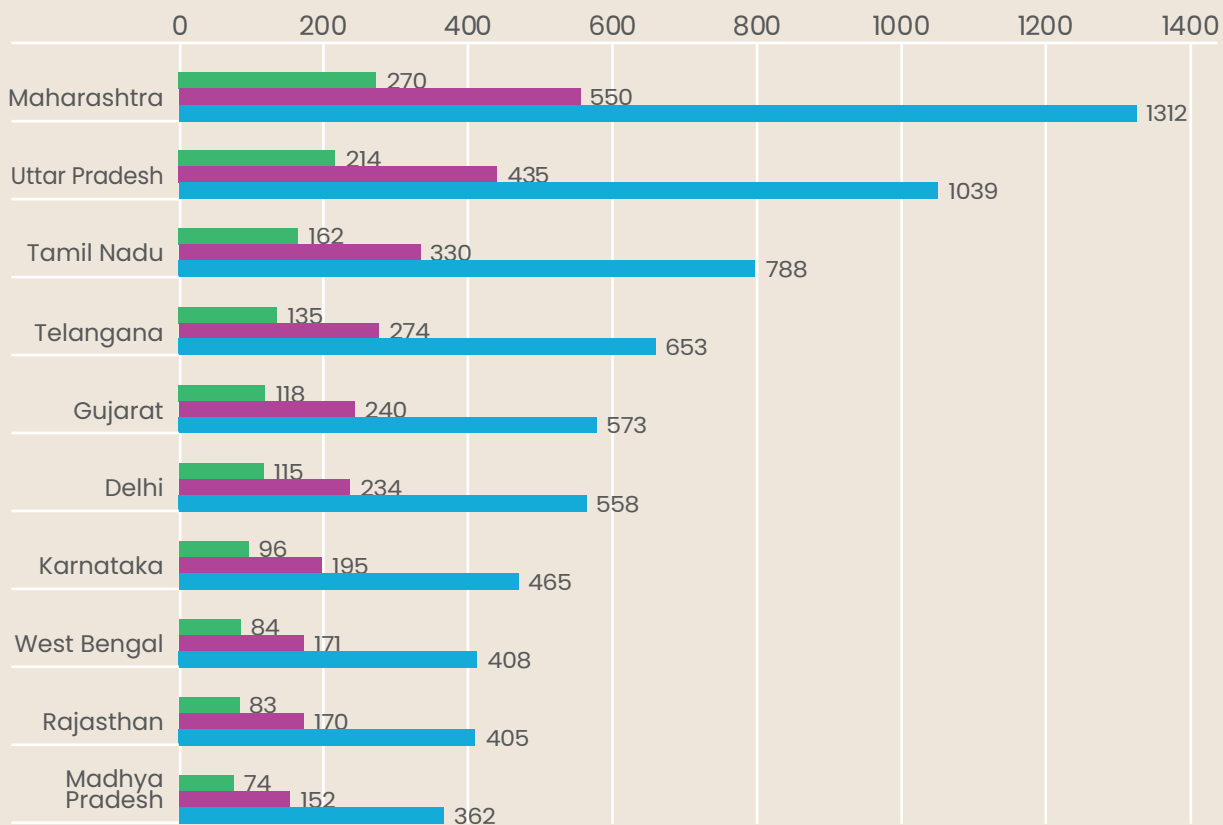
## 3.1 State-Wise CBG Potential Assessment

The first step for States in promoting Compressed Biogas (CBG) projects is to assess the potential of the organic fraction of municipal solid waste (OFMSW) as a viable feedstock for biomethanation. A state-level estimation of CBG potential, based on current and projected urban MSW generation, provides the foundation for strategic planning and targeted interventions.

For estimation purposes, it is assumed that approximately 50% of the total MSW generated consists of biodegradable organic waste. Further, it is recommended that Urban Local Bodies (ULBs) prepare plans to channelise and process at least 50% of this organic fraction through CBG facilities to ensure both environmental and financial viability.

For instance, consider a ULB with a population of around 5–6 lakh and a waste generation of 250–300 tonnes per day (TPD). Based on standard waste composition patterns, about 150 TPD is likely to be organic in nature. Accordingly, the ULB should aim to source segregate and channelise at least 75 TPD of this biodegradable fraction from HHs and BWGs into a CBG facility. Additionally, another 25–50 TPD can be sourced through vegetable *mandis*, *gaushalas*, STP sludge, agri based residues, etc. to make the CBG facility financially viable.

**Top ten State wise CBG production targets for 50%, 75% & 100% OFMSW generated in the year 2030, 2035 & 2050, respectively (Thousand MTPA)**



■ 2030 CBG Generation (Annually) (50% of actual)

■ 2035 CBG Generation (Annually) (75% of actual) ■ 2050 CBG Generation (Annually) (100% of actual)

**State-wise CBG production targets for 50%, 75% & 100% OFMSW generated in the year 2030, 2035 & 2050, respectively (Thousand MTPA)**

| S. No | State/UT      | 2030 | 2035 | 2050 |
|-------|---------------|------|------|------|
| 1     | Maharashtra   | 270  | 550  | 1312 |
| 2     | Uttar Pradesh | 214  | 435  | 1039 |
| 3     | Tamil Nadu    | 162  | 330  | 788  |
| 4     | Telangana     | 135  | 274  | 653  |
| 5     | Gujarat       | 118  | 240  | 573  |
| 6     | Delhi         | 115  | 234  | 558  |
| 7     | Karnataka     | 96   | 195  | 465  |

| S. No | State/UT                    | 2030        | 2035        | 2050        |
|-------|-----------------------------|-------------|-------------|-------------|
| 8     | West Bengal                 | 84          | 171         | 408         |
| 9     | Rajasthan                   | 83          | 170         | 405         |
| 10    | Madhya Pradesh              | 74          | 152         | 362         |
| 11    | Bihar                       | 73          | 149         | 354         |
| 12    | Andhra Pradesh              | 71          | 145         | 347         |
| 13    | Haryana                     | 56          | 113         | 270         |
| 14    | Punjab                      | 40          | 81          | 194         |
| 15    | Jharkhand                   | 27          | 56          | 133         |
| 16    | Chhattisgarh                | 27          | 55          | 132         |
| 17    | Odisha                      | 19          | 39          | 92          |
| 18    | Uttarakhand                 | 18          | 37          | 88          |
| 19    | Kerala                      | 16          | 32          | 77          |
| 20    | Assam                       | 14          | 28          | 68          |
| 21    | Jammu And Kashmir           | 10          | 19          | 46          |
| 22    | Chandigarh                  | 5           | 11          | 26          |
| 23    | Tripura                     | 4           | 8           | 18          |
| 24    | Himachal Pradesh            | 4           | 7           | 18          |
| 25    | Puducherry                  | 4           | 7           | 17          |
| 26    | Manipur                     | 3           | 6           | 15          |
| 27    | Meghalaya                   | 2           | 5           | 11          |
| 28    | Arunachal Pradesh           | 2           | 4           | 9           |
| 29    | Goa                         | 2           | 4           | 9           |
| 30    | Sikkim                      | 1           | 1           | 3           |
| 31    | Andaman And Nicobar Islands | 1           | 1           | 3           |
|       | <b>In million MTPA</b>      | <b>1.75</b> | <b>3.50</b> | <b>8.50</b> |

Sourced from: Swachh Bharat Mission (Urban)<sup>29</sup> The waste generation in States and UTs, including Daman Diu, Dadra & Nagar Haveli, Ladakh, Mizoram, and Nagaland, is currently very low; therefore, they are not being considered for CBG plant development at this stage. However, future assessments should be conducted as and when the population increases to evaluate the need for such facilities.

<sup>29</sup> Swachh Bharat Mission (Urban).

Based on the state-wise potential for CBG generation, States may be encouraged to:

- Prepare a state-level roadmap for CBG project development, outlining priority regions, investment facilitation, infrastructure planning, and inter-departmental coordination.
- Set ULB-wise implementation targets for CBG plants, aligned with the quantity and quality of organic waste generated across cities and towns.
- Identify high-potential clusters with anchor/lead ULBs, where CBG plants can be established to serve surrounding smaller municipalities under a cluster model.
- Mapping demand centres and off-take avenues (e.g., CGD networks, industrial hubs) to match potential CBG production with local energy needs.
- Integrate CBG targets with other urban and energy policies, including city sanitation plans and climate action roadmaps for cohesive implementation.

## 3.2 Policy and Regulatory Support

The formulation of an enabling policy and regulatory environment is one of the most effective levers States can use to accelerate the adoption of Compressed Biogas (CBG) projects. States are encouraged to either frame a dedicated Bio-Energy policy or integrate CBG-specific provisions within existing policies to provide clear direction and support to Urban Local Bodies (ULBs) and private developers.

### **Typical policy measures may include:**

- Provision of government land for CBG plants at concessional or nominal lease rates.
- Financial incentives, such as tipping fee, VGF support, and exemptions in electricity and water charges.
- Basic infrastructure support similar to industrial estates/SEZs.
- Fast-track approvals for environmental, building, and utility clearances to reduce project delays.
- Mechanisms for supporting carbon credit monetisation and integration of CBG projects into state-level climate finance or green budgeting frameworks.

In States like Uttar Pradesh, Bihar, Haryana, Madhya Pradesh, Andhra Pradesh, and Gujarat, a strong policy shift is underway through fiscal incentives (e.g., capital subsidies, GST/duty waivers, and interest subvention) with institutional enablers such as land access and simplified regulatory pathways.

Given below are examples of key state-level initiatives:

| State                              | Capital Subsidy on CBG Production                                                                                                                                 | Land                                                                | Operational Subsidy/Duty Exemption                                                                         | Biomass Aggregation                                                                                    | Interest Subvention                                                     | Electricity/Stamp Duty Exemption                                                     |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Andhra Pradesh<sup>30</sup></b> | 20% on Fixed Capital Investment (FCI) (Max INR 1 Cr per TPD capacity of CBG plant; only for plants >10 TPD capacity)                                              | INR 15,000/acre/year with 5% escalation for every 2 years           | Power subsidy INR 1/kWh for 5 yrs<br>100% SGST reimbursement for 5 years                                   | Capital Subsidy of 20% for biomass processing equipment                                                | –                                                                       | 100% reimbursement of electricity duty                                               |
| <b>Bihar<sup>31</sup></b>          | 15% of Plant & Machinery cost (up to INR 5 Cr)                                                                                                                    | 100% exemption of land conversion fees                              | 100% SGST reimbursement for 5 years                                                                        | –                                                                                                      | 10% of term loan for 5 years (up to 50% of project cost, max INR 20 Cr) | 100% reimbursement of electricity duty                                               |
| <b>Gujarat</b>                     | 15% of the cost of Plant & Machinery (up to INR 40 Cr)                                                                                                            | –                                                                   | 15% of OPEX for 5 years (cap INR 5 Cr)                                                                     | –                                                                                                      | 7% for 5 years (up to INR 100 Cr loan)                                  | 100% exemption                                                                       |
| <b>Haryana<sup>32</sup></b>        | –                                                                                                                                                                 | Panchayat/ agriculture land; 35-year lease; no CLU; outside ceiling | 100% waiver on cross subsidy, T&D, entry tax, surcharges                                                   | Reapers/ balers/ trawlers provided to farmers/FPOs on a subsidy to support biomass/ parali aggregation | –                                                                       | 100% stamp duty & registration fee exemption (eligible blocks)                       |
| <b>Madhya Pradesh<sup>33</sup></b> | Assistance of up to 40% on fixed capital investment. Additionally, 50% assistance up to INR 5 Cr on allied infra; 50% assistance up to INR 10 Cr for ETP with ZLD | Government land at ~50% of circle rate                              | 100% energy cess exemption (10 yrs); cross subsidy exemption; support for filing patents, copyrights, etc. | 30% subsidy on biomass equipment (up to INR 20 lakh/ set) + 50% under SMAM                             | –                                                                       | 10-year electricity duty & cess waiver; 50% stamp duty reimbursement on private land |
| <b>Uttar Pradesh<sup>34</sup></b>  | INR 75 lakh/tonne (up to INR 20 Cr)                                                                                                                               | INR 1/acre/ year lease for 30 years                                 | –                                                                                                          | 30% subsidy on biomass equipment (up to INR 20 lakh) + 50% under SMAM                                  | –                                                                       | 100% exemption                                                                       |

**CLU:** Change of Land Use, **ETP:** Effluent Treatment Plant, **FPO:** Farmers Producer Organisations, **OPEX:** Operating Expenses, **P&M:** Plant and Machinery, **SGST:** State Goods and Services Tax, **SMAM:** Sub-Mission on Agricultural Mechanization, **TPD:** Tonnes Per Day, **ZLD:** Zero Liquid Discharge.

<sup>30</sup> Integrated Clean Energy Policy, Andhra Pradesh.

<sup>31</sup> Bihar policy.

<sup>32</sup> Haryana Bio-energy Policy 2018, Haryana Government.

<sup>33</sup> Scheme for Implementation of Biofuel Project in Madhya Pradesh

<sup>34</sup> Uttar Pradesh State Bio-Energy Policy-2022

A few more States are in advanced stages of developing their state-level bio-energy policy. Such policy support not only improves the bankability of CBG projects but also ensures that ULBs receive the institutional support needed to implement these projects expeditiously under the guidance of the State Government.



*Picture-CBG plant at Hingonia, Jaipur*

### 3.3 Planning, Coordination, and Implementation Support

To accelerate the implementation of CBG projects, States must play a central role in institutional coordination, regional planning, and facilitation of market linkages. A structured governance mechanism at the State level, supported by decentralised planning at the ULB level, can greatly enhance the scalability and viability of CBG infrastructure.

#### A. State-Level Coordination Mechanism

States may establish a dedicated CBG Mission Cell or Steering Committee within the Urban Development Department or its equivalent, reporting to the Chief Secretary (CS). This body will serve as the apex planning and facilitation entity to:

- Guide ULBs on key aspects, such as project feasibility, land provision, technology evaluation, and cluster formation.
- Facilitate inter-departmental convergence with SATAT, state energy and transport departments, and existing CGD/OGMC infrastructure to support gas offtake and integration into energy networks.
- Monitor implementation progress, troubleshoot problems, and support ULBs in accessing financial and regulatory enablers.

## B. Cluster-Based Implementation Model

Many smaller ULBs may not be generating enough organic waste to sustain a viable CBG project. In such cases, a cluster-based approach should be adopted wherein neighbouring ULBs collaborate to aggregate waste and share infrastructure.

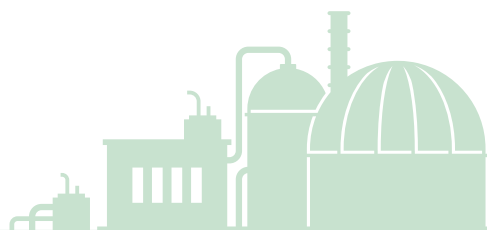
The State Government should:

- Identify anchor ULBs with higher waste generation and potential land availability, and connect/cluster them with smaller municipalities and local bodies (both rural and urban) for waste pooling.
- Coordinate project structuring and provide logistical and planning support, such as basic infrastructure of roads, electricity lines, common collection, and transportation fleet.
- Facilitate Tripartite or Multipartite Agreements among participating ULBs (with one acting as lead ULB), the private sector concessionaire, and the State Government (as a financial or institutional guarantor) to ensure clarity in roles, risk-sharing, and long-term accountability.
- Align this regional approach with the cluster-based model recommended under SBM (Urban) 2.0, enabling economies of scale and optimal utilisation of assets.

## C. Market Linkages and Product Offtake Facilitation

Ensuring the reliable offtake of CBG and co-products (FOM and LFOM) is crucial for project viability. States are encouraged to:

- Establish formal offtake arrangements with OGMCs and City Gas Distribution (CGD) entities for CBG sale.
- Facilitate partnerships with Fertilizer Marketing Companies (FMCs), cooperatives, or agri-input channels for the distribution of FOM.
- Coordinate with Agriculture, Horticulture, and PWD/Urban Development Departments to utilise FOM/LFOM in public parks, nurseries, and farming schemes.
- Issue government notifications or advisory circulars instructing relevant departments to prioritise the use of CBG and its by-products in their procurement, subsidy, or greening programmes and to support the States' Net Zero initiatives.



## 3.4 Monitoring and Reporting Framework

To ensure effective implementation and timely scaling of Compressed Biogas (CBG) projects, State Governments must establish robust monitoring and reporting mechanisms. Real-time tracking of project progress across Urban Local Bodies (ULBs) of the States will help identify bottlenecks, improve accountability, and strengthen policy outcomes.

It is recommended that States may use the national SBM (Urban) biogas portal for their CBG project monitoring, which enables centralised data collation and analysis at both the State and National levels.

### Key performance indicators may include:

- Number of ULBs with active/planned CBG projects.
- Waste processing capacity created vs. actual utilisation (Quantities of waste).
- Source segregation rate of municipal solid waste (Quality of waste).
- Volume of organic waste channelised and CBG generated.
- Revenue realisation from CBG, FOM, and LFOM.
- Product offtake metrics (e.g., linkages with OMCs, CGD, FMCs).

### Steering Committee for Monitoring Implementation and Governance

A State-level Steering Committee may be constituted under the chairmanship of the Chief Secretary, with representation from key departments to enable inter-departmental review and action.

Suggested composition of the Steering Committee:

- Chief Secretary – **Chairperson**
- Principal Secretary/Secretary – Revenue Department
- Principal Secretary/Secretary – Finance Department
- Principal Secretary/Secretary – Agriculture/Horticulture Department
- Principal Secretary/Secretary – Industry Department
- Principal Secretary/Secretary – Power/Energy Department
- Principal Secretary/Secretary, Urban Development, Municipal Administration/Local Self Government – **Convenor**

- State Mission Director SBM (Urban) – **Member Secretary**
- Representative from the State Pollution Control Board (SPCB)
- Representatives from Oil & Gas Marketing Companies (OGMCs) and CGD operators
- Representatives from selected ULBs or Municipal Commissioners
- Representatives from the State Nodal Bank
- Invitees: Nodal officials from planning departments, think tanks, institutions, etc.

The Steering Committee may conduct monthly reviews of progress, assess project implementation, project performance against defined KPIs, and guide inter-departmental coordination for land, offtake facilitation, regulatory approvals, and financial support. Periodic updates from this committee may be published on the state dashboard to ensure transparency and improve confidence in the CBG programmes.

## 3.5 Capacity Building and IEC

For the successful implementation and sustainability of Compressed Biogas (CBG) projects, State Governments must invest in building institutional and community-level capacity. Strengthening the capabilities of Urban Local Bodies (ULBs), operational staff, and citizens is essential to ensure the efficiency and endurance of CBG systems.

States should formulate a structured training and awareness plan, tailored to various stakeholder groups. This plan should cover technical, financial, regulatory, and behavioural aspects of CBG project development and operations.

Key focus areas include:

- Development and delivery of training modules for ULB officials, municipal engineers, plant operators, sanitation staff, and contractors. These should include topics, such as source segregation, project structuring, technology selection, O&M best practices, and monitoring protocols.
- Implementation of Information, Education, and Communication (IEC) campaigns to promote citizen participation, especially in source segregation of waste at the household and bulk generator levels, as well as in schools, colleges, etc.
- State-level workshops, webinars, and exposure visits involving successful CBG cities and experienced private developers to facilitate knowledge exchange and encourage adoption of best practices.
- Integration of IEC activities with SBM (Urban) communication strategies to amplify outreach and behaviour change at the grassroots.

By institutionalising regular training and public awareness efforts, States can build the human resources and community ecosystem, necessary for scaling and sustaining CBG initiatives across urban centres.

## Roles and Responsibilities of State Governments and ULBs for CBG Project Development

| S. No | Activity                                        | Responsibility of the State Government                                                                                                                               | Responsibility of the ULB                                                                                                            |
|-------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1     | CBG Potential Assessment and Target Setting     | Assess state-wise CBG potential; prepare roadmap; set ULB-wise implementation targets and identify high-potential clusters.                                          | Align ULB-level plans with state targets; identify at least 50% of organic waste for CBG project planning.                           |
| 2     | Policy and Financial Support                    | Frame CBG/Bio-Energy policy; offer capital subsidy, VGF, duty exemptions, land on concessional lease, and fast-track clearances. Similar to industrial estates/SEZs. | Facilitate developers in availing State/Central financial support; ensure land availability and administrative assistance.           |
| 3     | Project Planning and Coordination               | Form State CBG Mission Cell or Steering Committee; coordinate SATAT and CGD linkages; guide ULBs on clustering and project structuring.                              | Coordinate with State Cell for site readiness, DPR preparation, and stakeholder consultation; participate in cluster-based projects. |
| 4     | Regulatory and Statutory Approvals              | Enable single-window clearance for regulatory approvals; notify departments for prioritising the offtake/use of CBG products.                                        | Support a private developer in securing local approvals (building, environmental, utility connections, etc.)                         |
| 5     | Feedstock Assurance and Waste Management        | Allocate feedstock catchment area; support cluster formation and inter-ULB/cluster logistics.                                                                        | Ensure 90%+ source segregation; allocate and deliver at least 50% of organic MSW to CBG facility; maintain feed quality.             |
| 6     | Infrastructure Support (C&T, Transfer Stations) | Provide grants/financial assistance for vehicles and transfer stations in cluster projects.                                                                          | Deploy dedicated covered and partitioned vehicles for wet waste; establish transfer stations with separate organic waste bays.       |
| 7     | Market Linkages and Offtake                     | Facilitate MoUs with OMCs/CGDs/FMCs; notify line departments for use of FOM/LFOM in agri/horticulture.                                                               | Promote local use of FOM/LFOM in parks/gardens; support product marketing through IEC.                                               |
| 8     | Monitoring and Review                           | Establish a State-level dashboard linked to the SBM (Urban) portal; conduct monthly reviews under the Chief Secretary.                                               | Provide timely updates on project milestones; integrate reporting with the SBM (Urban) portal.                                       |
| 9     | Capacity Building and IEC                       | Develop state-level training modules and conduct workshops; promote best practice exchange.                                                                          | Train officials, staff, and collection workers; conduct local IEC for source segregation and citizen participation.                  |

04

# Layout of CBG Plant with Unit Operations



A standard Compressed Biogas (CBG) plant consists of several key components, including a weighbridge, feedstock reception area, pre-treatment and segregation zone, anaerobic digestion unit with a raw biogas collection balloon, biogas purification and upgradation system, CBG compression and bottling section, and a digestate management facility. Additionally, the plant is equipped with essential auxiliary systems, such as an Effluent Treatment Plant (ETP), biogas flare unit, diesel generator (DG) backup, and a comprehensive firefighting system.

This section provides an overview of the typical layout of a CBG plant and describes the major unit operations involved – from feedstock intake to biogas purification and CBG evacuation.

## 4.1 Overview of Major Unit Operations

The following flowchart shows the sequential operations from feedstock intake and digestion to gas purification, compression, and storage, along with supporting units, including FOM/LFOM handling and utility systems.



The **Weighbridge** is an essential part of a plant, used to measure the weight of vehicles carrying waste or other materials. Vehicles are weighed before and after unloading to calculate the net weight of waste delivered. This helps in tracking feedstock quantity, maintaining records, and ensuring accurate billing. Modern weighbridges often include automated systems for data logging and integration with plant software, improving efficiency and reducing manual errors.

The **Waste Reception Area**, where organic waste is unloaded into the receiving pit, must be maintained under negative pressure to minimise odour dispersion. This controlled environment helps contain foul smells and prevents them from escaping into surrounding areas. The extracted air should be routed through an effective odour control system, such as an activated carbon filtration unit or biofilter, ensuring compliance with environmental norms and maintaining a safe, odour-free working atmosphere.

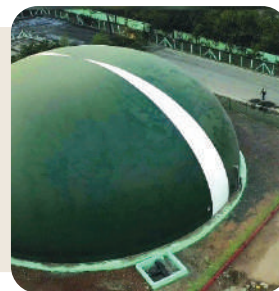


**Pre-treatment** ensures uniform feedstock by removing non-digestible materials like plastics, metals, and stones through source segregation or mechanical sorting. The organic waste is then shredded and mixed with water to create a slurry (8-12% solids) for efficient digestion. Source segregation is crucial, as it improves slurry quality, enhances manure output, and reduces energy and capital costs linked to mechanical separation, thus improving the plant's overall economic viability.



The **Anaerobic Digestion (AD)** unit uses technologies like CSTR or plug flow systems. In India, mesophilic conditions (35–38°C) are preferred due to favourable climate, with a Hydraulic Retention Time (HRT) of 25–40 days. While thermophilic digestion (50–65°C) offers faster processing, it demands higher energy input, tighter process control, and skilled operation, making it suitable only where technical expertise and infrastructure are available to manage the system effectively.

A **Gas-mounted Balloon** is a flexible, gas-tight storage unit used to temporarily hold purified biogas before compression in a CBG plant. It helps maintain consistent pressure and ensures a steady gas flow to the compressor. Typically made from UV-resistant and durable materials, these balloons play a crucial role in buffering gas fluctuations, supporting continuous operation, and enhancing the safety and efficiency of the overall biogas management system.



The **Biogas Purification and Upgradation Unit** is essential for increasing the methane content to ≥95% by removing impurities, such as CO<sub>2</sub>, H<sub>2</sub>S, moisture, and siloxanes. This ensures the biogas meets fuel-grade standards for CBG. Common technologies used for this process include Pressure Swing Adsorption (PSA), water scrubbing, and membrane separation, all of which enhance gas quality for safe storage, compression, and injection into gas grids or bottling systems.

The **CBG Compression, Bottling, and Dispatch Unit** compresses purified biogas to 200–250 bar for storage or transport. CBG is either filled into high-pressure cylinders for distribution or injected into the city gas grid, depending on the infrastructure and pressure requirements. The final use of CBG includes vehicle fuel, domestic cooking applications, or as a clean industrial energy source, supporting energy diversification and emissions reduction.



The **Digestate Management Unit** handles the slurry left after biogas production, which contains organic matter and nutrients like N, P, and K with 85–90% moisture. Solid-Liquid Separation (SLS) is carried out using equipment, such as screw presses or centrifuges, producing solid FOM and liquid LFOM. FOM is windrow-composted for 4–6 weeks, then sieved, tested, and bagged. LFOM may be filtered, enriched, and diluted (1:10) before use in soil or foliar application.

**Auxiliary Systems** in a CBG plant include an Effluent Treatment Plant (ETP) for managing wastewater generated during processing, a biogas flare system to safely burn off excess or unusable gas during emergencies or maintenance, and a diesel generator (DG) backup to ensure uninterrupted operations in areas with unreliable power supply. These systems are critical for maintaining environmental compliance, operational safety, and plant reliability.

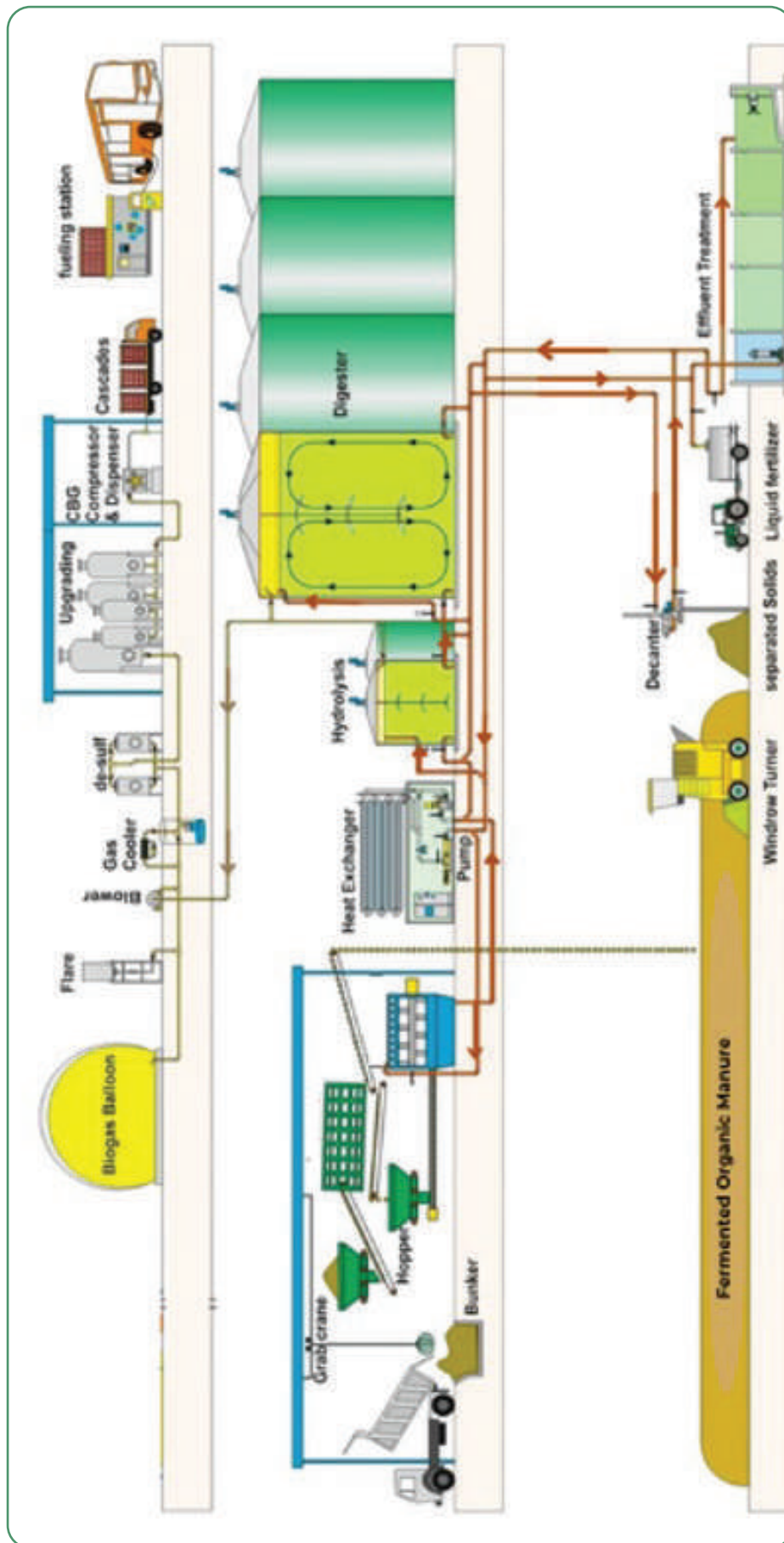


## 200 m

100 m

For a 100 TPD feedstock CBG plant, a Land area of 16,000 to 20,000 sq metre (4-5 acres) is required.

Process Flow Diagram of a Typical CBG Plant



## 4.2 Detailed Description of Various Processes in CBG Generation

### 4.2.1 Pre-treatment of Organic Fraction of MSW

The initial and the most critical step in pre-treatment is the removal of non-organic contaminants from the organic waste stream. Even visibly clean, source segregated organic waste often contains plastics, metals, glass, and other inert materials that can disrupt the digestion process or damage plant equipment. To mitigate this, a combination of manual and mechanical sorting methods is used. Trained workers and machines identify and separate contaminants, while specialised equipment enhances efficiency, magnets extract ferrous metals, eddy current separators remove non-ferrous metals, depackers separate packaging material, jaw crushers reduce particle size, and trommel screens classify waste based on size. These processes ensure that the organic fraction is clean, consistent, and ready for efficient digestion.

The operator should take care to exclude materials, such as wood, twigs, and fibrous or high-lignin food waste from the feedstock, as these can hinder biogas generation and affect digestion efficiency.

### 4.2.2 Digestion Process

Effective monitoring and control of anaerobic digestion are crucial for maintaining optimal conditions, maximising biogas production, and preventing process upsets. The process involves several key stages – hydrolysis, acidogenesis, acetogenesis, and methanogenesis, where organic materials are converted into carbon dioxide and methane by anaerobic microorganisms.

#### Anaerobic Digestion – Key Stages

- **Hydrolysis:** Breakdown of complex organics (carbohydrates, fats, proteins) into simpler compounds like sugars and amino acids.
- **Acidogenesis:** Conversion of these compounds into volatile fatty acids (VFAs), alcohols, CO<sub>2</sub>, H<sub>2</sub>, and ammonia.
- **Acetogenesis:** VFAs and alcohols are transformed into acetic acid, CO<sub>2</sub>, and H<sub>2</sub>.
- **Methanogenesis:** Methanogens convert acetic acid and hydrogen into methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>).

#### Key Monitoring Parameters

- **Temperature:** Maintain 25°C–37°C (mesophilic range).
- **pH:** Ideal range is 6.5–8.4 for optimal microbial activity.



**Picture**–Typical Digester Design for Anaerobic Process at Prayagraj

Digesters: Typically made from concrete, steel, or prefabricated plastic, with thermal insulation and heating systems for optimal temperature control.

## Monitoring Requirements for Optimised Performance

Regular assessment and analysis of key operational parameters are essential to ensure efficient digester operation, maximise biogas yield, and maintain overall plant performance. Critical parameters include biogas composition, particularly methane ( $\text{CH}_4$ ) and carbon dioxide ( $\text{CO}_2$ ) levels, which reflect gas quality and process health. Monitoring volatile fatty acids (VFAs) helps detect imbalances early, while the alkalinity ratio (FOS/TAC) indicates the system's buffering stability. Tracking total solids (TS), volatile solids (VS), and organic loading rate (OLR) provides insight into the organic load and feedstock management. Consistent mixing prevents stratification and supports uniform microbial activity. Ideally, temperature, pH, and biogas composition should be monitored twice daily, while TS, VS, and OLR should be checked once daily to sustain optimal digester performance.

### Key Parameters to Monitor

- Biogas Composition ( $\text{CH}_4$ ,  $\text{CO}_2$ )
- Volatile Fatty Acids (VFAs)
- Alkalinity Ratio (FOS/TAC)
- Total Solids (TS)
- Volatile Solids (VS)
- Organic Loading Rate (OLR)
- Temperature
- pH
- Mixing Efficiency

To ensure stable and efficient operations, CBG plants use sensors, meters, and control systems to monitor key parameters like temperature, pH, and gas composition. Integrated with SCADA or PLC, they enable real-time monitoring, remote control, and automated adjustments. This ensures stable operations, improves efficiency, and helps meet safety and compliance requirements.

## Sensors, Meters, and Control Systems

Equipment and systems, such as sensors, meters, and control units are installed to monitor and regulate key process parameters. Devices like fixed and portable gas analysers are commonly used for real-time gas composition analysis.



**Picture**–Laboratory at a CBG facility | CBG Gas Analysers

### 4.2.3 Collection and Storage of Biogas

The biogas generated during the anaerobic digestion process must be efficiently collected and stored to maintain a steady supply for purification and compression. A well-designed biogas storage system acts as a buffer between gas production and its downstream utilisation (compression, bottling, or grid injection). It also helps regulate pressure fluctuations and ensures operational continuity during variations in feedstock input or plant load.

Storage systems must be gas-tight, corrosion-resistant, and equipped with safety features, such as pressure relief valves and flame arrestors. Regular monitoring is essential to detect leaks and maintain safe operating conditions.

#### Types of Gas Holders

- Floating-drum Gas Holders: Feature a movable drum that rises or falls with gas volume, typically used in floating-drum systems.
- Fixed-dome Gas Holders: Store gas under a rigid, immovable dome structure, common in fixed-dome plants.
- Plastic Gas Holders: Flexible storage units, often used in balloon-type digesters or as stand-alone gas storage bags.



*Picture—Fixed-dome Gas Holder at Namakkal CBG plant*

#### 4.2.4 Biogas Purification and Utilisation

Biogas purification is essential to upgrade raw biogas by removing impurities, such as hydrogen sulphide ( $\text{H}_2\text{S}$ ), carbon dioxide ( $\text{CO}_2$ ), moisture, and particulates, enhancing methane content to over 95% for use as Compressed Biogas (CBG). Various techniques are employed, depending on plant scale and desired output quality:

- **Water Scrubbing:** Removes  $\text{CO}_2$  and  $\text{H}_2\text{S}$  by dissolving them in water under pressure (6–10 bar).
- **Pressure Swing Adsorption (PSA):** Eliminates  $\text{CO}_2$ ,  $\text{H}_2\text{S}$ , and moisture using selective adsorption at 3–10 bar.
- **Membrane Separation:** Separates methane from other gases at 5–20 bar using semi-permeable membranes.
- **Cryogenic Separation:** Cools the gas to condense and separate impurities based on temperature.
- **Activated Carbon:** Adsorbs  $\text{H}_2\text{S}$ ; requires periodic media replacement or regeneration.
- **Bio-filtration:** Uses microbial media (e.g., wood chips) to oxidise  $\text{H}_2\text{S}$  in an eco-friendly way.
- **Fine Filters:** Remove particulates (2–5  $\mu\text{m}$ ); require regular replacement.

The choice of purification system depends on biogas quality, end-use application, and operational considerations.



**Picture**–Purification System at Namakkal CBG plant

## End-Use Options for Purified Biogas (CBG)



### Injection into City Gas Network

Wherever pipeline infrastructure is available, CBG can be directly injected into city gas distribution networks for residential, commercial, or industrial consumption. Plants adhering to IS:16087 standards can partner with Oil and Gas Marketing Companies under the SATAT scheme. In areas lacking pipeline access, CBG may be compressed, stored in cascades, and transported to end users.

### Bottling and Market Supply

In the absence of pipelines, CBG can be bottled and sold as a clean fuel alternative to LPG for cooking and industrial applications. Bottled CBG can also be supplied to CNG dispensing stations, making it viable for fuelling city buses and other CNG-compatible vehicles, based on demand.





#### Electricity Generation

Though less efficient and not cost-effective than other uses, purified biogas can be used to run gas engines and generate electricity, particularly where power backup or off-grid solutions are needed. However, this is generally considered a secondary use due to lower returns.

### 4.2.5 Excess Gas Flaring

When purified biogas cannot be evacuated or utilised due to limited storage, downtime in grid injection, or offtake delays, safe flaring becomes essential to manage pressure and ensure plant safety. It involves controlled combustion of surplus biogas through a flare stack or enclosed flare. A controlled flaring system allows excess gas to be safely combusted, preventing the release of methane into the atmosphere.

Flaring is not a routine practice but serves as a necessary safety measure. Flare units should be equipped with flame arrestors, automatic ignition, and pressure control systems, ensuring compliance with environmental and safety standards during emergency or backup scenarios.



Picture-Gas Flare

### 4.2.6 Slurry Management

The solid and liquid residuals in biogas production are referred to as slurry. The slurry after digestion has economic value and can be utilised either as Fermented Organic Manure (FOM) and/or LFOM, depending on the requirement and suitability of use conditions. Separation of liquid and solid fractions of the slurry or digestate from the digester in the biomethanation plant leads to the production of Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (LFOM).

#### A. Fermented Organic Manure (FOM)

After biogas production, the remaining digestate contains partially decomposed organic material, essential plant nutrients (N, P, K), and moisture. To convert this into Fermented Organic Manure (FOM), the digestate's moisture is reduced to an optimal range of 30–70%, as specified in the Third Amendment Order of the Fertilizer Control Order (FCO), 2025. This is achieved by blending it with bulking agents like sawdust, garden clippings, or similar materials. The mixture is then cured for 4–6 weeks to stabilise and enrich its organic content.

## Usage of FOM

FOM can be marketed to Fertilizer Marketing Companies (FMCs) or sold directly to farmers, creating an additional revenue stream. Packaging must indicate that FOM should be applied 15-20 days before sowing. Producers may also enrich FOM with added nutrients, provided labelling complies with FCO norms. FOM improves soil health by enhancing aeration, moisture retention, and nutrient availability.



*Picture-Drying of FOM at Namakkal CBG project*

## B. Liquid Fermented Organic Manure (LFOM)

The liquid fraction of the digestate, rich in dissolved nutrients and beneficial microbes, is referred to as Liquid Fermented Organic Manure (LFOM). According to the Fertilizer (Inorganic, Organic or Mixed) (Control) (Third) Amendment Order, 2025, LFOM should contain 90-97% moisture and at least 1.5% organic carbon by weight.

## Usage of LFOM

LFOM is typically diluted before application. A standard dilution ratio is 1:10 (1 litre LFOM to 10 litres of water), but it can be adjusted based on crop needs and local agricultural guidelines. The diluted solution can be applied directly to the soil around plant bases or used as a foliar spray to improve nutrient absorption and plant health.

### Government incentive for the usage of FOM and LFOM

The Government of India promotes the adoption of LFOM and FOM through initiatives like the GOBARdhan scheme and Market Development Assistance (MDA), providing a subsidy of INR 1500/tonne.



05

# Tendering & Contracting for CBG Projects

Tendering and contracting for Compressed Biogas (CBG) projects require a well-defined and structured approach, typically anchored in a Public-Private Partnership (PPP) framework. In this setup, Urban Local Bodies (ULBs) play a pivotal role as facilitators, providing land, ensuring source segregated organic waste supply, enabling regulatory approvals, and offering institutional support. On the other hand, private developers or Oil and Gas Marketing Companies (OGMCs) are entrusted with the design, financing, construction, operation, and long-term maintenance of the CBG facilities.

This section provides a comprehensive overview of the recommended contracting structures, institutional roles, risk-sharing mechanisms, and compliance requirements for successful implementation of CBG projects in urban areas.

## 5.1 Contracting Arrangements for CBG Projects

Establishing a Compressed Biogas (CBG) facility requires a comprehensive project framework that integrates technical, operational, legal, and financial aspects. A Public-Private Partnership (PPP) model is strongly recommended for Urban Local Bodies (ULBs) intending to implement such projects. Under this approach, the private sector, either a private developer selected through competitive bidding or an Oil and Gas Marketing Company (OGMC) through a joint initiative with ULB, can act as the concessionaire.

### PPP Framework for Setting Up CBG Facilities

The selected PPP concessionaire is responsible for setting up the CBG plant on a DBFOT (Design, Build, Finance, Operate and Transfer) basis. This includes bearing the entire capital expenditure (CAPEX) and operational expenditure (OPEX). Revenue recovery is primarily through the sale of Compressed Biogas (CBG), Fermented Organic Manure (FOM), Liquid FOM (LFOM), and potential carbon credits. Government support in the form of capital subsidies is available to facilitate the initial infrastructure setup and incentivise the sale of CBG and its by-products, as outlined in earlier sections of this advisory. Additionally, a Viability Gap Funding (VGF) of up to 30% of the project's capital cost is available under central government assistance as per the DEA, MoF.

The ULB's key responsibilities include:

- Providing encumbrance-free land for the project site and utility connections for power, water supply, etc.;
- Ensuring a regular supply of good-quality, source segregated organic fraction of municipal solid waste (OFMSW) to maintain plant efficiency and product quality;
- Facilitating necessary statutory clearances and coordination with relevant authorities.

By leveraging the PPP model, ULBs can implement CBG projects without incurring upfront CAPEX while enabling sustainable waste processing, renewable energy generation, and circular economy outcomes through effective public-private collaboration.

## 5.2 Scope of ULBs and Other Government Authorities

Municipalities and relevant authorities play a crucial role in enabling compressed biogas projects through the following:

1. **Encumbrance-free Land Provision:** Leasing or allocation of land for the compressed biogas plant, including basic infrastructure, such as access roads, water, and power connection up to the plant site at designated points marked in the land maps/drawings.
2. **Infrastructure Support:** Ensuring the availability of essential utilities (power, water, sewage) at the project site and integrating waste collection and sorting systems to ensure a consistent feedstock supply. Provision of Viability Gap Funding (VGF) may be considered.
3. **Regulatory Facilitation:** Facilitating the issuance of authorisation, CTE, CTO, construction permits, and operating licences, etc.
4. **Off-take Guarantees:** Securing the off-take of biogas products (CBG and organic fertilisers) to ensure sustained operations and minimise the need for gas flaring of surplus generation.
5. **Organic Fraction of Municipal Solid Waste (OFMSW):** ULBs shall ensure segregation at the source and a regular supply of organic waste, with agreements stipulating minimum volumes and quality standards.
6. **Supply Chain Management:** Establishment of a dedicated logistics team or engagement of a contractor to manage feedstock collection and transport. ULBs may provide waste collection trucks or transfer stations.
7. **Collection Back of Inerts/Rejects:** Any non-biodegradable fraction separated during the initial sorting and material handling phase shall be collected back by the ULB and transported to the designated site for safe disposal.

## 5.3 Scope of Project for Private Partner/Contractor

The scope of work for the private partner/contractor shall include the following:

1. **Design and Built:** After selecting the suitable set of technology – designing, building, financing, and commissioning the project facilities by the Scheduled Commercial Operation Date (COD), in compliance with applicable laws, performance standards, applicable permits, technical specifications, designs, drawings, the project execution plan, DPR, construction plan, EMP, OHS plan, and good industry practices.
2. **Operation and Maintenance:** Operating and maintaining the project facilities as per applicable laws, performance standards, permits, technical specifications, designs, drawings, the O&M plan, EMP, OHS plan, and good industry practices to ensure compliance with KPIs.

3. **Output and Disposal:** Selling CBG to designated off-taker(s), managing by-products and recyclables, and delivering residual inert and reject waste to the ULB as per the agreement.
4. **Handover:** Returning the project facilities to the ULB at the end of the Concession Agreement, in line with the specified hand-back conditions and requirements.
5. **Indemnification:** If public or leased land is used, the developer must indemnify the ULB or landowner against environmental damage, accidents, or third-party claims arising from plant operations.

## 5.4 Approvals Required

Setting up CBG plants in India requires obtaining several approvals and adhering to various regulations. An overview of the necessary approvals involved is provided in the table below:

| S. No | Approvals Required                                            | Before Construction (New Factory) | After Construction but before Production/ Operation | Renewal        | Timeline   |
|-------|---------------------------------------------------------------|-----------------------------------|-----------------------------------------------------|----------------|------------|
| i.    | Land conversion to Non-Agricultural (for Non-Industrial land) | Conversion and Registration       | Not Applicable                                      | Not Applicable | 1-2 months |
| ii.   | Fire                                                          | NOC (No Objection Certificate)    | Licence                                             | Required       | 1-2 months |
| iii.  | Health & Safety                                               | NOC                               | Licence                                             | Required       | 1-2 months |
| iv.   | PCB (Pollution Control Board)                                 | Consent to Establish              | Consent to Operate                                  | Required       | 2-3 months |
| v.    | PESO (Petroleum and Explosives Safety Organization)           | Licence                           | Licence                                             | Required       | 2-3 months |
| vi.   | Factories or the Labour Department                            | Plan Approval                     | Factory Licence                                     | Required       | 1-2 months |

There is a need for coordinated efforts between State Governments and ULBs to support the implementation of CBG projects, as they play crucial roles in enabling policy, infrastructure, and operational frameworks. States should formulate and implement “State Bio-Energy Policies” aligned with national initiatives like GOBARDhan, SATAT, SBM, etc. Further, ULBs should engage actively in setting up and operating the CBG projects.

## 5.5 Standard Bidding Documents

To support the implementation of SBM (Urban), the Ministry of Housing and Urban Affairs (MoHUA) has developed Model Contract Documents, comprising a Model Request for Proposal (RFP) and a Model Concession Agreement (MCA), collectively referred to as Model Documents that can be accessed at the link:

<https://sbmurban.org/storage/app/media/Waste-to-compressed-BIOGAS.pdf>

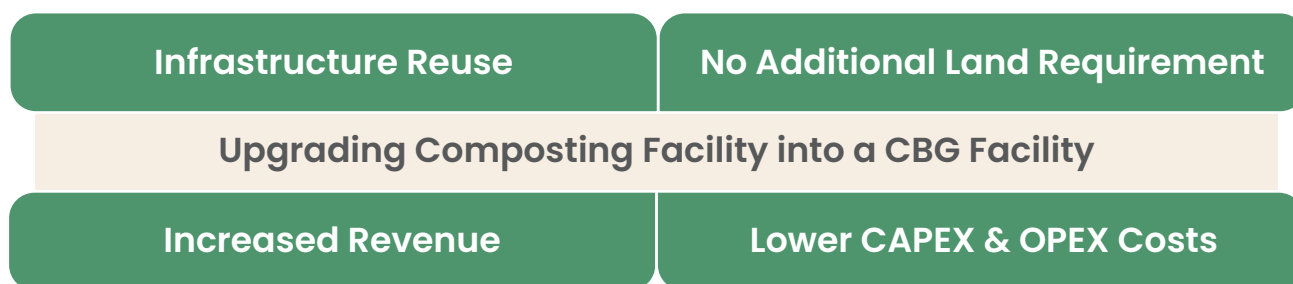
| Pre-Tendering Guidance Notes                                                                                                                                                                                                                                                                                                                                                           | Model Request for Proposal (RFP)                                                                                                                                                                                                                                                                                                                                                                      | Model Concession Agreement (MCA)                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Provide preparatory guidance and readiness checklist for ULBs before tendering.</li> <li>• Include project background, waste supply assurance, and site-specific details.</li> <li>• Require site assessment and contamination verification.</li> <li>• Ensure availability of land, statutory approvals, and utility connections.</li> </ul> | <ul style="list-style-type: none"> <li>• Enables transparent and competitive bidding with clear bid parameters.</li> <li>• Defines acceptable waste composition and project scope in the RFP.</li> <li>• Sets qualification thresholds emphasising bidder experience and track record.</li> <li>• Financial selection based on a single predefined parameter (e.g., grant or tipping fee).</li> </ul> | <ul style="list-style-type: none"> <li>• Defines legal roles and obligations of ULB and concessionaire over a 25-year term.</li> <li>• Mandates an Escrow Account to ensure transparent revenue and payment flows.</li> <li>• Requires a Letter of Credit (LoC) to safeguard ULB's payment commitments.</li> <li>• Includes Performance Security provisions to ensure contractual compliance.</li> </ul> |

**Figure**–Components of the Standard Bid Document Package

These Model Bid Documents are designed for use by Urban Local Bodies (ULBs) to implement Compressed Biogas (CBG) projects under the DBFOT (Design, Build, Finance, Operate, and Transfer) model through Public-Private Partnerships. To remain eligible for central assistance, such as Viability Gap Funding (VGF) under SBM (Urban) 2.0, ULBs must adopt these documents with only minimal and essential modifications, without altering key elements like bidding parameters, KPIs, and risk-sharing structures. Approved by the SBM (Urban) Mission Directorate at MoHUA, these documents serve as a standardised toolkit to promote transparency, enhance project bankability, reduce contractual risks, and ensure the long-term financial and operational viability of CBG projects across Indian cities.

## 5.6 Upgrading of Existing Composting Facilities to CBG Facilities

If the existing composting facilities fit the minimum site selection criteria for the CBG facility mentioned in this advisory, then its upgradation into a CBG facility should be considered. This upgradation brings significant advantages over greenfield development.



Figure–Upgrading composting facility into a CBG facility

## 1. Land Availability

Most composting plants in Urban Local Bodies (ULBs) are built on large parcels of land allocated specifically for solid waste management, spread over several acres, sufficient for establishing a 100 TPD CBG facility. This avoids the long process of land acquisition and environmental clearances.

## 2. Optimal Use of Concessionaire Lifecycle

Where facilities are run by private operators under PPP models, the remaining concession period can be leveraged to transition into higher-revenue operations like CBG production. This benefits both the concessionaire and the municipality with better returns and improved waste utilisation.

## 3. Infrastructure Reuse

A few of the existing machinery can be reused, such as:

- Waste receiving, storage, and segregation infrastructure, including trommels, conveyors, and feeding lines is reusable.
- Most composting facilities have leachate management systems, designed for anaerobic environments, which can be upgraded to handle digestate slurry from CBG plants.
- Compost drying beds can be used to dry the Fermented Organic Manure (FOM).
- Civil infrastructure (roads, drains, office, water, electricity) is already in place and might need upgradation as per site conditions.

## 4. Cost Benefits

- **CAPEX savings** compared to setting up a new plant due to several reusable components.
- **Faster commissioning** (6–9 months) due to shorter planning and approval cycles.
- **Less OPEX burden** on ULBs due to enhanced revenue streams from CBG and FOM sales.

 Rerouting of the MSW fraction during the construction period is to be planned

 Mandatory distance to nearest sensitive receptors to be reconfirmed

06

# Cost and Revenue



Investing in CBG plant infrastructure offers a valuable opportunity for sustainable project development through private sector or OGMC participation, provided financial planning and support mechanisms are effectively utilised. While capital investment is primarily undertaken by the promoter, Urban Local Bodies (ULBs) play a crucial facilitative role. ULBs must ensure timely approvals, land availability, and a consistent supply of source segregated organic waste to create a conducive environment for private investment. To enhance financial viability, ULBs should actively support the promoter in securing Viability Gap Funding (VGF) and other eligible grants under relevant Central and State Government schemes.

Nonetheless, achieving full financial closure requires close coordination between ULBs and the promoter or concessionaire to mobilise diverse funding sources, such as grants, loans, private equity, and carbon credits. A well-structured revenue model driven by the sale of CBG, FOM, and other by-products is essential for long-term project sustainability.

## 6.1 CAPEX Requirement

For a 100 TPD Compressed Biogas (CBG) facility, the estimated capital expenditure is approximately INR 32.00 crore, with an additional INR 8.00 crore required for the biogas upgradation and purification system. In addition, the development of pipeline infrastructure involves further investment; however, this cost is not to be borne by the promoter or concessionaire. Instead, it will be fully undertaken by the CBG off-taker (CGD or GPO), with financial support from the Government of India and in accordance with pipeline usage charges or tariffs, as mutually agreed under the tripartite agreement. Technical details of a CBG plant are provided in the table below:

| S. No. | Technical Details                                | >90% Segregated Waste      |
|--------|--------------------------------------------------|----------------------------|
| i.     | Total waste receipt at site                      | 120 TPD                    |
| ii.    | Organic waste recovered for biogas generation    | 100 TPD                    |
| iii.   | Raw biogas generation expected                   | 10,000 m <sup>3</sup> /day |
| iv.    | CBG generation expected (<4% methane losses)     | 3,500 kg/day               |
| v.     | Organic manure generation as per FCO norms (FOM) | 30 TPD                     |
| vi.    | Liquid manure generation (LFOM)                  | 60 TPD                     |
| vii.   | Number of operational days in a year             | 330 days/year              |
| viii.  | Power requirement                                | ~7500 kWh/day              |
| ix.    | Power purchase rate                              | 9.25 INR/kWh               |

Indicative capital expenditure of a 100 TPD CBG plant is provided in the table below:

| S. No. | CAPEX Break-up                                                                                         | Amount (INR lakh) |
|--------|--------------------------------------------------------------------------------------------------------|-------------------|
| i.     | Land development, pre-project expenses & costs incurred till COD                                       | 100               |
| ii.    | Pre-processing equipment                                                                               | 555               |
| iii.   | Biogas digesters & other tanks (civil and equipment)                                                   | 1,200             |
| iv.    | Civil work includes the construction of digesters, buildings, and footings and sheds for the machinery | 340               |
| v.     | Piping, valves, pumping and instruments                                                                | 90                |
| vi.    | Electrical and automation work                                                                         | 245               |
| vii.   | Effluent Treatment Plant                                                                               | 110               |
| viii.  | Manure processing (solid separation, enrichment & solar drying to FOM)                                 | 165               |
| ix.    | AHU & odour control system                                                                             | 75                |
| x.     | Fire & safety system                                                                                   | 30                |
| xi.    | Vehicles (front loaders, tractors, etc.)                                                               | 50                |
| xii.   | Compliances & permissions                                                                              | 40                |
| xiii.  | Design, engineering, EPC costs (approx. 8% of project cost)                                            | 240               |
|        | <b>CAPEX sub-total before upgradation</b>                                                              | <b>3,240</b>      |
| xiv.   | Biogas upgradation/purification system                                                                 | 675               |
| xv.    | CBG high pressure tubing, piping, online GC, metering                                                  | 125               |
|        | <b>CAPEX subtotal for upgradation</b>                                                                  | <b>800</b>        |
|        | <b>Total CAPEX for CBG production facility</b>                                                         | <b>4,040</b>      |



## 6.2 Financing Requirement

The total project cost of INR 4,040 lakh includes the central government support and the share to be contributed by the PPP concessionaire. Considering a VGF support of 25% of the overall cost, gap funding of INR 1,010 lakh is available for the project. The remaining 75% (INR 3,030 lakh) is to be mobilised by the concessionaire under PPP model, with a financing structure of 70% debt and 30% equity.

| Component                      | Amount (INR lakh) |
|--------------------------------|-------------------|
| Total Project Cost             | 4,040             |
| VGF Support (25%)*             | 1,010             |
| PPP Concessionaire Share (75%) | 3,030             |

*\*In case of PPP projects, payment of VGF support can be availed as per central government support assistance. For the above calculation, VGF support of 25% of the project cost is considered.*

### Financing Structure of PPP Share

| Mode of Financing | Ratio (%) | Amount (INR lakh) |
|-------------------|-----------|-------------------|
| Debt              | 70%       | 2,121             |
| Equity            | 30%       | 909               |
| Total (PPP Share) | 100%      | 3,030             |

*\*Debt is considered to be financed at an interest rate of 12% per annum over a 15-year repayment period with equal annual instalments (EPI). Based on this, financing cost has been calculated annually and referred into the annual OPEX in section 5.5 that is required to service the loan taken under the PPP financing model.*

## 6.3 Timelines of Project Implementation

Effective project implementation requires meticulous planning and adherence to timelines to prevent delays and cost overruns. The schedule should encompass key phases, such as detailed engineering and design approvals, procurement, construction, and operationalisation. It must reflect the duration, sequencing, and dependencies of each activity, while factoring in project complexity, resource availability, regulatory clearances, climatic conditions, and potential risks. Timely execution across all stages is critical to ensuring project success and financial discipline.

An indicative timeline for a typical large-scale CBG project is given below:

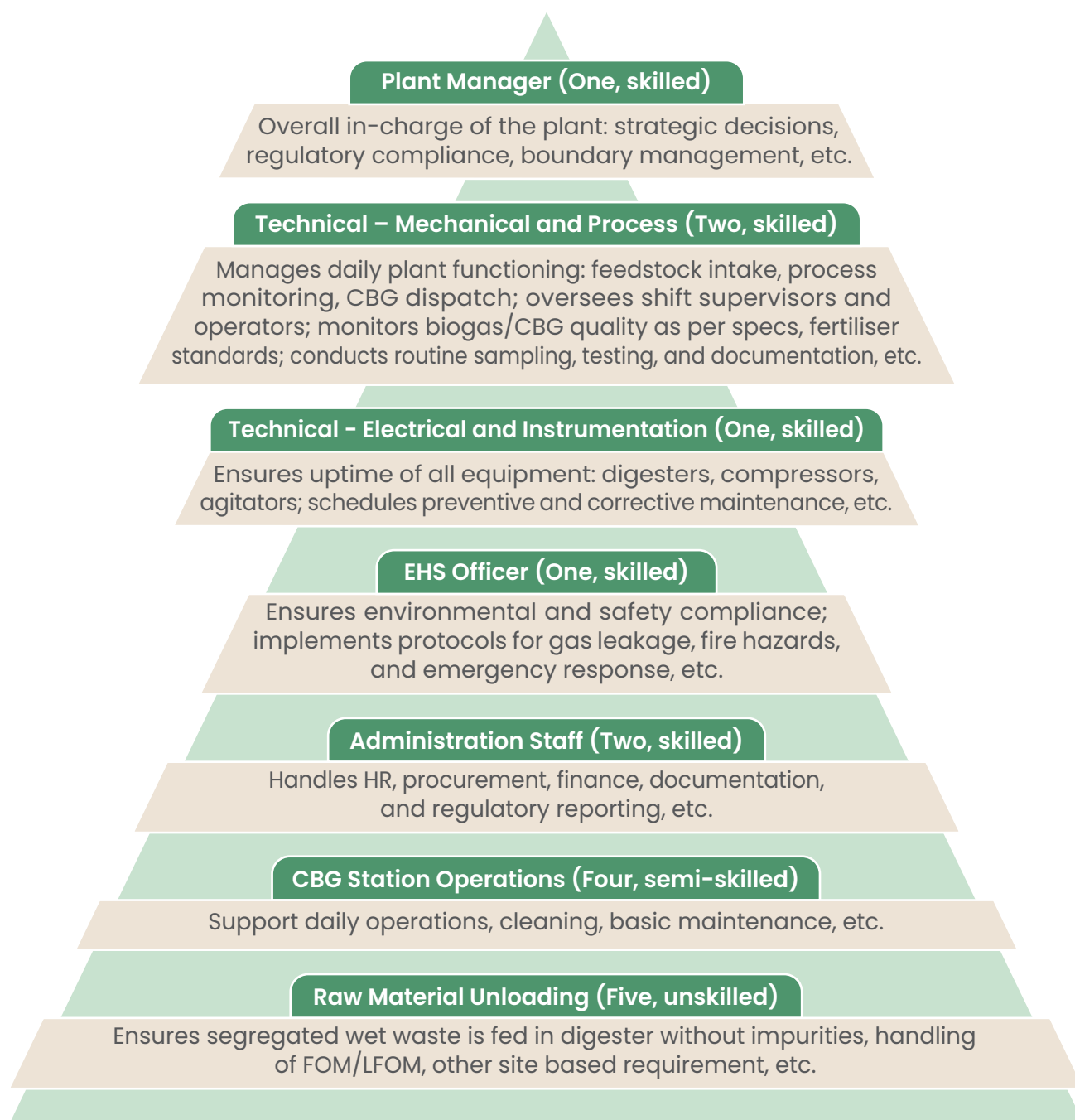
| Activities                                                                                                                                                                       | Months                                          |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---|---|---|---|---|---|---|--------------------------------------------------------------------------------|----|----|----|----|----|----|----|----|----|
|                                                                                                                                                                                  | 1                                               | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9                                                                              | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|                                                                                                                                                                                  | Initial 6 Months Project Development Activities |   |   |   |   |   |   |   | 12 Months for Tendering, Award of Work, Project Construction and Commissioning |    |    |    |    |    |    |    |    |    |
| <b>Preliminary Planning</b>                                                                                                                                                      |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Identify potential sources of feedstock; assess the availability of feedstock in segregated manner; evaluate the quality and quantity of feedstock                               |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Land Assessment and Acquisition</b>                                                                                                                                           |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Identify suitable land for CBG plant; conduct suitability analysis and accessibility                                                                                             |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Technology Selection</b>                                                                                                                                                      |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Explore various CBG technology options; assess the suitability and efficiency of different technologies; select the most appropriate technology for ULB's requirements           |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Project Development</b>                                                                                                                                                       |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Obtain necessary approvals from local authorities; prepare Detailed Project Report (DPR); conduct environmental due-diligence; estimate project costing and funding requirements |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Funding Arrangements</b>                                                                                                                                                      |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Identify sources of funding; prepare and submit proposals to funding agencies; finalise funding agreements                                                                       |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Tendering and Work Award</b>                                                                                                                                                  |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Prepare tender documents; float tenders; evaluate bids; and award work to selected contractor                                                                                    |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Mobilisation &amp; Infrastructure Setup</b>                                                                                                                                   |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Site mobilisation; procurement of materials; civil works, erection of electro-mechanical components; other infrastructure development, mechanical commissioning                  |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| <b>Commissioning and Testing</b>                                                                                                                                                 |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |
| Conduct testing and trial runs; ensure system performance; PGTR and regulatory compliance                                                                                        |                                                 |   |   |   |   |   |   |   |                                                                                |    |    |    |    |    |    |    |    |    |

▼ Achieving mechanical commissioning by the end of the 15<sup>th</sup> month

## 6.4 Institutional Setup

A well-defined institutional setup is essential to ensure efficient operations and clear accountability in CBG plants. For a 100 TPD CBG facility, a dedicated operations team typically comprises 15–16 personnel, working across two (2) shifts to manage daily activities effectively.

An ideal institutional setup with designation and role is provided below:



**Figure**–Flow chart of institutional setup with designation and role

All the above personnel (except the Plant Manager) shall need to be deployed for two (2) shifts.

## 6.5 OPEX Requirements

The Operation and Maintenance (O&M) cost of a CBG plant varies, depending on plant capacity, feedstock type, personnel, and site-specific conditions. For a 100 TPD CBG facility, assuming grid injection into the City Gas Distribution (CGD) network, the estimated annual operational cost is approximately INR 426 lakh per annum (as shown in the table below). This includes material handling, electricity consumption, consumables, maintenance & repair, personnel costs, and other incidental costs.

An overview of the major cost components is provided below:

| S. No. | Description                                   | Annual Cost (in lakh INR) | Remarks                                                                                                                                   |
|--------|-----------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| A.     | Day-to-Day Operations & Maintenance           |                           |                                                                                                                                           |
|        | 1. Material Handling Cost                     | 17.50                     | Initial waste sorting and removal of inorganics from the input feed                                                                       |
|        | 2. Electricity Consumption                    | 229                       | Estimated requirement of 7,500 kWh/day at a rate of INR 9.25/kWh                                                                          |
|        | 3. Consumables                                | 63                        | Includes diesel, chemicals, spares, lube oil, etc.                                                                                        |
|        | 4. Personnel                                  | 108                       | As per requirements mentioned in section 5.4                                                                                              |
|        | 5. Other Contingencies (@2%)                  | 8.35                      | Lump-sum                                                                                                                                  |
|        | <b>Sub-total O&amp;M</b>                      | <b>~426</b>               |                                                                                                                                           |
| B.     | Financing Cost Associated with Debt Servicing | ~311                      | Considering the debt is to be financed at an interest rate of 12% per annum over a 15-year repayment period with equal annual instalments |
|        | <b>Total Cost (A+B)</b>                       | <b>737</b>                |                                                                                                                                           |

**Note:**

- A total of 330 operating days per year has been considered for project calculations.
- Land lease charges or rental costs, if any, are not included in the current OPEX cost estimates.
- Evacuation costs, including pipeline usage charges or tariffs, if applicable, will be considered as additional expenses.



## 6.6 Revenue Model for CBG

The revenue model for a 100 TPD CBG plant primarily relies on the sale of CBG and FOM. Based on an annual production of 11.55 lakh kg of CBG and 9,900 MT of FOM, the total annual revenue from these two streams is projected at approximately INR 980 lakh. A tentative revenue model for a CBG plant is provided in the table below:

| S. No. | Revenue Stream     | Quantity          | Rate Revenue | (INR lakh) |
|--------|--------------------|-------------------|--------------|------------|
| 1      | CBG Sales          | 11,55,000 kg/year | INR 72/kg    | 832        |
| 2      | Manure (FOM) Sales | 9,900 MT/year     | INR 1,500/MT | 149        |
|        |                    |                   | Total        | 980        |

**Note:**

- It is essential that the Urban Local Body (ULB) ensures regular delivery of source segregated organic fraction of MSW to the plant to sustain operations and revenue.*
- Revenue from the sale of FOM is considered as INR 1,500/MT. However, as per current market practices, the plant operator may get a higher price, providing additional viability to the plant operations.*
- Revenue from Liquid Fermented Organic Manure (LFOM) has not been included in the above estimates, as its sale is typically not feasible due to the long distances between plant sites and agricultural areas. In such cases, it is recommended that LFOM be diverted to the nearest Sewage Treatment Plant (STP) for co-treatment or safe disposal.*

It is envisaged that the plant can be financially viable, with the above-mentioned revenue streams, VGF and other GOI grants, while aligning with the projected operating costs and debt servicing requirements. Wherever additional land is available within the CBG plant premises, ULBs may also explore setting up solar power systems to meet the internal power load of the facility. This can help reduce operational electricity cost and further enhance the overall financial viability of the project. Further, ULBs are suggested to review the detailed financials of the PPP concessionaire to check the critical financial viability parameters.



| Planning Considerations            |                                                                                                          |                                    |
|------------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------------|
| 1                                  | Organic waste input feed quantity at the CBG facility                                                    | 100 TPD                            |
| 2                                  | Raw biogas generation expected                                                                           | 10,000 m <sup>3</sup> /day         |
| 3                                  | CBG generation expected (with <4% methane losses)                                                        | 3,500 kg/day                       |
| 4                                  | Organic manure generation as per FCO norms (FOM)                                                         | 30 TPD                             |
| 5                                  | Liquid manure generation (LFOM)                                                                          | 60 TPD                             |
| 6                                  | Number of operational days in a year                                                                     | 330 days/year                      |
| 7                                  | Power requirement                                                                                        | ~7500 kWh/day                      |
| 8                                  | Land                                                                                                     | 4-5 acres                          |
| 9                                  | Personnel                                                                                                | 15-16 persons, working in 2 shifts |
| Costing and Revenue Considerations |                                                                                                          |                                    |
| I.                                 | CAPEX of CBG plant (INR lakh)                                                                            |                                    |
| 1                                  | Land development cost (INR lakh)                                                                         | 100                                |
| 2                                  | Civil cost {including Biodigester (equipment as well), tanks, buildings, footings for machinery & sheds} | 1540                               |
| 3                                  | Equipment, preprocessing, electrical, ETP, FOM, AHU, fire & safety                                       | 1660                               |
| 4                                  | Soft cost includes insurance & design costs                                                              | 280                                |
| 5                                  | CBG upgradation costs                                                                                    | 800                                |
|                                    | <b>Total CAPEX (INR lakh)</b>                                                                            | <b>4040</b>                        |
| II.                                | Annual OPEX of CBG plant (INR lakh)                                                                      |                                    |
| 1                                  | Day to day (O&M) incl. material handling cost, electricity, consumables, personnel & contingencies       | 426                                |
| 2                                  | Financing cost associated with debt servicing                                                            | 311                                |
|                                    | <b>Total Annual OPEX (INR lakh)</b>                                                                      | <b>737</b>                         |
| III.                               | Annual Revenue Generation (INR lakh)                                                                     |                                    |
|                                    | From the sale of CBG (@INR 72/kg)                                                                        | 832                                |
|                                    | Manure-FOM Sales (@1500/MT)                                                                              | 149                                |
|                                    | <b>Total Annual Revenue (INR lakh)</b>                                                                   | <b>980</b>                         |

## 6.7 Reduction in GHG Emissions and Carbon Credit Revenue

Compressed Biogas (CBG) plants offer significant climate mitigation benefits by capturing methane from organic waste, a potent greenhouse gas, and replacing fossil fuels like natural gas, thereby reducing CO<sub>2</sub> emissions. These avoided emissions can be scientifically measured and monetised through carbon credit mechanisms, providing an additional revenue stream for project developers. As per India's Fourth Biennial Update Report (BUR) to the UNFCCC (2018), the solid waste disposal sector emitted about 18.9 million tonnes of CO<sub>2</sub>eq emissions that can be greatly reduced through biomethanation technologies. Urban Local Bodies (ULBs), in collaboration with concessionaires, should actively explore carbon finance opportunities to improve project viability and support climate goals.

### International Carbon Credit Mechanisms

CBG projects are eligible under international voluntary markets through certification under Verra (VCS) and Gold Standard, which recognise biogas-to-energy and methane avoidance projects with verifiable GHG reductions. Additionally, under the Paris Agreement's Articles 6.2 and 6.4, CBG projects can participate in cooperative international carbon trading to help countries meet their Nationally Determined Contributions (NDCs). Eligible activities under Article 6.2 are listed in Annexure 3. Emission reductions can be calculated using approved Clean Development Mechanism (CDM) methodologies, such as ACM0022 – Alternative Waste Treatment Processes, Version 3.

### Domestic Carbon Market – India

India is also establishing a national carbon trading platform, the Indian Carbon Market (ICM), under the Energy Conservation (Amendment) Act, 2022. It includes a compliance mechanism for obligated entities and an offset mechanism for sectors like waste management to generate carbon credits through voluntary emission reductions. CBG projects are eligible under the "waste handling and treatment" category. The Bureau of Energy Efficiency (BEE), under the Ministry of Power, is leading this initiative. Guidance and updates are available at the BEE Carbon Market Portal.

#### Case Study of Carbon Credit Revenue for CBG Project

A 20 TPD biomethanation plant in Indore is registered under the Verra Standard and has recorded 4151 tCO<sub>2</sub>eq (tonnes of CO<sub>2</sub> equivalent) emission reductions from 1 January 2021 to 31 December 2021, leading to carbon credit revenue for the Urban Local Body. The details of the project are available at:

<https://registry.verra.org/app/projectDetail/VCS/1941>

07

# Operations and Maintenance (O&M)



Operation and Maintenance (O&M) is critical for the efficient, reliable, and cost-effective functioning of a CBG plant. It enables continuous CBG production, minimises downtime, and maintains consistent output quality while extending equipment life. Although daily O&M is carried out by the assigned contractor or concessionaire, it is essential for ULBs to actively monitor adherence to performance standards. ULBs must regularly track operational planning, process control, equipment upkeep, personnel deployment, and overall plant performance to ensure contractual obligations are met. This section outlines the key O&M aspects that ULBs should supervise to ensure sustained and optimal plant operations.

## 7.1 Operational Planning

After gaining a clear understanding of the CBG process, the operator must prepare a detailed operational plan, and the ULB must ensure the key elements are in place and effectively implemented. ULBs should regularly review implementation against these planning factors to ensure accountability, operational efficiency, and compliance with contractual obligations.

**ULBs must ensure that the following elements are in place for effective plant operation and oversight:**

- A detailed operations schedule covering all stages – from feedstock intake to gas upgradation and utilisation.
- Implementation of safety measures, environmental compliance protocols, and defined performance benchmarks.
- Availability of essential resources, including trained personnel, necessary equipment, and consumables.
- Established procedures for routine and preventive maintenance of all key systems.
- Infrastructure and planning in place for grid injection.
- Proper logbooks or digital systems are maintained for tracking maintenance activities.

## 7.2 CBG Process Management Framework: Roles, Responsibilities & Oversight

Efficient and compliant operation of a CBG plant requires a clear understanding of the process workflow, technical parameters, and daily performance requirements. It is very important for the Urban Local Body (ULB) to actively monitor, verify, and enforce adherence to standard operating procedures, safety norms, and output quality benchmarks. This section suggests frameworks for the step-wise process management responsibilities of the operator, along with corresponding oversight points for ULBs, covering both operational functions and the maintenance of critical mechanical systems.

## A. Roles and Oversight Responsibilities

| S. No. | Stage                                                    | Key Activities                                                                                | Responsibility        | ULB Monitoring Checkpoints                                                                            | Key Process Parameters                                                                                                             |
|--------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | <b>Feedstock Collection &amp; Receipt</b>                | Collection of segregated wet waste, receipt and recording of incoming waste quantity and type | Operator              | Ensure waste is source segregated, timely delivered by ULB/collection agency, and weighed at the site | Volume (TPD), % moisture, contamination level                                                                                      |
| 2.     | <b>Pre-processing (Shredding &amp; Slurry Making)</b>    | Waste sorting, shredding, and dilution with water to form a slurry                            | Operator              | Confirm machinery operation, maintenance logs, and no plastic contamination                           | Particle size uniformity, consistent slurry texture                                                                                |
| 3.     | <b>Anaerobic Digestion</b>                               | Feeding slurry to the digester, microbial breakdown in an oxygen-free environment             | Operator              | Monitor process parameters and logbooks, inspect for foaming/scum issues                              | Temp:<br>1) Mesophilic condition: 35–38°C,<br>2) Thermophilic: 50–55°C,<br>3) pH: 6.8–7.2,<br>4) HRT: 30–35 days,<br>VFA: Alk <0.4 |
| 4.     | <b>Biogas Collection &amp; Cleaning</b>                  | Biogas collected, cleaned via H <sub>2</sub> S, CO <sub>2</sub> , moisture removal            | Operator              | Review filter replacement schedules, biogas composition logs                                          | CH <sub>4</sub> >90%, total sulphur <20 ppm, CO <sub>2</sub> <4%, moisture <5 ppm                                                  |
| 5.     | <b>Biogas Compression &amp; Bottling/ Grid Injection</b> | Upgraded gas compressed to 250 bar max for bottling and grid injection <20 bar.               | Operator (with OMGCs) | Validate grid connection, review compressor uptime, and bottling records                              | Pressure: 250 bar (max), moisture <prescribed limit                                                                                |

| S. No. | Stage                                   | Key Activities                                                               | Responsibility | ULB Monitoring Checkpoints                                                   | Key Process Parameters                                                                                                                                                                                                                     |
|--------|-----------------------------------------|------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.     | <b>Digestate Management</b>             | Handling of solid (FOM) and liquid (LFOM) fractions, storage or co-treatment | Operator       | Ensure safe handling, test reports, and proper disposal/use in compost/FSTPs | Organic carbon, NPK value (FOM), BOD/COD (LFOM)                                                                                                                                                                                            |
| 7.     | <b>Safety and Regulatory Compliance</b> | Fire safety, emissions control, BIS quality standards (IS 16087:2016)        | Operator/ULB   | Periodic safety audits, PPE availability, and logbook checks                 | BIS compliance, SOPs followed                                                                                                                                                                                                              |
| 8.     | <b>Record Keeping &amp; Monitoring</b>  | Maintain logs for feedstock, gas output, maintenance, and operations         | Operator       | Ensure digital or manual logs are updated daily and accessible to ULB        | Real-time SCADA, daily/monthly reporting/updating in web portal regularly:<br><br><a href="https://sbmw2w.sbmunban.org/">https://sbmw2w.sbmunban.org/</a><br><br><a href="https://gobardhan.sbm.gov.in/">https://gobardhan.sbm.gov.in/</a> |
| 9.     | <b>Training &amp; Capacity Building</b> | Periodic staff training on O&M, safety, and compliance                       | Operator/ULB   | Verify training sessions conducted and attendance records                    | At least 2 trainings/year, refresher sessions                                                                                                                                                                                              |

### Additional ULB Responsibilities

- Ensure uninterrupted supply of source segregated organic waste.
- Monitor operator performance as per the concession/contract agreement.
- Facilitate coordination with CGD companies for grid injection.
- Assist in awareness and compliance campaigns with Bulk Waste Generators.
- Facilitate land, water, electricity, and disposal linkages.

| B. Mechanical Equipment O&M |                        |                                                                                                                            |                                                                                      |                                                            |
|-----------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------|
| S. No.                      | Mechanical System      | Key Activities (by Operator)                                                                                               | ULB Monitoring Checkpoints                                                           | Key Parameters/ Remarks                                    |
| 1.                          | Piping System          | Inspect manual/automatic valves, check for leaks, maintain isolation valves                                                | Verify leak test reports, ensure emergency shutoff valves are operable               | Zero leakage, valve operability logs                       |
| 2.                          | Pressure Testing       | Conduct pressure tests before commissioning or after modifications using air/nitrogen, soap-water spray for leak detection | Review pressure test records before plant startup or after repairs                   | Test pressure log, no leak indications                     |
| 3.                          | Pumps                  | Monitor suction/discharge pressures, prevent overheating, check for vibration and leaks                                    | Verify maintenance log, inspect vibration reports, ensure standby pump readiness     | Normal pressure range, vibration < permissible limits      |
| 4.                          | Mixers                 | Lubricate gearboxes, maintain seals, inspect for vibration in submersible and fixed mixers                                 | Review lubrication schedules, check seal integrity and vibration status              | Gear oil level, seal tightness                             |
| 5.                          | Blowers & Compressors  | Monitor pressures, gas/oil temps; detect leaks; resolve vibration/seal issues                                              | Confirm gas monitoring system near compressors, check compressor maintenance records | Inlet/outlet pressure, CH <sub>4</sub> levels, temperature |
| 6.                          | Gas Leakage Control    | Test pipelines, digester covers, joints using portable leak detectors                                                      | Inspect logbooks for regular testing, spot-check leak-prone points                   | Leak readings within safe limits                           |
| 7.                          | Gas Monitoring Systems | Calibrate sensors, ensure accurate biomethane composition and leak detection                                               | Verify calibration certificates, cross-check with standard values                    | Methane content >90%, detection response time              |

| S. No. | Mechanical System                              | Key Activities (by Operator)                                                                                     | ULB Monitoring Checkpoints                                                                  | Key Parameters/ Remarks                          |
|--------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|
| 8.     | <b>Engines/ Generators</b>                     | Routine servicing, oil changes, and ensuring spare part availability                                             | Confirm preventive maintenance compliance, check inventory of critical spares               | Engine hours, fuel/oil consumption logs          |
| 9.     | <b>Biomethane Storage (Cascade/ Cylinders)</b> | Inspect cylinders for corrosion/damage, test relief valves, clean storage units, monitor pressure and gas levels | Review inspection reports, check for pressure regulator functionality and leak test records | Gas pressure, leak test status, cylinder tagging |

### ULB's Oversight Role in Mechanical O&M

- Ensure the operator maintains SOPs, checklists, and logs for all critical mechanical equipment.
- Inspect safety compliance for pressurised gas handling and compressor/blower operations.
- Periodically audit calibration and testing reports to ensure the reliability of leak detection and gas composition systems.
- Track preventive maintenance schedules and spare part readiness to avoid plant downtime.

## 7.3 Monitoring and Reporting

Building on the importance of operational planning and maintenance, regular monitoring and reporting are equally vital to ensure the stable and efficient functioning of the CBG plant. Consistent tracking of operational performance helps identify issues early, avoid technical failures, and prevent potential financial losses. Monitoring should include routine checks on equipment functionality, process parameters, and maintenance activities. It is standard practice to document these through operational logbooks, whether manually or through automated systems, to maintain traceability and accountability.

### Digital Interface for Monitoring

**GOBARDhan portal:** All entities setting up or operating a CBG plant in India (government, cooperative, private sector) are required to register and update their project details on the GOBARDhan portal, regardless of plant capacity.

Link to GOBARDhan portal: <https://gobardhan.sbm.gov.in/>





Picture–Snapshot of GOBARDhan Portal

**SBM (U) CBG Portal:** In addition to internal records, ULBs must ensure timely reporting of plant performance and related data on the national Swachh Bharat Mission (Urban) portal, as mandated. This enables alignment with national monitoring systems, ensures transparency, and supports policy-level decision-making on urban waste management initiatives. Link to Swachh Bharat Mission (Urban) CBG portal: <https://sbmw2w.sbmurban.org/>

The portal captures the lifecycle of CBG projects from concept to commissioning and then for performance monitoring. ULBs need to ensure continuous updation of authentic data on the portal as per the guidelines provided. This portal will be monitored by decision makers at MoHUA.



Picture–Snapshot of CBG Portal

The process of integration of the two portals is under consideration.

## 7.4 Health & Safety Risk Assessment and Mitigation – CBG Facility

The operation of a CBG facility involves various health and safety risks, ranging from fire and electrical hazards to occupational health issues. While the operator is primarily responsible for implementing mitigation measures, ULBs must ensure regular monitoring, documentation, and compliance with regulatory standards, including BIS specifications, SBM guidelines, CPCB waste handling protocols, and other prevalent safety norms.

The following table outlines key identified risks, their potential impacts, and recommended mitigation measures:

| Identified Risk                                | Potential Impact                                                                                                                                                                  | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fire Breakouts During Site Operations</b>   | <ul style="list-style-type: none"> <li>• Injuries to workers</li> <li>• Smoke-related air pollution</li> <li>• Asset damage and downtime</li> <li>• Operational delays</li> </ul> | <ul style="list-style-type: none"> <li>• Avoid spontaneous combustion zones and ensure controlled temperature/moisture</li> <li>• Equip the site with Class B extinguishers and smoke detectors</li> <li>• Maintain fire lanes and water supply access</li> <li>• Conduct routine fire drills and emergency response training</li> <li>• Limit flammable storage, use trained personnel for containment</li> </ul> |
| <b>Occupational Health &amp; Worker Safety</b> | <ul style="list-style-type: none"> <li>• Physical injuries</li> <li>• Exposure to pathogens and gases</li> <li>• Legal and insurance liabilities</li> </ul>                       | <ul style="list-style-type: none"> <li>• Mandatory safety orientation and periodic drills</li> <li>• PPE: masks, gloves, boots, overalls</li> <li>• Facilities for washing, sanitation, and changing</li> <li>• Worker health surveillance (e.g., for Hepatitis B, Tetanus)</li> <li>• Onsite first-aid, signage, and emergency contact info</li> </ul>                                                            |
| <b>Electrical Hazards</b>                      | <ul style="list-style-type: none"> <li>• Electrocution or burns</li> <li>• Short circuits or plant downtime</li> </ul>                                                            | <ul style="list-style-type: none"> <li>• Ensure full compliance with CEA Regulations, 2010</li> <li>• Regular inspection of wiring and control panels</li> <li>• Use MCB/ELCB, restrict access to HV areas</li> <li>• Maintain logbooks and implement LOTO (lock-out/tag-out) protocols</li> <li>• Train all relevant O&amp;M staff in electrical safety</li> </ul>                                                |

| Identified Risk                                                       | Potential Impact                                                                                                                                                                                             | Mitigation Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Non-compliance with PESO Guidelines for Flammable Gas Handling</b> | <ul style="list-style-type: none"> <li>• Legal penalties and licence revocation</li> <li>• Fire or explosion due to non-certified equipment</li> <li>• Unsafe gas storage and public safety risks</li> </ul> | <ul style="list-style-type: none"> <li>• Obtain PESO approval for CBG storage/compression systems under the Gas Cylinder Rules, 2016</li> <li>• Use PESO-certified vessels, cascades, PRVs, and compressors</li> <li>• Maintain minimum safe distances between digesters/compressors and nearby structures</li> <li>• Conduct periodic inspections, leak tests, and maintain pressure vessel test records</li> <li>• Install flame-proof fittings and signage as per PESO norms</li> <li>• Submit emergency response plans and conduct regular safety drills with trained staff</li> </ul> |
| <b>Noise Pollution</b>                                                | <ul style="list-style-type: none"> <li>• Worker hearing loss</li> <li>• Local community grievances</li> </ul>                                                                                                | <ul style="list-style-type: none"> <li>• Equip systems with acoustic insulation</li> <li>• Limit activities to permissible hours</li> <li>• Enforce noise levels under 80 dBA at 10 m distance</li> <li>• Engage with communities, avoid disturbances during festivals</li> </ul>                                                                                                                                                                                                                                                                                                          |
| <b>Air Pollution &amp; Odour</b>                                      | <ul style="list-style-type: none"> <li>• Health issues for staff and public</li> <li>• Environmental impact and complaints</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>• Install 5 m barricades and odour-neutralising systems</li> <li>• Conduct regular site spraying and floor cleaning</li> <li>• Gas sensors for CH<sub>4</sub>, H<sub>2</sub>S, and NH<sub>3</sub> in key areas</li> <li>• Cover vehicles and clean truck wheels before exit</li> </ul>                                                                                                                                                                                                                                                              |



## Additional Safety Measures to be Ensured at CBG Facilities

In addition to key risk mitigation practices, the following general safety measures must be implemented by the operator and monitored by ULBs:

### Signage and Restricted Access

- Install bilingual safety signs (e.g., “Flammable Gas – No Smoking”, “Authorised Personnel Only”) at key locations.
- Restrict entry to hazardous zones using fencing and controlled access.

### Periodic Inspection & Recordkeeping

- Conduct routine inspections of gas systems, compressors, and storage units.
- Maintain records of maintenance logs, drill reports, and incident registers.

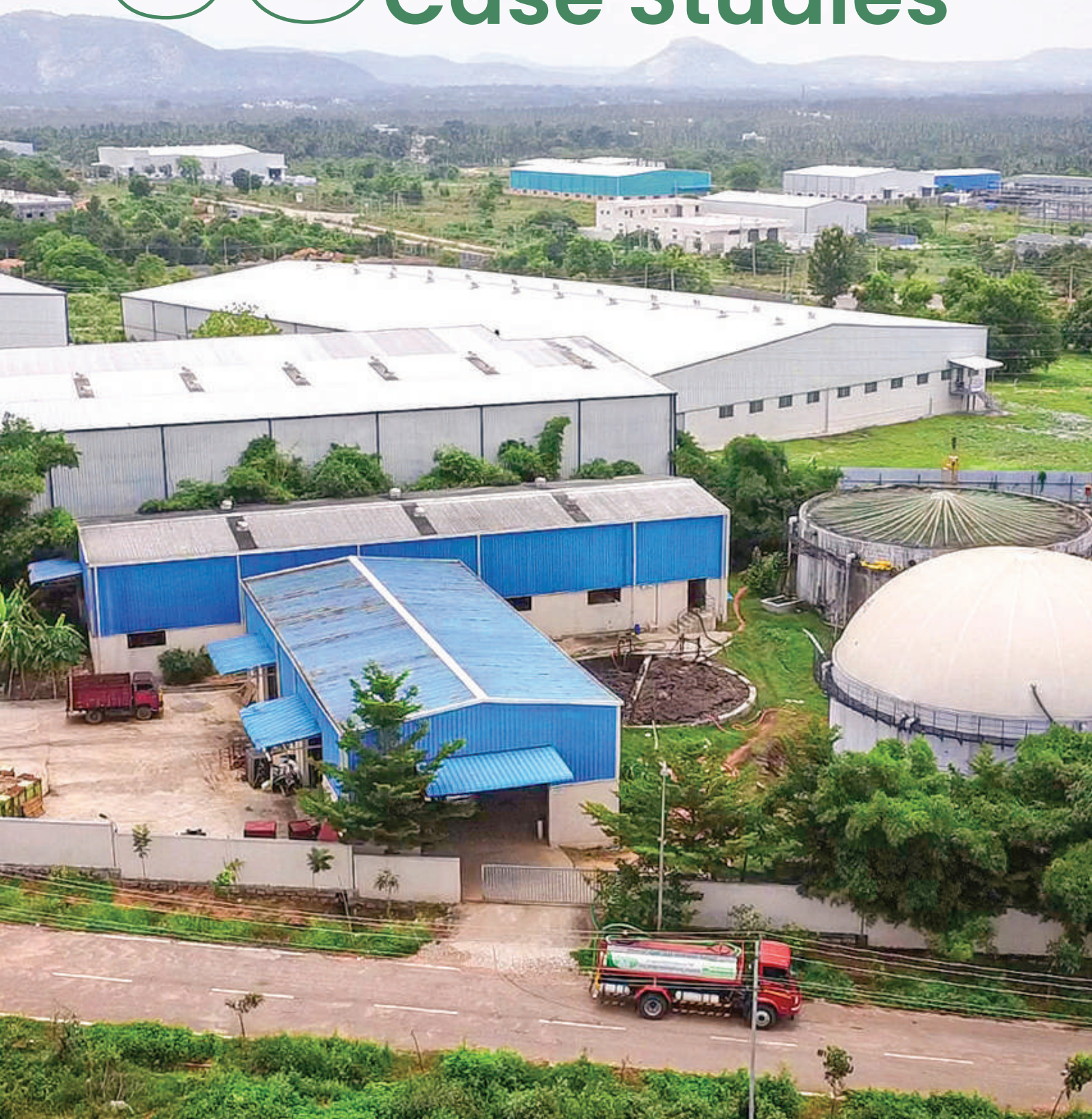
### Training & Emergency Preparedness

- Train staff on biogas handling, fire safety, and emergency procedures.
- Keep an updated emergency response plan with evacuation routes.
- Organise regular safety drills with plant and municipal staff.



Picture-CBG Cascade at Pune CBG plant

# 08 Case Studies



The case studies across three Indian cities — **Indore, Pune, and Chennai** — demonstrate varied scales of CBG plant implementation, predominantly following the **Design-Build-Finance-Operate-Transfer (DBFOT) model** under **Public-Private Partnership (PPP)**.

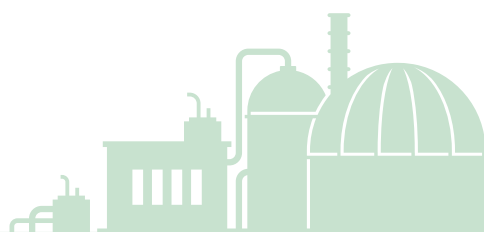
Notably, large-scale projects have demonstrated CAPEX efficiency and operational economies of scale in compressed biogas (CBG) generation, while smaller-capacity plants suffer from lower CBG yields and higher per-unit operational expenditure (OPEX). These trends highlight the importance of scale in determining financial sustainability.

The revenue models are primarily based on CBG sales, with price realisations ranging from INR 62 to INR 94.5 per kg, depending on the offtake arrangement — preferential pricing for municipal transport fleets (e.g., Indore) or sales to industrial clients (e.g., Pune). In most cases, tipping fees are not provided by the Urban Local Bodies (ULBs), with the notable exception of Pune, where the municipal corporation pays INR 571/MT to the private operator for pre-processing and slurry transport.

The case studies also underscore the importance of monetising by-products, such as Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (LFOM). While revenue data for these products is limited, they are generally distributed to local farmers, thereby supporting nutrient recycling and aligning with circular economy principles. However, challenges remain in the sale of Liquid Fermented Organic Manure (LFOM), as it is typically not feasible due to the long distances between plant sites and agricultural areas. In such cases, it is recommended that LFOM be diverted to the nearest Sewage Treatment Plant (STP) for co-treatment or safe disposal.

Importantly, these real-world examples reflect the key challenges faced during CBG project implementation in India. **Land availability** remains a critical bottleneck, especially in dense urban areas, where securing 4–5 acres for a 100 TPD facility is often challenging. Another challenge is the **scarcity of skilled human resources**, particularly in smaller cities, where technical capacity to operate and maintain complex biomethanation systems is limited. Financial viability is also influenced by the **policy environment**, while central schemes like SATAT and the Waste-to-Energy programme provide incentives, **Viability Gap Funding (VGF)** remains a key dependency for most projects, especially those below 100 TPD. Additionally, the current Market Development Assistance (MDA) framework also supports offtake of FOM & LFOM from CBG facilities.

By offering a comparative lens on varying business models and the scale of CBG plants, this chapter aims to guide ULBs and private developers in making informed decisions on planning, designing, and implementing biomethanation facilities tailored to their local contexts.



# Indore City – 550 TPD Compressed Biogas Plant

Indore is the most populous and largest city in Madhya Pradesh. It is considered an education hub of the state and has a campus of IIT and IIM. It is located on the southern edge of the Malwa Plateau, at an average altitude of 553 metres. It has been ranked as India's cleanest city for 8 years in a row in Swachh Survekshan. The Indore Municipal Corporation (IMC) had implemented two projects with wet waste inputs of 15 TPD and 20 TPD, respectively, before implementing the 550 TPD CBG project.

- **Waste Generation:** 1,115 TPD
- **Per capita Waste Generation:** 0.550 kg/person/day

| Salient Features                      |                                                                                              |
|---------------------------------------|----------------------------------------------------------------------------------------------|
| Parameters                            | Description                                                                                  |
| Year of Establishment                 | November 2021                                                                                |
| PPP Partner                           | M/s Ever Environment Resource Management Pvt. Ltd.                                           |
| Area of CBG Plant                     | 60,705 sq. m (15 acres)                                                                      |
| Land Ownership                        | Indore Municipal Corporation                                                                 |
| Designed Capacity                     | 550 TPD                                                                                      |
| Capacity of Raw Biogas Generation     | 44,000–45,000 m <sup>3</sup> /day                                                            |
| Average Yield of Biogas               | 90 m <sup>3</sup> /tonne                                                                     |
| The Quantity of CBG Generated         | 17,000 kg/day                                                                                |
| The Quantity of GHG Emissions Reduced | 1,30,000 CO <sub>2</sub> tonnes emissions reduced annually                                   |
| Feedstock                             | Segregated biodegradable waste from Indore                                                   |
| Business Model                        |                                                                                              |
| Parameters                            | Description                                                                                  |
| Type of Business Model                | DBFOT Model (Design-Build-Finance-Operate Transfer) on PPP (Public-Private Partnership) mode |
| Total CAPEX                           | INR 150 crore                                                                                |
| Total OPEX                            | INR 1.50 crore/month                                                                         |
| Share of Capital Investment           | 100% capital investment by Ever Enviro Resource Management Pvt. Ltd. (concessionaire)        |

| Parameters                                   | Description                                                                        |
|----------------------------------------------|------------------------------------------------------------------------------------|
| Funding Mechanism                            | 100% capital investment is made by the concessionaire, and land is provided by IMC |
| Unit Rate of CBG and Expected Annual Revenue | INR 94.50/kg for IMC to run waste trucks<br>INR 75/kg for industrial customers     |
| Slurry Management (FOM & LFOM)               | Sale to nearby farmers                                                             |
| Payback Period                               | 6 Years                                                                            |
| Concession Period                            | 20 Years                                                                           |
| Tipping Fees                                 | No                                                                                 |

## Pune City – 300 TPD Compressed Biogas Plant

Pune, also called Poona, is a city in west-central Maharashtra state in western India. Pune is widely regarded to be the second major IT hub and the most important automobile and manufacturing hub of India. Pune has several world class educational institutions.

- **Waste Generation:** 1,600 TPD
- **Per capita Waste Generation:** 0.45 kg/person/day

| Salient Features                      |                                                     |
|---------------------------------------|-----------------------------------------------------|
| Parameters                            | Description                                         |
| Plant Owner & Operator                | Noble Exchange Environment Solutions                |
| Year of Establishment                 | Commissioned in January 2016                        |
| Area of Biomethanation Plant          | 20,234 sq. m (Processing Unit) (5 acres)            |
| Area of the Preprocessing Unit        | 1,400 sq. m (Pre-processing Unit)                   |
| Land Ownership                        | Noble Exchange                                      |
| Designed Capacity                     | 300 TPD                                             |
| Operational Capacity                  | 130–140 TPD                                         |
| Average Yield of Biogas               | 85 m <sup>3</sup> /tonne                            |
| Quantity of CBG Generated             | 4.5 tonnes/day                                      |
| The Quantity of GHG Emissions Reduced | 0.9 kg CO <sub>2</sub> per tonne of waste processed |

| Parameters                  | Description                                                                         |
|-----------------------------|-------------------------------------------------------------------------------------|
| Feedstock                   | Segregated biodegradable waste from hotels, marriage halls & households             |
| <b>Business Model</b>       |                                                                                     |
| Parameters                  | Description                                                                         |
| Type of Business Model      | Design-Build-Finance-Operate-Transfer (DBFOT) model on PPP mode                     |
| Total CAPEX                 | Plant cost: INR 65 cr, Land cost: INR 10 cr                                         |
| Total OPEX                  | INR 31 lakh/month (borne by operator)                                               |
| Share of Capital Investment | 100% by private party                                                               |
| Funding Mechanism           | 100% investment by developers, including land at Talegaon                           |
| Unit Rate of CBG            | INR 70/kg as per the SATAT Scheme                                                   |
| Payback Period              | 11 Years (estimated)                                                                |
| Concession Period           | 30 years                                                                            |
| Subsidy Availed             | Yes, under the SATAT & MNRE Scheme                                                  |
| Tipping Fees                | INR 571/MT for pre-processing and transportation of slurry, paid by PMC to operator |

## Chennai City – 90 TPD Compressed Biogas Plant

Chennai is the capital city of Tamil Nadu State, which is located on the Coromandel Coast, off the Bay of Bengal. It is a major commercial, cultural, economic, and educational centre in South India.

- **Waste Generation:** 5,100 TPD
- **Per capita Waste Generation:** 0.47 kg/person/day



## Salient Features

| Parameters                        | Description                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------------------|
| Plant Owner Operator              | Srinivas Waste Management Services (SWMS) (P) Ltd.                                              |
| Year of Establishment             | Commissioned in November 2021                                                                   |
| Area of Biomethanation Plant      | 12,141 sq. m (3 acres)                                                                          |
| Land Ownership                    | Greater Chennai Corporation (GCC)                                                               |
| Designed Capacity                 | 100 TPD                                                                                         |
| Operational Capacity              | 90 TPD                                                                                          |
| Capacity of Raw Biogas Generation | 10,000 m <sup>3</sup> /day                                                                      |
| Current Raw Biogas Generation     | 7,500–8,000 m <sup>3</sup> /day                                                                 |
| Average Yield of Biogas           | 90–100 m <sup>3</sup> /tonne                                                                    |
| Current CBG Generation            | 3 tonnes/day                                                                                    |
| Quantity of GHG Emissions Reduced | 20,000 MT emissions/year is reduced                                                             |
| <b>Business Model</b>             |                                                                                                 |
| Parameters                        | Description                                                                                     |
| Type of Business Model            | DBFOT (Design–Build–Finance–Operate–Transfer) model on PPP (Public–Private Partnership) mode    |
| Total CAPEX                       | Around 25 crore                                                                                 |
| Total OPEX                        | INR 2000/MT                                                                                     |
| Share of Capital Investment       | 100% investment by SWMS                                                                         |
| Funding Mechanism                 | 100% investment is made by SWMS, and a concession agreement for 20 years is signed with the GCC |
| Unit Rate of CBG                  | INR 70/kg                                                                                       |
| Payback Period                    | 6.8 years                                                                                       |



# Annexure 1: Specification of Biogas as per IS 16087:2016

भारतीय मानक  
Indian Standard

IS 16087 : 2016  
(Reaffirmed 2020)

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बायो गैस ( बायो मीथेन ) — विशिष्टि  
( पहला पुनरीक्षण )

**Biogas (Biomethane) —  
Specification**  
( First Revision )

ICS 75.060

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भारतीय मानक ब्यूरो  
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May 2016

Price Group 1

# Indian Standard

## BIOGAS (BIOMETHANE) — SPECIFICATION

### ( First Revision )

#### 1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for biogas (biomethane) use in stationary engines, automotive (bio-CNG/bio compressed gas [CBG]) and thermal and industrial applications as supplied in cylinders and through piped network.

#### 2 REFERENCES

The following standards contain provisions which through reference in this text constitute the provisions of the standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below:

| <i>IS No./<br/>International<br/>Standard</i>  | <i>Title</i>                                                                                                                                                                                                             |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1070 : 1992                                    | Reagent grade water ( <i>third revision</i> )                                                                                                                                                                            |
| 7285 (Part 2) :<br>2004                        | Refillable seamless steel gas cylinders: Part 2 Quenched and tempered steel cylinders with tensile strength less than 1100 MPa (112 kgf/mm <sup>2</sup> )                                                                |
| 15125 : 2002/<br>ISO 10715 : 1997              | Natural gas — Sampling guidelines                                                                                                                                                                                        |
| 15130 (Part 3) :<br>2002/ISO<br>6974-3 : 2000  | Natural gas — Determination of composition with defined uncertainty by gas chromatography: Part 3 Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and hydrocarbons up to C8 using two packed columns |
| 15319 : 2003/<br>ISO 13734 :<br>1998           | Natural gas — Organic sulphur compounds used as odorants — Requirements and test methods                                                                                                                                 |
| 15320 : 2003/<br>15403 : 2000                  | Natural gas — Designation of the quality of natural gas for use as a compressed fuel for vehicles                                                                                                                        |
| 15490 : 2004                                   | Cylinders for on-board storage of compressed natural gas as a fuel for automotive vehicles                                                                                                                               |
| 15641 (Part 2) :<br>2006/ISO<br>10101-2 : 1993 | Natural gas — Determination of water by Karl Fischer method: Part 2 Titration procedure                                                                                                                                  |

| <i>IS No./<br/>International<br/>Standard</i> | <i>Title</i>                                                                                                                                                  |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 6326-3 :<br>1989                          | Natural gas — Determination of sulphur compounds: Part 3 Determination of hydrogen sulphide, mercaptan sulphur and carbonyl sulphide sulphur by potentiometry |
| ISO 14532 : 2001                              | Natural gas — Vocabulary                                                                                                                                      |

#### 3 TERMINOLOGY

For the purpose of this standard, the definitions given in ISO 14532 shall apply.

#### 4 REQUIREMENTS

**4.1** Biogas (biomethane) shall be free from liquids over the entire range of temperatures and pressures encountered in the storage and dispensing system, fuel containers, engine and fuel system and piped network.

**4.2** The biogas (biomethane) fuel shall be free from particulate matter such as dust, dirt, etc.

##### 4.3 Odour

Biogas (biomethane) delivered as fuel shall be odorized similar to a level found in the local distribution (see IS 15319).

**4.4** The biogas (biomethane) for automotive application, piped network and cylinder applications shall also comply with the requirements given in Table 1 when tested in accordance with the methods given in col 4 and col 5 of Table 1.

**Table 1 Requirements for Biogas (Biomethane)**  
(Clause 4.4)

| Sl No. | Characteristic                                                       | Requirement | Method of Test, Ref to |            |
|--------|----------------------------------------------------------------------|-------------|------------------------|------------|
|        |                                                                      |             | IS No. (4)             | ISO (5)    |
| i)     | Moisture, mg/m <sup>3</sup> , Max                                    | 5           | 15641 (Part 2)         | —          |
| ii)    | Methane, percent, Min                                                | 90.0        | 5130 (Part 3)          | —          |
| iii)   | Total sulphur (including H <sub>2</sub> S), mg/m <sup>3</sup> , Max  | 20          | —                      | ISO 6326-3 |
| iv)    | CO <sub>2</sub> +N <sub>2</sub> +O <sub>2</sub> , percent, Max (v/v) | 10          | 15130 (Part 3)         | —          |
| v)     | Only CO <sub>2</sub> , percent, Max (v/v)                            | 4           | 15130 (Part 3)         | —          |
| vi)    | Oxygen percent, Max                                                  | 0.5         | 15130 (Part 3)         | —          |

## 5 SUPPLY OF BIOGAS (BIOMETHANE)

5.1 Biogas (biomethane) shall be stored and transported through cylinders conforming to IS 7285 (Part 2). For automotive use, it shall be filled in cylinders conforming to IS 15490.

5.2 It may be transported through piped network or injected into existing system of pipelines as per regulatory requirements.

## 6 SAMPLING

The representative samples of biogas (biomethane) shall be drawn as per sampling plan prescribed under IS 15125.

## 7 QUALITY OF REAGENTS

Unless specified otherwise, pure chemicals and distilled water shall be used in tests (see IS 1070).

NOTE — Pure chemicals shall mean chemicals that do not contain impurities which affect the result of the analysis.

## 8 BIS CERTIFICATION MARKING

The container may also be marked with the Standard Mark.

8.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufactures or producers may be obtained from the Bureau of Indian Standards.

### 8.2 Marking

Each cylinder shall be marked with the following information:

- a) Name of the material;
- b) Indication of the source of manufacture, initials or trade-mark, if any;
- c) Volume of the contents, in litre;
- d) Lot/Batch No.; and
- e) Month and year of manufacture.

## Annexure 2: Specification of Organic Fertiliser

The specification of organic fertilisers is given as per the Third Amendment to the Fertiliser (Inorganic, Organic or Mixed) (Control) Order, 2025

### MINISTRY OF AGRICULTURE AND FARMERS WELFARE

(Department of Agriculture and Farmers Welfare)

#### ORDER

New Delhi, the 27th March, 2025

**S.O. 1477(E).**—In exercise of the powers conferred by section 3 of the Essential Commodities Act, 1955 (10 of 1955), the Central Government hereby makes the following Order further to amend the Fertiliser (Inorganic, Organic or Mixed) (Control) Order, 1985, namely: -

1. (1) This Order may be called the Fertiliser (Inorganic, Organic or Mixed) (Control) (Third) Amendment Order, 2025.

(2) It shall come into force on the date of its publication in the Official Gazette

2. In the Fertilizer (Inorganic, Organic or Mixed) (Control) Order, 1985, in Part A, Schedule VIII, the following after the words "Organic Carbon Enhancer from Compressed Bio Gas plants" shall be inserted, namely,-

1. Fermented Organic Manure,-

|       |                                              |                   |
|-------|----------------------------------------------|-------------------|
| (i)   | Moisture per cent by weight, maximum         | 30-70             |
| (ii)  | Organic carbon (minimum)                     | 12-14%            |
| (iii) | pH                                           | 6.0 – 8.4         |
| (iv)  | Electrical conductivity                      | Not more than 4.0 |
| (v)   | pathogens                                    | Nil               |
| (vi)  | Heavy metal content (as mg/kg) maximum       |                   |
|       | Arsenic as (As <sub>2</sub> O <sub>3</sub> ) | 10                |
|       | Cadmium (Cd)                                 | 5                 |
|       | Chromium (Cr)                                | 50                |
|       | Copper (Cu)                                  | 300               |
|       | Mercury (Hg)                                 | 0.15              |
|       | Nickel (Ni)                                  | 50                |
|       | Lead (Pb)                                    | 100               |
|       | Zinc (Zn)                                    | 1000              |

**Note:-1.** Every manufacture shall categorically indicate on bags that Fermented Organic Manure shall be added 15-20 days prior to sowing.

**Note :- 2.** The manufacturer shall enrich Fermented Organic Manure/Liquid Fermented Organic Manures with nutrient by claiming on label.

2. Liquid Fermented Organic Manure,-

|       |                                               |                   |
|-------|-----------------------------------------------|-------------------|
| (i)   | Moisture (liquid) per cent by weight, maximum | 90 -97            |
| (ii)  | Organic carbon (minimum) per cent by weight   | 1.5%              |
| (iii) | pH                                            | 6.0 – 8.4         |
| (iv)  | Electrical conductivity                       | Not more than 4.0 |
| (v)   | Infectious pathogens                          | Nil               |
| (vi)  | Heavy metal content (as mg/kg) maximum        |                   |
|       | Arsenic as (As <sub>2</sub> O <sub>3</sub> )  | 10                |
|       | Cadmium (Cd)                                  | 5                 |
|       | Chromium (Cr)                                 | 50                |
|       | Copper (Cu)                                   | 300               |
|       | Mercury (Hg)                                  | 0.15              |
|       | Nickel (Ni)                                   | 50                |
|       | Lead (Pb)                                     | 100               |
|       | Zinc (Zn)                                     | 1000              |

**Note:- 1.** Every manufacture shall categorically indicate on containers that Liquid Fermented Organic Manure shall be added 15-20 days prior to sowing.

**Note:- 2.** The manufacturer shall enrich Fermented Organic Manure/Liquid Fermented Organic Manures with nutrient by claiming on label.

## Annexure 3: List of Activities to be Considered under Bilateral/Cooperative Approaches in India under Article 6.2 Mechanism

F.No. CC-13008/238/2022-CC (E-187765)  
**Government of India**  
**Ministry of Environment, Forest and climate Change**  
**(HSM Division)**

6th Floor, Jal Wing,  
Indira Paryavaran Bhawan,  
Jor Bagh, New Delhi-110003

Date: 07.06.2024

### **OFFICE MEMORANDUM**

**Subject: Revised list of activities under bilateral/ cooperative approaches in India under Article 6.2 mechanism of Paris Agreement - reg.**

This is in reference to the list of activities for trading of carbon credits under bilateral/ cooperative approaches in India under Article 6.2 mechanism of Paris Agreement.

2. The list was deliberated in the 4<sup>th</sup> meeting of National Designated Authority for the Implementation of the Paris Agreement (NDAIAPA) held on 10.04.24 under the chairpersonship of Secretary, MoEFCC.
3. Upon recommendation of NDAIAPA, the revised list has been finalized and enclosed at Annexure I.
4. These activities will facilitate adoption/transfer of emerging technologies. The list of activities will initially be for first 03 years and may be updated/revised by NADAIPA.

This issues with approval of the Competent Authority.

Yours sincerely,

Encl: As above.

  
(Dr. Satyendra Kumar)  
Director  
Email: satyendra.kumar07@nic.in

To,

1. CEO, NITI Aayog
2. Secretary, Ministry of External Affairs
3. Secretary, Department of Economic Affairs
4. Secretary, Department of Industry and Internal Trade
5. Secretary, Ministry of New and Renewable Energy

## **Annexure- I**

### **List of activities to be considered under bilateral/cooperative approaches in India under Article 6.2 Mechanism**

Following list of activities will be considered for trading of carbon credits under bilateral/ cooperative approaches under Article 6.2 mechanism. These activities will facilitate adoption/transfer of emerging technologies. The list of identified activities will initially be for first 03 years and it may be updated/revised by NADAIPA.

#### **I. GHG Mitigation Activities:**

1. Renewable energy with storage (only stored component)
2. **Solar thermal power plant**
3. Off- shore wind
4. Green Hydrogen
5. Compressed bio-gas
6. Emerging mobility solutions like fuel cells
7. High end technology for energy efficiency
8. Sustainable Aviation Fuel
9. Best available technologies for process improvement in hard to abate sectors
10. Tidal energy, Ocean Thermal Energy, Ocean Salt Gradient Energy, Ocean Wave Energy and Ocean Current Energy
11. High Voltage Direct Current Transmission in conjunction with the renewal energy projects
12. **Clean cooking using renewable energy at scale (Government or Public-Private Partnership project only)**

#### **II. Alternate Materials**

13. Green Ammonia

#### **III. Removal Activities:**

14. Carbon Capture, Utilization and Storage

# Annexure 4: Pricing Structure under CBG-CGD Synchronisation Scheme (applicable till 31.10.2025)

## Modalities and Pricing

**Pricing Structure under CBG-CGD Synchronisation Scheme**  
(Applicable from 01.06.2025 to 31.10.2025)

| Commodity | Delivery options                                  |                             | Purchase Price by GAIL from Producer              | Sale Price by GAIL to CGD Entity        |
|-----------|---------------------------------------------------|-----------------------------|---------------------------------------------------|-----------------------------------------|
|           | Delivery Point                                    | Mode of Transport           |                                                   |                                         |
| CBG       | Retail Outlet (RO) of CGD entity and/or CBG Plant | Through Cascades            | Rs 1478/MMBTU + Compression charge (Rs.8/Kg)      | UBP + Compression charge (Rs.8/Kg)      |
| Biogas    | Pipeline network of CGD entity                    | Through Tie-in Pipeline     | Rs 1478/MMBTU + P/L Compression charge (Rs.2/Kg)  | UBP + P/L Compression charge (Rs. 2/Kg) |
|           |                                                   | Cascade-Decompression (DCU) | Rs 1478/MMBTU + DCU Compression charge (Rs.8/Kg)* | UBP + DCU Compression charge (Rs.8/Kg)* |

\*Applicable from 01.06.2024 to 31.05.2026

### Transportation Charges for supply through Cascades and through DCU arrangement

For cascade transportation, a transportation charge (in Rs/kg) from Biogas plant upto the delivery point shall be paid directly by the beneficiary CGD entity to the Biogas producers, as mentioned below:

| One-way distance from Biogas plant upto delivery point | Transportation Charges                                                                |
|--------------------------------------------------------|---------------------------------------------------------------------------------------|
| 0 – 50 km                                              | NIL (as transportation charges upto 50km is included in the Biogas procurement price) |
| >50 – 75 km                                            | Rs. 1.5/kg                                                                            |
| >75 km                                                 | Rs. 2.5/kg                                                                            |

Illustration:

- For distance of 65 kms (one-way), the transportation charge payable is Rs 1.5/kg
- For a distance of 80 kms (one-way), the transportation charge payable is Rs 2.5/kg.

Pricing methodology for determination of procurement price of Biogas under CBG-CGD Synchronization scheme

# Annexure 5: CFA under MNRE Waste to Energy Programme

188935/2022/MNRE-WASTE TO ENERGY

1384

Appendix

Guidelines for implementation of

## **Waste to Energy Programme**

*“Programme on Energy from Urban, Industrial and Agricultural Wastes/Residues”*



सत्यमेव जयते

Government of India

Ministry of New and Renewable Energy

New Delhi – 110003

November - 2022

## 1. INTRODUCTION

**1.1. Name of the Programme:** "Programme on Energy from Urban, Industrial and Agricultural Wastes/Residues". It may also be referred as "Waste to Energy Programme".

**1.2. Objective:** The objective of the programme is to support the setting up of Waste to Energy projects for generation of Biogas/ BioCNG/ Power/ producer or syngas from urban, industrial and agricultural wastes/residues.

**1.3. Scope:** The programme provides Central Financial Assistance (CFA) to project developers and service charges to implementing/inspection agencies in respect of successful commissioning of Waste to Energy plants for generation of Biogas, Bio-CNG/enriched Biogas/Compressed Biogas, Power/ generation of producer or syngas.

## 2. FUNDING PATTERN

**2.1. Standard CFA pattern:** Standard pattern of CFA for grant of 'In-principal Approval' to Waste to Energy projects under the programme is as follows:

| S.No. | Type of project                                                                           | Standard CFA rate @ installed capacity of the plant                                                                                                                                                                                                                                            |
|-------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Biogas                                                                                    | Rs 0.25 Cr per 12000cum/day (maximum CFA of Rs. 5.0 Cr/project)                                                                                                                                                                                                                                |
| 2     | BioCNG / Enriched Biogas/ Compressed Bio Gas                                              | -Rs 4.0 Cr per 4800 kg/day (for BioCNG generation from new biogas plant)<br>-Rs 3.0 Cr per 4800 kg/day (for BioCNG generation from existing Biogas plant#)<br>-Maximum CFA of Rs. 10.0 Cr/project for both cases.                                                                              |
| 3     | Power (based on Biogas)                                                                   | -Rs 0.75 Cr/MW (for power generation from new biogas plant)<br>-Rs 0.5 Cr /MW (for power generation from existing Biogas plant#)<br>-Maximum CFA of Rs. 5.0 Cr/project for both cases.                                                                                                         |
| 4     | Power based on bio & agro-industrial waste (other than MSW through incineration process). | Rs 0.4 Cr/MW<br>(maximum CFA of Rs. 5.0 Cr/project)                                                                                                                                                                                                                                            |
| 5     | Biomass Gasifier for electricity/thermal applications                                     | <ul style="list-style-type: none"> <li>Rs. 2,500 per kW<sub>e</sub> with dual fuel engines for electrical application</li> <li>Rs. 15,000 per kW<sub>e</sub> with 100% gas engines for electrical application</li> <li>Rs. 2 lakh per 300 kW<sub>th</sub> for thermal applications.</li> </ul> |



**\*Note:** In case Developer is setting up a new BioCNG/ Power plant based on Biogas already available or generated from already commissioned/operational/existing biogas plant or have already availed financial assistance from Government of India for Biogas plant, then CFA will be provided only for conversion of biogas to BioCNG (@Rs 3.0 Cr per 4800 kg/day) or biogas to power (Rs 0.5 Cr /MW), as mentioned in the [table](#) above.

## 2.2. Special CFA pattern

**i) Special Category States:** In case the Waste to Energy plants are set up in Special Category States (NE Region, Sikkim, Himachal Pradesh and Uttarakhand), Jammu & Kashmir, Ladakh, Lakshadweep and Andaman & Nicobar Islands, the eligible CFA would be 20% higher than Standard CFA pattern given in [para 2.1](#) above.

**ii) Biomethanation plants set up in registered Gaushala/Shelter:** Biogas/BioCNG/Power (biogas based) generation plants based on cattle dung as main feedstock set up by Gaushalas independently or through joint ventures/partnerships will be eligible for 20% higher CFA than Standard CFA pattern given in [para 2.1](#) above. These Gaushalas (Shelters) should be registered with the respective State Government.

## 2.3. Service Charge to Implementing Agency and Inspection Agency

**i)** Implementing agency (IA) shall be provided a service charge @1% of total CFA (minimum of Rs 50,000/-) for receiving and processing the applications. Indian Renewable Energy Development Agency Limited (IREDA) shall be the implementing agency. However the Ministry of New and Renewable Energy (MNRE) may change the IA by way of a suitable notification.

**ii)** Inspection Agency would be provided service charge @ Rs 1% of the eligible CFA (minimum of Rs 50,000/-) towards monitoring of implementation progress, performance inspection and verification of generation record, and post installation monitoring of the plants.

## 3. TERMS & CONDITIONS

**i)** Developers shall share plant generation data with MNRE or any other agency designated by MNRE, except in the case of Biomass Gasifiers, through installation of SCADA System/remote monitoring system. (This is applicable for project proposals submitted after notification of this guideline).

**ii) Expansion of Plants:** Grant of CFA to plants which intend to add capacity to the existing plants shall also be considered. CFA for such plants will be considered only for the enhanced capacity by way of installation of new plant and machinery. Applications received for



# Annexure 6: CFA Disbursement Guidelines under MNRE Waste to Energy Programme

File No. 300/1/2024-Waste To Energy  
Government of India  
Ministry of New and Renewable Energy  
(Waste to Energy Division)

\*\*\*\*

Atal Akshay Urja Bhawan  
Opp. CGO Complex, Lodhi Road  
New Delhi-110003  
Dated: 27.06.2025

## OFFICE MEMORANDUM

Subject: Revision in Waste to Energy Guidelines dated 02.11.2022, 28.02.2020 and 30.07.2018  
-Reg.

The Guidelines for the Waste to Energy Schemes issued on 02.11.2022, 28.02.2020 and 30.07.2018, were introduced to promote the for generation of Biogas/BioCNG/Power/producer or syngas from urban, industrial and agricultural wastes/residues. To further simplify the processes certain amendments are being introduced.

2. The changes/modifications/amendments will be applicable to all projects sanctioned under WTE Scheme guidelines dated 02.11.2022, 28.02.2020 and 30.07.2018.

3. The following clauses of Guidelines are amended:

| Sl. no. | Clauses in Current Scheme Guidelines                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | To be read as                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | <b>Plant Performance:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|         | 4.4 (iii) Performance testing of the plant would inter-alia imply the following: -<br><br>a) <b>Waste to Energy Plants:</b> The condition of successful commissioning of the Waste to Energy plants would imply operation of the plants for at least 3 consecutive months, including continuous operation for at least 72 hours at an average of 80% of the rated capacity of the plant.<br><br>In case of bio-methanation plants (Biogas, BioCNG, Power based on biogas), continuous operation of the plant implies continuous operation of digester (raw biogas generation) for 72 hours. | 4.4 (iii) Performance testing of the plant would inter-alia imply the following: -<br><br>a) <b>Waste to Energy Plants:</b> The condition of successful commissioning of the Waste to Energy plants would imply operation of the plants for at least 3 consecutive months, including continuous operation for at least 24 hours at an average of 80% of the rated capacity of the plant.<br><br><b>Phase-wise Release of CFA for Waste-to-Energy projects:</b><br><br>50% of total CFA will be released after obtaining the Consent to Operate (CTO) certificate from State Pollution Control Board, against the Bank Guarantee for the amount to be released. Balance CFA will be released |

*B. Singh*

|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Based on the performance of the project for at least three consecutive months, following graded structure for release of CFA based on average PLF over a period of atleast three months shall be applicable: -                                                                                                                                                                                                                                          |            | after achieving (during continuous running of 24 hours) 80% of the rated capacity or maximum eligible capacity whichever is lesser.                                                                                                                                                                                                                                                                                                                                                                  |
| Average achieved minimum 3 consecutive months                                                                                                                                                                                                                                                                                                                                                                                                           | PLF during | % of eligible CFA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ≥80%                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            | 100%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| ≥ 60% and < 80%                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | 80%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ≥ 50% and < 60%                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | 60%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <50%                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            | 0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | In cases, where developer fails to operate the plant at minimum 80% of the rated capacity or maximum CFA eligible capacity whichever is lesser during performance inspection of the plant by the inspection agencies, the below-mentioned pro-rata based disbursement will be made based on the percentage output achieved.                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | For example:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | >80% PLF - 100% of eligible CFA                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | If 73% PLF - CFA would be on pro-rata basis i.e.,                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | (100*73)/80 = 91.25% of eligible CFA                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | However, no CFA will be given if the PLF is < 50%.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | The claim for CFA shall be made within 18 months from the date of commissioning or the date of In-principle approval of CFA (whichever is later).                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            | <i>Note: The second instalment for release of the eligible CFA will be calculated after deducting the first instalment of 50%.</i>                                                                                                                                                                                                                                                                                                                                                                   |
| 2. Performance Inspection of a Waste-to-Energy project:                                                                                                                                                                                                                                                                                                                                                                                                 |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4.4 (i) Inspection team will visit the plant for performance inspection based on request from the developer. The performance inspection of the plant will have to be carried out within 18 months from the date of commissioning beyond which "In-Principle" approval will be cancelled except in those cases where reason(s) of delay in inspection is (are) beyond the control of Developer. For such cases, an extension of suitable period over the |            | 4.4 (i) Inspection team will visit the plant for performance inspection based on request from the developer after successful commissioning. The performance inspection of the plant will have to be carried out within 18 months from the date of commissioning or within 18 months from the date of issue of 'In-principle' approval, whichever is later. In case of delay in inspection where reasons for delay in inspection are beyond the control of Developer, an extension of suitable period |

*Bikas*



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>original performance inspection period can be granted by Secretary, MNRE provided an application is made by the developer, with supporting documents, before the completion of original inspection period of 18 months as given above.</p> <p><b>4.4 (ii)</b> The developer may choose any one of the following agencies for inspection of the plant: -</p> <p>(a) Concerned State Nodal Agencies for Renewable Energy (SNAs); or</p> <p>(b) Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE); or</p> <p>(c) Biogas Technology Development Centre (BTDC) (List at Annexure-VIII).</p> | <p>over the original performance inspection period can be granted by Secretary, MNRE based on application submitted by the developer, prior to the deadline of inspection along with justification.</p> <p><b>4.4 (ii)</b> Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE) shall do a joint inspection along with Concerned State Nodal Agencies for Renewable Energy (SNAs) or with Biogas Technology Development Center (BTDC) (List at Annexure-VIII) or any empanelled agency by MNRE. Subject expert from Government Institute may be involved for monitoring plant operation post release of CFA.</p> <p>The Joint inspection team has to visit the facility and submit inspection reports both, prior to 50% release of CFA after obtaining the Consent to Operate (CTO) certificate from State Pollution Control Board, and secondly, prior to the release of remaining CFA.</p> <p>If the developer does not opt for advance CFA, only one single inspection report will be needed to submit by inspection agencies.</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

4. Powers to relax any of the provisions in the WTE Scheme guidelines dated 02.11.2022, 28.02.2020 and 30.07.2018, would vest with Hon'ble Minister of New & Renewable Energy.

5. Remaining contents of the Guidelines for the WTE Scheme dated 02.11.2022, 28.02.2020 and 30.07.2018 shall remain unchanged.

6. This issues w.r.t. Department of Expenditure's OM dated 30.04.2025 and with the approval of Hon'ble Minister of New & Renewable Energy.

  
 (Bikash Upadhyaya)  
 Scientist 'C'  
 Email: [bikash.mnre@gov.in](mailto:bikash.mnre@gov.in)  
 Phone No.: 011 20849092

# Annexure 7: Market Development Assistance for the Offtake of FOM/LFOM from CBG Production



**No. 11017/29/2021-PMI-II (Part-1) (e-34602)**

**भारत सरकार/Government of India**

**रसायन और उर्वरक मंत्रालय/Ministry of Chemicals & Fertilizers**

**(उर्वरक विभाग/Department of Fertilizers)**

शास्त्री भवन/Shastri Bhawan,

नई दिल्ली/ New Delhi-1

**दिनांक/Dated: 20<sup>th</sup> September, 2023**

## **कार्यालय ज्ञापन/OFFICE MEMORANDUM**

**Subject: Guidelines on Market Development Assistance (MDA) for Promotion of Organic Fertilizers - Regarding**

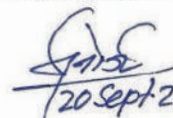
Organic fertilizers are decomposed derivatives of plant and animal sources such as agri-waste, cattle dung, poultry droppings and domestic sewage. They help in improving the soil texture, increase carbon content of soil, enhance water holding capacity of soil and increase the bacterial and fungal activity inside the soil. Increased use of organic fertilizers will help in balanced use of nutrients thereby reducing excess use of chemical fertilizers which is one of the key elements for sustainable agriculture.

II Fermented Organic Manure (FOM), Liquid Fermented Organic Manure (LFOM) and enriched Phosphate Rich Organic Manure (PROM) are organic fertilizers which are by-products of Bio-Gas (BG) and Compressed Bio-Gas (CBG) plants established under umbrella of Galvanizing Organic Bio-Agro Resources Dhan (GOBARDhan) initiative. Government of India has approved the Market Development Assistance Scheme for promotion of FOM/LFOM/PROM produced in the BG/CBG units under GOBARDhan with a budget outlay of ₹1451.82 Crore for 3 years, i.e., from FY 2023-24 to FY 2025-26.

III The detailed guidelines for Market Development Assistance (MDA) are as follows:

### **1. Eligibility Criteria:**

- 1.1 The Market Development Assistance @ ₹1,500/MT will be provided for the sale of FOM/LFOM/PROM produced at BG/CBG plants established under umbrella Galvanizing Organic Bio-Agro Resources Dhan (GOBARDhan) initiative only. These GOBARDhan units are supported under Sustainable Alternative Towards Affordable Transportation (SATAT) scheme of Ministry of Petroleum & Natural Gas (MoP&NG), 'Waste to Energy' programme of Ministry of New & Renewable Energy (MNRE), Swachh Bharat Mission (Grameen) of Department of Drinking Water & Sanitation (DDWS), etc.

  
20 Sept 2023<sup>1</sup>

- 1.2 Registration of the BG/CBG units with the GOBARDhan portal of the Department of Drinking Water & Sanitation is the pre-requisite condition for availing Market Development Assistance (MDA).
2. **Marketing Strategies:**
  - 2.1 The manufacturing units registered under Unified GOBARDhan portal will have the option to market FOM/LFOM/PROM through Fertilizer Marketing Companies in packed form or they can market themselves either in packed form or in bulk or both.
  - 2.2 **Marketing of Packed Fertilizers:** Marketing of FOM/LFOM/PROM should be done in packed form by Fertilizer Marketing Companies and/or by manufacturing plants.
  - 2.3 **Bulk Sale:** Marketing of FOM/LFOM/PROM in bulk/loose form by manufacturing plants is allowed for two quarters (October, 2023 to March, 2024) on experimental basis, subject to necessary notification by the Department of Agriculture & Farmers Welfare (DA&FW) and maintaining of quality standards of Fertilizer Control Order (FCO), 1985, as amended from time to time. On the basis of sustained supply and certified quantity during experimental period, appropriate decision will be taken regarding bulk sale.
  - 2.4 **Conformity to FCO Specifications:** FOM/LFOM/PROM should be in conformity to the specifications mentioned in Fertilizer Control Order (FCO), 1985, as amended from time to time.
  - 2.5 **Quality Assurance for Packed/Bulk Fertilizers:** Quality testing shall be ensured at Government notified laboratories/NABL accredited private laboratories. The quality test report is to be validated by State Agriculture Department or State Energy Development Agency, before issuing 'B2-MDA' Certificate.
    - 2.5.1 **Packed Sale:** In case of marketing in packed form, batch-wise quality test should be done.
    - 2.5.2 **Bulk Sale:** In case of bulk sale, sampling and quality testing will be done for every dispatch.
  - 2.6 Primary Agricultural Cooperative Societies (PACS) may be engaged as aggregator by the Fertilizers Marketing Companies/manufacturers, wherever feasible.

*G. N. S.*  
120 Sept 2023



# Annexure 8: Classification of CBG under Respective Categories



केन्द्रीय प्रदूषण नियंत्रण बोर्ड  
CENTRAL POLLUTION CONTROL BOARD  
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार  
MINISTRY OF ENVIRONMENT FOREST & CLIMATE CHANGE GOVT OF INDIA

CP-18/1/2023-IPC-VI-HO-CPCB-HO

Date: 25.03.2025

To

The Chairman  
State Pollution Control Board/Pollution Control Committee  
(As per the list)

**Sub: Directions under section 18(1)(b) of the Water (Prevention & Control of Pollution) Act, 1974 and the Air (Prevention & Control of Pollution) Act, 1981 regarding harmonization of classification of industrial sectors under Red, Orange, Green, White and Blue categories.**

WHEREAS, under section 16 (2)(b) of the Water (Prevention and Control of Pollution) Act, 1974 and under Section 16 (2)(c) of the Air (Prevention & Control of Pollution) Act, 1981, one of the functions of the Central Pollution Control Board (CPCB), constituted under the Water (Prevention and Control of Pollution) Act, 1974, is to coordinate activities of the State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs); and

WHEREAS, under section 16 (2)(c) of the Water (Prevention and Control of Pollution) Act, 1974 and under Section 16 (2)(d) of the Air (Prevention & Control of Pollution) Act, 1981, one of the functions of the CPCB is to provide technical assistance and guidance to SPCBs and PCCs; and

WHEREAS, CPCB has classified a total of 419 sectors into Red (125), Orange (137), Green (94), White (54) and Blue (9) category, by following a revised methodology based on PI index by assigning equal weightage to scores arising due to Water, Air and Hazardous waste, hereafter referred as Classification-2025. In this revised Classification, a new Blue Category has also been introduced to distinguish the Essential Environmental Services required for management of environmental concerns arising from anthropogenic pollution due to domestic/household activities which otherwise will have large littering potential. CPCB, vide letter dated 12.02.2025, issued directions to all SPCBs/PCCs for adoption and implementation of Classification-2025.

WHEREAS Compressed Biogas (CBG/Bio-CNG) plants, divided into 5 sub sectors, were classified under Red, Orange and White categories, based on respective Pollution Index scores, as per Classification 2025.

WHEREAS, a need was felt to revisit the classification of Compressed Biogas (CBG/Bio-CNG) plants based on the representations received for reclassification of the said sector. The Committee constituted for classification of sectors examined the representation, feed stock

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## Annexure-I

## CLASSIFICATION OF COMPRESSED BIOGAS (CBG)/BIO-CNG PLANTS

| S. N. | Sector                                                                                                                                                                                                                                                                                                                                                   | W 1 | W 2 | W 3 | PI <sub>w</sub> | A 1 | A 2 | A 3 | PI <sub>A</sub> | H1 | H2 | PI <sub>H</sub> | PI   | Category | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----------------|-----|-----|-----|-----------------|----|----|-----------------|------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 67.0  | <b>Compressed Biogas (CBG/Bio-CNG) Plants</b>                                                                                                                                                                                                                                                                                                            |     |     |     |                 |     |     |     |                 |    |    |                 |      |          |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 67.1  | CBG plants irrespective of feed stock- MSW, agro-residue, energy crops/grass/weeds, animal waste, press mud, etc. (apart from industrial/ process waste) generating wastewater of 50 KLD or above                                                                                                                                                        | 25  | 25  | 25  | 75              | 25  | 20  | 15  | 60              | 0  | 0  | 0               | 82.5 | Blue     | Environmental Guidelines of CPCB for Compressed Biogas (CBG)/Bio-CNG plant and household Bio-digester, as amended from time to time to be followed.                                                                                                                                                                                                                                                                     |
| 67.2  | CBG plants irrespective of feed stock- MSW, agro-residue, energy crops/grass/weeds, animal waste, press mud, etc. (apart from industrial/ process waste) generating wastewater less than 50 KLD                                                                                                                                                          | 25  | 25  | 20  | 70              | 25  | 20  | 15  | 60              | 0  | 0  | 0               | 79.0 | Blue     | Environmental Guidelines of CPCB for Compressed Biogas (CBG)/Bio-CNG plant and household Bio-digester, as amended from time to time to be followed.                                                                                                                                                                                                                                                                     |
| 67.3  | CBG plants irrespective of feed stock- MSW, agro-residue, energy crops/grass/weeds, animal waste, press mud, etc. (apart from industrial/ process waste), not discharging any wastewater and producing by-products- (i) Fermented Organic Manure (FOM)/ Liquid Fermented Organic Manure (LFOM)/ enriched manure and/or (ii) Briquette/pellet using fuel. | 0   | 0   | 0   | 0               | 25  | 20  | 15  | 60              | 0  | 0  | 0               | 60.0 | Blue     | i. FOM & LFOM production in conformity with requirements of Gazette Notification No. 2051 dated 14.07.2020 & No. 1972 dated 01.06.2021, respectively and/or enriched manure as governed by Fertilizer Control Order, 1985, as amended from time to time.<br><br>ii. Environmental Guidelines of CPCB for Compressed Biogas (CBG)/Bio-CNG plant and household Bio-digester, as amended from time to time to be followed. |

|      |                                                                                                                                                                                                                                                                                                                                                                 |    |    |    |    |    |    |    |    |   |   |   |      |       |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----|----|----|----|----|---|---|---|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 67.4 | CBG plants irrespective of feed stock- MSW, agro-residue, energy crops/grass/weeds, animal waste, press mud, etc. (apart from industrial/ process waste), not discharging any wastewater and producing by-products- (i) Fermented Organic Manure (FOM)/ Liquid Fermented Organic Manure (LFOM)/ enriched manure and/or (ii) Briquette/pellet using electricity. | 0  | 0  | 0  | 0  | 0  | 20 | 0  | 20 | 0 | 0 | 0 | 20.0 | White | i. FOM & LFOM production in conformity with requirements of Gazette Notification No. 2051 dated 14.07.2020 & No. 1972 dated 01.06.2021, respectively and/or enriched manure as governed by Fertilizer Control Order, 1985, as amended from time to time.<br><br>ii. Environmental Guidelines of CPCB for Compressed Biogas (CBG)/Bio-CNG plant and household Bio-digester, as amended from time to time to be followed. |
| 67.5 | CBG plants based on industrial/ process waste.                                                                                                                                                                                                                                                                                                                  | 25 | 25 | 25 | 75 | 25 | 20 | 15 | 60 | 0 | 0 | 0 | 82.5 | Red   | Environmental Guidelines of CPCB for Compressed Bio Gas (CBG)/Bio-CNG plant and household Bio-digester, as amended from time to time to be followed.                                                                                                                                                                                                                                                                    |



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As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

**Published by:**

Ministry of Housing and Urban Affairs (MoHUA),  
Government of India  
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

**Registered offices:**

Ministry of Housing and Urban Affairs (MoHUA)  
Nirman Bhawan, Maulana Azad Road, New Delhi, Delhi - 110001  
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH  
Bonn and Eschborn, Germany

**Project description:**

Waste Solutions for a Circular Economy in India,  
Management of Organic Waste in India  
B5/5, Safdarjung Enclave, New Delhi - 110029  
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**Design/layout:**

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July 2025