Overview and Current Status of CBG in India

National Seminar On
Promotion of Clean Energy Access in North East India

Presented By:
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Deputy Program Manager
Centre for Science and Environment (CSE)
India’s Energy Demand and Bioenergy

➢ India is expected to experience the greatest rise in energy demand compared to any other country

➢ India's demand for oil and gas is anticipated to triple by 2050, with gas consumption growing threefold by 2030

➢ About 46% of the CNG used in India is presently imported

➢ Bioenergy is an energy source that derives from organic matter present in plants or other organic waste

➢ According to IEA’s energy analysts, bioenergy is projected to account for 18% of the total energy supply in 2050
Highlights of Union Budget 2023-24

➢ Announced on 1 Feb 2023 rolled out **35,000 cr** to move towards **energy transition**

➢ **GOBARdhān** (Galvanizing Organic Bio-Agro Resources Dhan) scheme: Install **500 new 'waste to wealth' CBG plants**

➢ Consist of 200 compressed biogas (CBG) plants, 75 of which will be located in urban areas, and 300 community-based plants, with a total investment of **10,000 crores**

➢ **5% CBG mandate** will be introduced

➢ **Excise duty** on CBG has been **exempted**
Are Biogas, CBG, Bio-CNG the Same?

<table>
<thead>
<tr>
<th>No</th>
<th>Composition</th>
<th>Biogas</th>
<th>Bio-CNG/CBG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Methane</td>
<td>55-65%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>2</td>
<td>Carbon Dioxide</td>
<td>30-40%</td>
<td>&lt;4%</td>
</tr>
<tr>
<td>3</td>
<td>Hydrogen Sulfide</td>
<td>0.1-4%</td>
<td>&lt;16 ppm</td>
</tr>
<tr>
<td>4</td>
<td>Nitrogen</td>
<td>3%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>5</td>
<td>Oxygen</td>
<td>0.1-2%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>6</td>
<td>Moisture</td>
<td>1-2%</td>
<td>0%</td>
</tr>
<tr>
<td>7</td>
<td>Calorific Value</td>
<td>19.5 MJ/kg</td>
<td>47-52 MJ/kg</td>
</tr>
</tbody>
</table>

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### What 1 m³ of Biogas Looks Like?

<table>
<thead>
<tr>
<th>Name of the fuel</th>
<th>Equivalent quantity to 1 m³ of biogas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerosene</td>
<td>0.62 lit.</td>
</tr>
<tr>
<td>Firewood</td>
<td>3.50 kg</td>
</tr>
<tr>
<td>Cattle dung cake</td>
<td>12.3 kg</td>
</tr>
<tr>
<td>Charcoal</td>
<td>1.46 kg</td>
</tr>
<tr>
<td>Furnace oil</td>
<td>0.40 lit.</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.25 kW</td>
</tr>
<tr>
<td>LPG</td>
<td>0.43 kg</td>
</tr>
<tr>
<td>Diesel</td>
<td>0.52 lit.</td>
</tr>
<tr>
<td>Coal</td>
<td>1.6 kg</td>
</tr>
</tbody>
</table>
Science Behind Biogas Production

01. HYDROLYSIS
Complex organic matter: carbohydrates, fats & proteins are broken down into glucose molecules, fatty acids & amino acids.

02. ACIDOGENESIS
Bacteria break down glucose molecules, fatty acids & amino acids into volatile fatty acids & alcohols.

03. ACETOGENESIS
Volatile fatty acids & alcohols are converted into hydrogen, CO₂ & ammonia.

04. METHANOGENESIS
Archaea convert hydrogen & acetate into methane & CO₂.

The solid material left over is called digestate.

GLOBAL CITIZENS

ORGANIC WASTE
(FARM, FOOD, SEWAGE)

ANAEROBIC DIGESTION

GAS GRID

ELECTRICITY GRID

CROP PRODUCTION

TRANSPORT FUEL

DOMESTIC USE (COOKING)

TRASH

HEAT

BIORESOURCES

BIOGAS

CHP UNIT

DIGESTATE TO LAND

BIOGAS

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India’s Installed CBG Capacity

➢ **58 Commissioned Plants** (46 under SATAT)

➢ **4090** potential investors have been issued a letter of intent (LOI)

➢ **16,164 tons of CBG** has been sold

➢ **Gujarat** has the maximum of **13 plants** among all states

➢ **North-East’s first Plant coming up in Assam**
Environmental, Economic, and Social Benefits

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Economic</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas reduction</td>
<td>Reduce dependence on Imports</td>
<td>Job creation</td>
</tr>
<tr>
<td>_reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of non-greenhouse gas pollutants</td>
<td>Value from waste by converting it to energy and digestate</td>
<td>Local energy transition</td>
</tr>
<tr>
<td>Improvement in soil heath</td>
<td>Byproducts like Biogenic carbon dioxide</td>
<td>Rural development</td>
</tr>
<tr>
<td>Wastewater Management</td>
<td>Other High value fuels like hydrogen</td>
<td>Decentralized energy access</td>
</tr>
</tbody>
</table>
# Potential of Bio-CNG Production from Organic Wastes

<table>
<thead>
<tr>
<th>No</th>
<th>Categories of Organic Waste</th>
<th>Annual Feedstock Potential</th>
<th>Estimated Potential of Bio-CNG (MMT)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Surplus Agro-residues</td>
<td>150 MT</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Spent wash/Press Mud</td>
<td>20 MT</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Municipal Solid Waste (MSW)-Organic Fraction</td>
<td>62 MT</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Sewage Treatment Plants</td>
<td>50 MT</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>Animal and Poultry Waste</td>
<td>190 MT</td>
<td>25</td>
<td>41</td>
</tr>
</tbody>
</table>
Bio-CNG Obtained From Different Feed-stocks

~10 kg of Agriculture Residue OR
~25 kg of Vegetable Waste OR
~20 kg of Press Mud OR
~20 kg of Waste STP Sludge

Feedstock

- Pre-treatment
- Recovered Water

~2.22 m3 Biogas

Biogas Storage

Purification & Compression

BioCNG Storage

~1 kg BioCNG

Bio CO2 Storage

~1 kg BioCNG
Napier Grass: A Promising Feedstock for NER?

➢ Also known as elephant grass, is a productive and versatile forage grass native to Africa and Southeast Asia.

➢ This fast-growing perennial grass can reach a height of 10-15 feet and can be harvested 5-6 times annually.

➢ With an energy output-to-input ratio of approximately 25:1, it emerges as one of the most promising energy crops with low maintenance.

➢ In India, the reported annual production yield of Napier grass ranges from 150-200 tonnes per acre per year.

➢ Higher yields of up to 350-400 tonnes per acre per year by cultivating a hybrid variety called Super Napier has also been reported.
Bio-CNG from Napier?

➢ **20 Tons** of Napier Grass **Gives 1 Ton** of Bio-CNG (Reported Studies)

➢ Co-digestion, involving a combination of Napier grass with cow dung or food waste, results in higher yields compared to using Napier grass alone

➢ Another challenge in effectively utilizing Napier grass lies in its resistance to enzymatic and microbial hydrolysis.

➢ Pretreatment of the lignocellulosic biomass is imperative to enhance digestibility and maximise biogas production.
Biogas Digestate: An Important Byproduct

➢ Digestate is a nutrient-rich substance produced by anaerobic digestion that can be used as a fertilizer.

➢ It consists of left over indigestible material - the volume is around 90-95% of what was fed into the digester.

➢ Digestate is not compost, although it has some similar characteristics. Compost is produced by aerobic micro-organisms, meaning they require oxygen from the air.

➢ It is a good fertiliser for crops and improves the soil fertility, soil structure and yields of crops.

➢ The liquid part of slurry has beneficial microbes, folic acid, nitrogen and micronutrients traces in an easily available form for crops.

<table>
<thead>
<tr>
<th>No</th>
<th>Parameter</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total nitrogen (%)</td>
<td>1.40–1.84</td>
</tr>
<tr>
<td>2</td>
<td>Total phosphorus (%)</td>
<td>1.10–1.72</td>
</tr>
<tr>
<td>3</td>
<td>Total potash (%)</td>
<td>0.84–1.34</td>
</tr>
<tr>
<td>4</td>
<td>Organic carbon (%)</td>
<td>35.0–38.4</td>
</tr>
<tr>
<td>5</td>
<td>Zinc (mg/kg)</td>
<td>103–116</td>
</tr>
<tr>
<td>6</td>
<td>Copper (mg/kg)</td>
<td>51–68</td>
</tr>
<tr>
<td>7</td>
<td>Manganese (mg/kg)</td>
<td>231–295</td>
</tr>
</tbody>
</table>
The economics of a CBG plant can vary depending on various factors such as the scale of the plant, technology used, feedstock cost, government incentives and market demand for CBG.

- The approximate cost of installing a 5 TPD capacity CBG plant is estimated between Rs 20–25 cr.
- About 75–80% of the CAPEX cost is for purchasing plant machinery.
The yearly operation cost to run a **5 TPD capacity** bio-CNG plant in India can vary depending on various factors such as the **cost of raw materials, labour costs, electricity costs, maintenance costs** and other operational expenses.

However, to give a rough estimate, the yearly operation cost for a **5 TPD capacity** bio-CNG plant in India can be around **Rs 2.5–4 cr.**
Policies or Financial Assistance Related to CBG

➢ Sustainable Alternative Towards Affordable Transportation (SATAT) Scheme

➢ MNRE: Waste to Energy Scheme

➢ GOBAR (Galvanizing Organic Bio-Agro Resources) DHAN Scheme

➢ Agro Infrastructure Fund (AIF)

➢ State Specific Incentives

➢ Carbon Credits

➢ Corporate Social Responsibility (CSR) Funds

➢ Priority Sector Lending
1) SATAT Scheme: MoPNG

➢ SATAT’ scheme encourages entrepreneurs to set up CBG plants, produce & supply CBG to Oil Marketing Companies (OMCs) for sale as automotive & industrial fuels

➢ Provide assurance for CBG Off-take at fixed prices
A Step Towards A Sustainable Future

SATAT

‘SATAT’ scheme on Compressed Bio Gas (CBG) encourages entrepreneurs to set up CBG plants, produce & supply CBG to Oil Marketing Companies (OMCs) for sale as automotive & industrial fuels.
2) MNRE: Waste to Energy

<table>
<thead>
<tr>
<th>Type of project</th>
<th>Standard CFA rate @ installed capacity of the plant</th>
</tr>
</thead>
</table>
| BioCNG / Enriched Biogas / Compressed Bio Gas | -Rs 4.0 Cr per 4800 kg/day (for BioCNG generation from new biogas plant)  
- Rs 3.0 Cr per 4800 kg/day (for BioCNG generation from existing Biogas plant#)  
-Maximum CFA of Rs. 10.0 Cr/project for both cases. |

- 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.

- Plants based on cattle dung as main feedstock set up by Gaushalas independently or through joint partnerships will also be eligible for 20% higher CFA.
Welcome to
BIO-URJA Portal

About Portal
About the Programmes
Steps to avail CFA
Scheme Highlight

Government of India
Ministry of New and Renewable Energy
3) GOBARDHAN: Ministry of Drinking Water and Sanitation

➢ Financial assistance of **Rs. 50 lakh per district** is available for setting up model GOBARDHAN projects

➢ The **District is the nodal agency** for planning, implementation, monitoring and approval of GOBARDHAN projects

➢ Districts can take up model projects at District/Block level and cluster & community models at GP level.

➢ The District will examine the proposals of GPs with the support of a technical committee/experts, if needed, and approve the proposal ensuring its long-term sustainability
A Jan Andolan on safe management of cattle and organic waste

552

193
Bio-Gas/CBG Plants - Construction in progress

18053
Installed Capacity of Bio-Gas (in m³)

311086
Installed Capacity of Commercial CBG Plant (in kg)

157
Number of Districts covered

"भारत में मांवेशियों की आबादी पूरे विश्व में सबसे ज्यादा है। मांवेशियों के गोबर, कृषि से निकले कचरे, आदि से बायोगैस बनाने की दिशा में 'GOBAR-Dhan' योजना अहम है। यह सिर्फ एक योजना नहीं, बल्कि गाँवों को स्वच्छ रखने, किसानों एवं पशुपालकों की आमदनी बढ़ाने और बायोगैस के माध्यम से waste to wealth और waste to energy पाने का सशक्त माध्यम है।"
4) Agri Infrastructure Fund (AIF)

➢ AIF provides financial support for investment in viable projects relating to post-harvest management infrastructure and community farming assets. All loans under this financing facility will have an interest subvention of **3 percent per annum** up to a limit of **loan amount of Rs. 2 crores**. This subvention will be available for a maximum period of **7 years**.

➢ **CBG is one of the eligible project** under community farming assets Project

➢ Administered by **Ministry of Agriculture & Farmers' Welfare**

https://agriinfra.dac.gov.in/

Go to beneficiary

Registered yourself as a beneficiary

Login through your registration details

Loan application

Fill the project details with all necessary document required as checklist including DPR.

Submit for approval of your loan

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5) Carbon Credits, Priority Sector Lending, and CSR Funds

- **Carbon Credits** are a tradable commodity that represent a **reduction or removal of one ton of carbon dioxide equivalent (CO\textsubscript{2}e) from the atmosphere**. Bio-CNG plants are eligible to earn carbon credits for the reduction in greenhouse gas emissions achieved through the production and use of Bio-CNG as a clean and renewable fuel. The earning potential of carbon credits can provide an additional source of revenue for Bio-CNG plants.

- **Priority Sector Lending (PSL)** is a framework established by the Reserve Bank of India (RBI) to ensure that certain sectors of the economy receive adequate and timely credit from banks and financial institutions.

- **Corporate Social Responsibility (CSR)** funds are funds that companies set aside for social welfare and environmental projects. In recent years, many companies in India have invested CSR funds in Bio-CNG projects to promote sustainable development and reduce greenhouse gas emissions. Eg: Mahindra Waste to Energy Solutions has set up Bio-CNG plants in Pune and Mumbai with the support of CSR funds from Mahindra & Mahindra Ltd.
State Specific Incentives

➢ Uttar Pradesh recently launched its **Bioenergy Policy 2022**

➢ Rs 1,040.75 cr have been sanctioned with a maximum **Rs 750 cr contribution towards CBG**

➢ It also sets a highly ambitious target to generate **1,000 TPD of CBG by 2026-27**

➢ The scheme provides a subsidy of **Rs 75 lakh per ton of CBG** with a cap of Rs 20 cr

➢ **100% electricity charge waiver** for 10 years from the date of product commencement.

➢ **Stamp duty for rent agreement, lease and sale deed registration fees** for the land for units has been **waived**

➢ **Land on lease @Re 1 per acre**

➢ **Online portal** for single window clearance
Factors to Consider while Installation of Bio-CNG Plant
<table>
<thead>
<tr>
<th>S.No</th>
<th>List of Items</th>
<th>Approving Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No objection certificate (NOC) for setting up the project</td>
<td>Local municipality cooperation/gram panchayat</td>
</tr>
<tr>
<td>2</td>
<td>Electricity and water connections</td>
<td>Utilities/distribution company and jal board</td>
</tr>
<tr>
<td>3</td>
<td>Taxes</td>
<td>Revenue Department</td>
</tr>
<tr>
<td>4</td>
<td>Change of Land Use (CLU), if required</td>
<td>State Town Planning Board</td>
</tr>
<tr>
<td>5</td>
<td>Consent to establish and consent to operate</td>
<td>State Pollution Control Board</td>
</tr>
<tr>
<td>6</td>
<td>Explosive substance license</td>
<td>Petroleum and Explosives Safety Organization (PESO)</td>
</tr>
<tr>
<td>7</td>
<td>Certificate of incorporation of Project SPV, if required</td>
<td>Ministry of Corporate Affairs</td>
</tr>
<tr>
<td>8</td>
<td>Factory license</td>
<td>Indian Factories Act, 1948 from Chief Inspector of Factories</td>
</tr>
<tr>
<td>9</td>
<td>Labour license</td>
<td>Department of Labour</td>
</tr>
<tr>
<td>10</td>
<td>NOC from Fire Department</td>
<td>State Fire and Emergency Services</td>
</tr>
<tr>
<td>11</td>
<td>NOC for forest clearances, if required</td>
<td>State Forest Department</td>
</tr>
<tr>
<td>12</td>
<td>Certificate of Manufacture of Mixture of Fertilizers/ Micronutrient mixtures/ Bio-fertilizers/ Organic Manures, if required</td>
<td>Department of Agriculture</td>
</tr>
</tbody>
</table>
## Pollution Category of CBG Plants

<table>
<thead>
<tr>
<th>Industrial Sector</th>
<th>Category</th>
<th>Pollution Index Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBG plants based on municipal solid waste</td>
<td>Orange</td>
<td>41-59</td>
</tr>
<tr>
<td>CBG plants based on process waste (industrial waste, press mud, molasses, organic sludge)</td>
<td>Orange</td>
<td>41-59</td>
</tr>
<tr>
<td>CBG plants based on crop residue (paddy straw, wheat straw, corn sweet sorghum, nappier grass)</td>
<td>Green</td>
<td>21-40</td>
</tr>
<tr>
<td>CBG plants based on animal waste (dairy farms, poultry farms, other animal waste)</td>
<td>Green</td>
<td>21-40</td>
</tr>
<tr>
<td>CBG plants (irrespective of the type of feed) producing FOM and LFOM and not discharging any wastewater</td>
<td>White</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

- Projects under the category of “WHITE”, which is practically non-polluting, will not require either Environmental Clearance under Environment (Protection) Act, 1986 or Consent under Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution) Act, 1974.
CASE STUDIES
Site1: Agricultural Waste

- **Name of the Plant**: Verbio AG
- **Plant Start Date**: 18-10-2022
- **Location**: Lehragaga, Sangrur, Punjab
- **Bio-CNG Production Capacity**: 33 TPD
- **Number of Digesters**: 8
- **Feedstock Used**: Paddy straw and other agricultural waste
- **Daily Feedstock Requirement**: 300 tons
- **Land Requirement**: 20 acres
- **Biogas Purification Method**: Amines (Chemical Based)
- **Gas Offtake Method**: Dispensed at Nearby CNG Pumps using Cascades
- **Biodigestate Production**: 60-65 TPD
- **Plant Cost**: 230 crores
Verbio Bio-CNG Plant, (Weather Monitoring System)

Inhouse Farm Equipments for Feedstock Procurement

Biogas Digesters

Paddy Straw Bails (400 kg each)
Site 2: Municipal Solid Waste

- **Name of the Plant**: EverEnviro
- **Plant Start Date**: February 2022
- **Location**: Indore, Madhya Pradesh
- **Bio-CNG Production Capacity**: 17-18 TPD
- **Number of Digesters**: 4
- **Feedstock Used**: Biodegradable Municipal Waste
- **Daily Feedstock Requirement**: 500 TPD
- **Land Requirement**: 15 acre
- **Biogas Purification Method**: PSA
- **Gas Offtake Method**: 50% gas to IMC city buses, 50% Industrial, Commercial
- **Biodigestate Production**: 100 TPD
- **Plant Cost**: 150 cr
Site 3: Press-mud (Sugar Industry Waste)

- **Name of the Plant**: Mittal Enterprises
- **Plant Start Date**: 01-01-2023
- **Location**: Garhmukteshwar, Uttar Pradesh
- **Bio-CNG Production Capacity**: 8 TPD
- **Number of Digesters**: 2
- **Feedstock Used**: Pressmud
- **Daily Feedstock Requirement**: 200 TPD
- **Land Requirement**:
- **Biogas Purification Method**: Water Scrubbing Technology
- **Gas Offtake Method**: Agreement with IGL (Cascades)
- **Biodigestate Production**: 33 tons solid, 40,000 L liquid
- **Plant Cost**: 26 crores including land
Biogas Digester (Capacity: 4 TPD)

Biogas Digestate Soild-Liquid Separator

Water Scrubbing Unit
Site 4: Community Level Plant

➢ Name of the Plant: IIT Delhi Biogas Plant
➢ Plant Start Date: 2010
➢ Location: IIT Delhi, New Delhi
➢ Bio-CNG Production Capacity: 25 m³
➢ Number of Digesters: 1
➢ Feedstock Used: Kitchen waste
➢ Daily Feedstock Requirement: 250 kg
➢ Land Requirement: 1500 m²
➢ Biogas Purification Method: Water Scrubbing
➢ Gas Offtake Method: 2-wheeler, 4-wheeler
➢ Biodigestate Production: 25 kg
➢ Plant Cost: 35-40 lakhs
Pulverization Unit

Biogas Digester

Mixing Tank

Car run by Prof. V.K. Vijay on Bio-CNG

2-wheeler integrated with Bio-CNG kit
Challenges in the CBG Sector

➢ **Uncertainty of long-term** regular supply of feedstock

➢ **Source segregation** is important – receiving non-segregated waste is an operational challenge

➢ **Less private sector banks are financing** Bio-CNG project that too at **high cost of debt**

➢ **Lack of access to infrastructure** i.e. road network and CGD network near project sites

➢ **Year-on-year variation in feedstock price** – established feedstock pricing mechanism is required

➢ **Poor marketability and no fixed price for off-take of biogas fertilizer**

➢ **Lack of single window for large set of approvals**
Companies Operating in CBG Sector