1. INTRODUCTION: Compressed Biogas (CBG)

- What is Compressed Biogas (CBG)?
- Different Names Globally
- Conventional CNG vs CBG?
- CBG: A Tool to Promote Circular Economy
- Difference Between Biogas and CBG
- Feedstocks for CBG production
- Environmental, Economic, and Social Benefits
- Various Applications of CBG

GLOBAL BIOFUELS ALLIANCE

Glossary

Anaerobic: A condition or process that occurs without oxygen.

Anaerobic Digestion: A biological process where microorganisms break down organic material in the absence of oxygen to produce biogas and nutrient-rich material.

Digestor: A sealed container or tank where anaerobic digestion takes place.

Digestate: The leftover material after anaerobic digestion, often used as a fertilizer.

Feedstock: The organic material fed into a system, such as a digestor, for processing.

Bio-CO_2: Carbon dioxide produced in anaerobic digestion, which makes up a component part of biogas (25-50%), and can be separated out in the biogas upgrading process for use in industrial processes

Greenhouse Gas: A gas that traps heat in the Earth's atmosphere, contributing to the greenhouse effect and global warming.

Bagasse: The fibrous residue left after extracting juice from sugarcane

Steam Reforming: It is a process that reacts hydrocarbons with steam at high temperatures to produce hydrogen and carbon monoxide, widely used in hydrogen production.

What is Compressed Biogas (CBG)?

- CBG is **a green alternative to natural gas** and can be utilized without requiring modifications to transmission and distribution systems or user equipment, and is **fully compatible for use in natural gas vehicles**
- It is produced by the **breakdown of organic matter** in the absence of oxygen (**anaerobic digestion**)

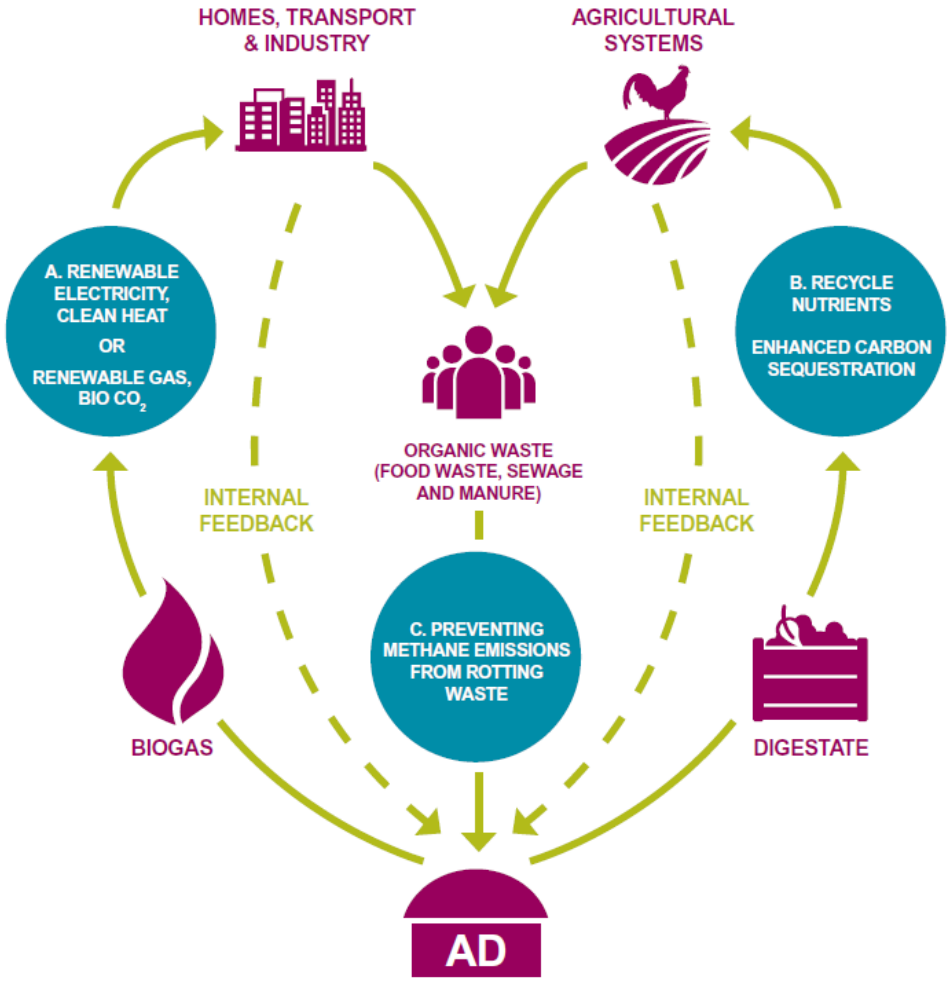
Different Names Globally

- CBG, Compressed Biogas or Bio-CNG (***India***)
- RNG, Renewable Natural Gas (***United States, Brazil***)
- Biomethane (***UK and Europe***)
- Bio-natural gas (***China***)

Conventional CNG vs CBG?

- Conventional CNG is **extracted from underground rock formations** using traditional drilling techniques and hydraulic fracking methods (*fossil fuel*)
- CBG is produced from **organic waste materials** (*green fuel*)

CBG: A Tool to Promote Circular Economy



Biomethane contributes to **emission reductions** across the entire value chain through a **three-fold approach**:

1. It **prevents natural emissions** by capturing and utilizing the gases released **during the decomposition of organic matter**, which would otherwise enter the atmosphere.
2. It **replaces fossil fuels as an energy source**, reducing reliance on carbon-intensive fuels.
3. The digestate byproduct from biogas production serves as a **biofertilizer, enriching soil with organic carbon** and lowering the need for carbon-heavy mineral fertilizer production.

Source: Biomethane: The Pathway To 2030 (ADBA)

Difference Between Biogas and CBG

No	Composition	Biogas	CBG/RNG
1	Methane	55-65%	>90%
2	Carbon Dioxide	30-40%	<4%
3	Hydrogen Sulfide	0.1-4%	<16 ppm
4	Nitrogen	3%	<0.5%
5	Oxygen	0.1-2%	<0.5%
6	Moisture	1-2%	0%
7	Calorific Value	19.5 MJ/kg	47-52 MJ/kg

Source: The Global Green Growth Institute; Landscape analysis of Bio-CNG in India

Feedstocks for CBG production

ANIMAL WASTE

AGRICULTURAL RESIDUE

INDUSTRIAL WASTE

MUNICIPAL SOLID WASTE/LANDFILLS

LIQUID EFFLUENT

ENERGY CROPS

Animal Waste

- Cattle Dung
- Poultry Litter
- Pig feces
- Slaughterhouse Waste

Agricultural Residue

- Rice/Wheat/Maize Straw
- Sugarcane Tops
- Sorghum/Cotton Stalk
- Legume Crops Residue
- Bagasse

Industrial Waste

- Sugar Manufacturing Industrial Waste: **Pressmud**
- Food Processing Industrial Waste: **Pomace**
- Potato Industry: **Rejected Potatoes/Potato Peelings/Waste Pulp**

Municipal Solid Waste/Landfills

- Organic fraction of municipal solid waste

Liquid Effluent

- Municipal Wastewater
- Distillery Effluent
- Milk Processing Plants Discharge
- Paper and Pulp Effluent
- Food Processing Industrial Effluent

Energy Crops

- Napier Grass
- Sorghum
- Corn
- Clover
- Maize
- Switchgrass
- Miscanthus

Feedstock Quantity Required to Produce 1 Ton CBG

- Cattle Dung (**55 tons**)
- Pressmud (**26 tons**)
- Paddy Straw (**15 tons**)
- Napier Grass (**20 tons**)
- Municipal Solid Waste (**31 tons**)

The provided figures are preliminary estimates based on input from the biogas industry, with actual values depending on the total and volatile solids in the feedstock

Environmental Benefits

- Reduce greenhouse gas emissions
- Reduces non-greenhouse gas emissions
- Enables waste management
- Improves soil health by producing organic manure

Social Benefits

- Job Creation in Rural Areas
- Improved Farmers Income
- Decentralized Energy Access
- Drive Cleanliness

Economic Benefits

- Provides Energy Security
- Reduce Import Dependence
- Multiple By-products
- Monetary Value of Green Attributes

Various Applications of CBG

- Vehicular Fuel
- Generate Electricity
- Produce Heat
- Gas Pipeline for Cooking
- Industrial Fuel
- Produce Green Hydrogen

Transportation Fuel

- Direct Replacement of **CNG** and **LNG**
- **No Engine Retrofitting** Requirements
- Fuel for **Cars, Buses**, and **Trucks**
- **Tractors** and **2-wheelers** also developed to run on CBG

Generate Electricity

- Biogas can produce electricity using a **combustion engine** or **gas turbine**
- The electricity can be used on-site or supplied to the **electric grid**
- **1 cubic meter** of biogas = **2 kilowatt hours (kWh)** of electricity

Cooking Fuel

- Biomethane can be used for cooking in a variety of settings, including **households, highway restaurants, hotels**, and **community kitchens**

Heating

- Biomethane can fuel gas **boilers and heat pumps** which can provide households and tertiary buildings with **renewable, cost-competitive heat**
- **Combined heat and power generation** (CHP) units can be run on biomethane and provide heat through a heating network

Industrial Fuel

- Biomethane can be used in industries that use natural gas like **chemical, glassmaking, mineral industries; pulp and paper industry; in steelmaking, fertilizer** or in the **food and beverage** industry

Produce Green Hydrogen

- **Biohydrogen**, a type of green hydrogen could be produced from biomethane using **steam reforming** process