

# Technology for Upgrading Raw Biogas to Pipeline Quality Bio-methane

**CSIR-IIP's efficient Vacuum Swing Adsorption (VSA) process for the upgradation of Raw Biogas to Bio-Methane meeting BIS:16087 specifications for Compressed Biogas (CBG) applications.**

## Raw-Biogas

- Renewable energy source generated through anaerobic decomposition of organic matter
- Composition depends on the source and production process Methane (55-65% v/v), CO<sub>2</sub> (35-45% v/v), H<sub>2</sub>S (0-3% v/v), Moisture saturated
- Lower heating value (LHV) ranging from 18-22MJ/m<sup>3</sup>
- Can be utilized for electricity generation, heating applications, and as a cooking fuel
- Sustainable alternative to fossil fuels that can help reduce greenhouse gas emissions after upgradation

## Bio-methane

- Also known as **Renewable Natural Gas**, is a high-purity form of methane produced by upgrading biogas
- India imports 50% Natural Gas (NG). Gol has a target of 10% NG import reduction by 2025.
- India has CBG potential of ~60MMTPA. Gol has target of producing 15MMTPA CBG by 2025 under SATAT
- LHV of approximately 36MJ/m<sup>3</sup>, making it a highly efficient energy source
- Virtually identical to natural gas and can be used without any modification to existing infrastructure or equipment, including natural gas vehicles

The process was developed at bench scale and validated at a pilot unit designed by CSIR-IIP. This pilot unit was integrated into a biogas-producing digester at a Municipal Corporation site. The process was further demonstrated in a commercial unit of 1.5TPD scale. A process patent has been granted in India.



Organic Solid Waste Sorting



Biogas Digester



Integrated VSA Pilot Skid

Gas Composition	CH <sub>4</sub> , Vol%	CO <sub>2</sub> +N <sub>2</sub> +O <sub>2</sub> , Vol%	O <sub>2</sub> , Vol%	Total S incl. H <sub>2</sub> S, ppmw	Moisture (mg/m <sup>3</sup> )
Revised BIS Spec. for CBG: IS16087 (2016)	Min. 95	Max. 5	Max. 0.5	Max. 10	Max. 5

**The Basic Design and Engineering Package (BDEP) and cost estimate for 2TPD and 5TPD Compressed Biogas plants have been prepared. CSIR-IIP is currently licensing the technology. 70% indigenous technology**

## Design Basis for 2 and 5 TPD Plant:

Raw Biogas throughput as feed	350 Nm <sup>3</sup> /h and 875 Nm <sup>3</sup> /h
Raw Biogas composition to VSA Unit	CH <sub>4</sub> : 55-75 Vol%; CO <sub>2</sub> : 25-40 Vol%, H <sub>2</sub> S: 0-3 Vol%; O <sub>2</sub> : <0.2 Vol%, Moisture: Saturated
CBG Throughput as per BIS:16087 (2016) spec.	2TPD CBG with 350Nm <sup>3</sup> /h raw biogas and 5TPD CBG with 875 Nm <sup>3</sup> /h raw biogas processing (Daily 16 hours of VSA plant operation considered)
Scope of Supply	VSA unit along with pre-treatment unit for upgrading raw biogas to CBG, conforming to BIS:16087 (2016) spec., with methane content up to 97 Vol% at a recovery of at least 93%. Exclusion: Raw biogas generating anaerobic digester



Lab. Scale Study (2-10 LPM) TRL-3



Pilot Demonstration (350 LPM) TRL-6



Performance Validated at Commercial Scale (2000 LPM) TRL-8

**The first demo plant based on CSIR-IIP process know-how is currently running inside the Haibowal Dairy Complex, Ludhiana, Punjab**

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