



West Asia Tensions Renew India's Push Towards Biogas to Strengthen Energy Security and Reduce Import Dependence

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Recent Developments:

- The recent escalation of conflicts in **West Asia** has renewed concerns over India's **Liquefied Petroleum Gas (LPG)** supply because nearly **90%** of India's LPG imports transit through the strategically important **Strait of Hormuz**.
- In response, the Government of India has intensified efforts to promote **Biogas** and **Compressed Biogas (CBG)** as indigenous, renewable alternatives capable of enhancing long-term **energy security** and reducing dependence on imported fossil fuels.

Biogas and India's Energy Security Architecture:

What is Biogas?

- **Biogas** is a **renewable, carbon-neutral** gaseous fuel produced through the biological decomposition of biodegradable organic matter under oxygen-free conditions.
- It primarily consists of **Methane (CH₄)**, **Carbon Dioxide (CO₂)** and small quantities of other gases.
- After purification and compression, biogas is converted into **Compressed Biogas (CBG)**, which is chemically equivalent to **Compressed Natural Gas (CNG)** and can be used as its direct substitute.

Importance for India's Energy Security:

- India imports nearly **85%** of its crude oil requirement, making the economy highly vulnerable to external geopolitical disruptions and volatile energy markets.
- Expanding domestic **CBG** production can diversify India's energy basket, strengthen energy self-reliance, and reduce foreign exchange expenditure on fossil fuel imports.

Key Facts and Statistics:

Energy Import Dependence:

- India meets around **85%** of its crude oil demand through imports, exposing the country to supply disruptions and global price fluctuations.

Feedstock Market Trends:

- The administered price of **maize-based biofuels** recorded a **Compound Annual Growth Rate (CAGR)** of **11.7%** between **FY22** and **FY25**.
- Higher procurement prices have encouraged excessive maize cultivation, affecting crop diversification and food security.

Financial Support under GOBARdhan:

- Under the **GOBARdhan** initiative, financial assistance of up to **₹50 lakh per district** is available for establishing community and cluster-based biogas plants.

Pipeline Infrastructure Support:

- The Government has allocated **₹994 crore** under the **Development of Pipeline Infrastructure (DPI) Scheme** to connect CBG plants with the **City Gas Distribution (CGD)** network and the national gas grid.

Formation of Biogas:

Anaerobic Digestion Process:

- Biogas is produced when microorganisms decompose animal dung, crop residues, food waste and sewage in the complete absence of oxygen.

Hydrolysis and Acidogenesis:

- Complex organic compounds such as carbohydrates, proteins and fats are converted into simpler soluble compounds and volatile fatty acids through microbial activity.

Methanogenesis:

- **Methanogenic Archaea** convert volatile fatty acids and hydrogen into methane, which forms the principal energy component of biogas.

Purification and Compression:

- Raw biogas undergoes purification to remove **Carbon Dioxide, Hydrogen Sulphide (H₂S)** and moisture.
- The methane concentration is increased to more than **90%**, after which the gas is compressed to produce **Compressed Biogas (CBG)**.

Strategic Importance of Biogas:

Reducing Fossil Fuel Dependence:

- **CBG** can directly replace fossil-based **CNG** in transport and industrial applications using locally available feedstock.
- Indigenous production reduces vulnerability to disruptions at global maritime chokepoints.

Supporting Clean Cooking Energy:

- Purified **Biomethane** can be supplied through **Piped Natural Gas (PNG)** networks for domestic cooking.
- Mandatory blending obligations are expected to gradually integrate **CBG** into urban gas distribution systems.

Promoting Decentralised Rural Energy:

- Rural biogas plants can generate electricity for local agricultural processing units and off-grid communities.
- Community-based plants under the **GOBARdhan** initiative also support local energy security.

Producing Organic Fertilisers:

- Digestion leaves behind nutrient-rich **Bio-slurry**, which functions as an organic fertiliser.

- Bio-slurry improves soil fertility, enhances soil organic carbon and reduces dependence on chemical fertilisers.

Supporting Circular Economy:

- Biogas production converts agricultural residues, animal waste and municipal organic waste into valuable energy and fertilisers.
- The process simultaneously addresses waste management, resource efficiency and greenhouse gas mitigation.

Major Government Initiatives:

GOBARdhan Scheme:

- **GOBARdhan (Galvanising Organic Bio-Agro Resources Dhan)** is a flagship **Waste-to-Wealth** initiative promoting scientific management of biodegradable waste through biogas and CBG production.
- The scheme integrates support from multiple ministries for feedstock collection, plant establishment, pipeline connectivity and bio-fertiliser utilisation.

SATAT Initiative:

- **SATAT (Sustainable Alternative Towards Affordable Transportation)** was launched in **2018** to promote commercial production of **Compressed Biogas** and its marketing through Oil Marketing Companies.
- The initiative initially targeted establishment of **5,000 CBG plants**, although implementation has progressed slower than expected.

Mandatory CBG Blending:

- The **National Biofuels Coordination Committee** approved phased mandatory blending of **CBG** in **CNG** for transport and **PNG** for domestic consumers.
- Blending obligations begin at **1%** and are planned to increase progressively to **5%** by **FY29**.

Challenges Facing the Biogas Sector:

Feedstock Collection Constraints:

- Seasonal availability of crop residues and dispersed livestock holdings increase transportation costs and complicate biomass aggregation.
- Limited availability of specialised biomass collection machinery further delays project implementation.

Food Security Concerns:

- Attractive pricing for selected biofuel feedstocks encourages monocropping, reducing cultivation of pulses and oilseeds.
- Such distortions may increase dependence on imports of edible oils and other food commodities.

High Capital Requirement:

- Modern purification systems, corrosion-resistant equipment and compression facilities require substantial initial investment.
- Small developers often face difficulties in obtaining institutional finance and meeting technical compliance requirements.

Limited Pipeline Connectivity:

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- Many rural biogas plants remain distant from **City Gas Distribution** networks.
- Inadequate pipeline infrastructure forces producers to transport CBG by road, increasing costs and reducing commercial viability.

Slow Project Implementation:

- Although numerous Letters of Intent have been issued under **SATAT**, commissioning of commercial CBG plants has remained slower than originally envisaged because of logistical, financial and regulatory constraints.

Way Forward:

Prioritise Agricultural Waste over Food Crops:

- Feedstock policy should focus primarily on crop residues, animal manure and municipal organic waste instead of food grains.
- This approach can simultaneously strengthen energy security and protect food security.

Replicate the Ethanol Blending Model:

- Long-term purchase guarantees, fiscal incentives and robust monitoring mechanisms similar to the **Ethanol Blending Programme (EBP)** can accelerate CBG adoption.
- India's ethanol blending in petrol reached **20%** by **late 2025**, demonstrating the effectiveness of coordinated policy support.

Strengthen Financial Incentives:

- Accelerated depreciation benefits, tax incentives and concessional financing can attract greater private investment into commercial biogas infrastructure.

Improve Infrastructure:

- Fast-track utilisation of infrastructure allocations for biomass aggregation machinery and pipeline connectivity.
- Expand direct connections between rural biogas plants and the national gas grid to reduce transportation costs.

Promote Research and Innovation:

- Develop efficient digestion technologies, advanced purification systems and improved biomass logistics to enhance plant productivity and commercial viability.

Conclusion:

- **Biogas** offers India a strategic opportunity to simultaneously enhance **energy security**, strengthen **waste management**, support **rural incomes**, reduce **greenhouse gas emissions**, and promote a **circular economy**.
- Sustained policy support, reliable infrastructure, diversified feedstock utilisation and greater private participation will be essential to transform biogas into a major pillar of India's clean energy transition.

Value Addition for UPSC:

Important Terms:

- **Biogas.**

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- **Compressed Biogas (CBG).**
- **Compressed Natural Gas (CNG).**
- **Piped Natural Gas (PNG).**
- **Anaerobic Digestion.**
- **Methanogenesis.**
- **Bio-slurry.**
- **Circular Economy.**
- **Waste-to-Wealth.**
- **Energy Security.**

Important Schemes and Institutions:

- **GOBARdhan (Galvanising Organic Bio-Agro Resources Dhan).**
- **SATAT (Sustainable Alternative Towards Affordable Transportation).**
- **National Biofuels Coordination Committee (NBCC).**
- **City Gas Distribution (CGD) Network.**
- **Development of Pipeline Infrastructure (DPI) Scheme.**
- **Ministry of Petroleum and Natural Gas (MoPNG).**
- **Ministry of New and Renewable Energy (MNRE)**