

# Challenges and Opportunities in India's City Gas Distribution (CGD) Sector: A Critical Analysis

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Sept, 2025

## Abstract

This paper examines the evolution, current status, key challenges and emerging opportunities in India's City Gas Distribution (CGD) sector, and offers a set of policy and industry recommendations to accelerate CGD rollout in a financially sustainable and environmentally meaningful way. Using a mix of policy-document analysis, secondary data from regulatory and industry reports, and comparative literature, the paper highlights (i) the rapid expansion ambitions and regulatory framework driving the sector, (ii) structural constraints — financing, infrastructure, feedstock security and pricing volatility — that dampen project economics, (iii) demand-side and technological opportunities (CNG/LNG for transport, PNG for households and industry, RNG/CBG and LNG bunkering), and (iv) practical policy levers to balance growth, investor returns and energy-transition objectives. The analysis stresses that while CGD networks are critical to India's aspiration for a larger gas share in the energy mix, success will require durable gas supply contracts, tariff rationalisation, targeted subsidy / viability-gap support for Tier-2/3 regions, and fostering market mechanisms for RNG and small-scale LNG. Key policy suggestions include long-term offtake contracts, phasing exclusivity carefully, pipeline financing innovations, and integration of CGD planning with urban and waste-management policies.

**Keywords:** City Gas Distribution, PNG, CNG, RNG/CBG, gas infrastructure, PNGRB, gas-based economy, pipeline financing.

**JEL Codes:** Q41, L95, L98, R48

## 1. Introduction

India's energy transition ambitions place natural gas centrally — as a lower-carbon pathway relative to liquid fuels and coal, and as a flexible complement to renewables. The Government of India and stakeholders view the expansion of City Gas Distribution (CGD) networks as instrumental in increasing the share of natural gas in the primary energy basket and enabling cleaner urban transport and cooking solutions. Recent estimates and institutional outlooks foresee substantial growth in gas demand to 2030, with CGD identified as one of the fastest-growing demand segments. The International Energy Agency (IEA) projects India's gas consumption could rise markedly, driven in part by CGD expansion and higher industrial use.

Nevertheless, the CGD sector faces a classic growth-profitability trade-off: while geographic expansion and policy momentum create large demand potential, project economics are vulnerable to high capex for pipeline and compression infrastructure, gas price volatility (notably because of LNG import dependency), and the financing challenges associated with long gestation infrastructure in smaller towns. This paper critically examines these challenges and identifies opportunities and policy actions to de-risk investment and accelerate equitable access.

## 2. Policy and Regulatory Background

### 2.1 The regulatory architecture

City Gas Distribution networks in India are regulated primarily by the Petroleum and Natural Gas Regulatory Board (PNGRB). The PNGRB issues authorisations for Geographical Areas (GAs),

regulates access, technical and safety standards, and has periodically amended the CGD regulatory framework (including exclusivity rules, access codes, tariff principles and technical standards) to adapt to market evolution. PNGRB's consolidated regulations and amendments form the legal scaffolding that determines CGD development models and commercial terms.

## 2.2 Allocation rounds and geographic coverage

Through competitive bidding and allocation rounds (for example the 12/12A CGD bid rounds), PNGRB has authorised entities across hundreds of Geographical Areas. Parliamentary and ministry disclosures indicate that, following recent bid rounds, authorised entities cover a very large share of the mainland, with specific targets to provide millions of PNG connections, thousands of CNG stations and extensive pipeline build-out by the early 2030s. These authorisations reflect a clear government push to make CGD near-ubiquitous across Indian towns and cities.

## 3. Literature Review

### Academic and industry analyses of the CGD sector fall into several strands:

Infrastructure economics and regulatory design. Studies emphasise the impact of exclusivity periods, tariff frameworks and access codes on returns and competition in CGD. The trade-off between offering longer exclusivity to attract capex and enabling competition for consumer benefits is a recurring theme.

**Supply security and price risk.** Multiple reports (industry analysts and international agencies) highlight that import dependence for LNG exposes CGD economics to global market swings and underlines the importance of long-term supply contracts and domestic production.

**Demand adoption studies.** Research focused on household PNG and transport CNG adoption looks at consumer willingness, infrastructure convenience, and cross-subsidy issues. Evidence suggests that adoption speeds up with reliable supply, transparent connection processes, and targeted awareness campaigns.

**Environmental and transition analyses.** Some literature maps CGD's role in lowering urban air

pollution (via CNG and PNG replacing diesel and liquid fuels) and in facilitating future low-carbon fuels (biomethane/RLNG, hydrogen blends).

The literature underscores that while CGD is strategically valuable, policy and market design must manage supply, financing and tariff signals to align social, environmental and investor objectives.

## 4. Methodology

This paper uses a mixed-methods desk-research approach:

**Document analysis:** Key regulatory documents (PNGRB regulations, GA allocation notices), ministry reports and press releases (Ministry of Petroleum & Natural Gas / PIB), and authoritative international analyses (IEA) were reviewed.

**Industry reports:** Financial and sectoral analyses (e.g., CARE/Care Edge sector studies) provided insights into commercial risk, LNG dependence and capital structure.

**Synthesis and critical analysis:** The paper synthesises quantitative facts from these sources with qualitative policy assessment to derive challenges, opportunities and recommendations.

**Limitations:** This is a secondary-data study; primary interview or field data were not collected. Exact pipeline kilometres, connection counts and investment figures vary across sources and time; where precise figures are cited, they are drawn from the latest cited reports.

## 5. Current Status — Key Facts & Figures

**Pipeline network:** Operational length of natural gas pipelines in India has grown substantially in the 2014–2024 decade. The Government's year-end review notes an increase from about 15,340 km (2014) to nearly 24,945 km by 2024. This expanding trunk and distribution backbone supports CGD rollout.

**Authorized Geographical Areas and targets:** After recent bidding rounds (12/12A), PNGRB authorised entities for over 300 Geographical Areas,

with targets to provide approximately 12.6 crore (126 million) PNG connections, over 18,000 CNG stations and several hundred thousand inch-km of pipeline by the early 2030s. This reflects a nationwide strategic objective of near-comprehensive CGD coverage.

**Demand outlook:** The IEA's India Gas Market Report forecasts a significant rise in gas consumption to 2030, with CGD as a notable contributor. The IEA highlights potential to increase gas consumption by nearly 60% to about 103 bcm/yr by 2030 under plausible scenarios — a demand trajectory that requires robust CGD and pipeline infrastructure.

**Industry profitability and LNG dependence:** Sectoral analyses indicate growing LNG import share and concerns around costlier imported gas negatively affecting CGD margins if supply contracts are not secured and tariffs fail to reflect economics. Analysts flag the growth-profit trade-off and the need for long-term supply strategies.

## 6. Major Challenges

This section organises the key challenges into supply-side, demand-side, financial and institutional/cross-sectoral categories.

### 6.1 Supply-side constraints

#### a) Gas supply security and price volatility.

A large and growing fraction of India's gas needs is met by LNG imports. Reliance on spot/short-term LNG markets exposes CGD to price swings that compress distribution margins. Without long-term, competitively priced offtake contracts — and without commensurate tariff mechanisms — CGD operators face revenue risk.

#### b) Infrastructure bottlenecks and last-mile delivery.

While trunk pipelines have expanded, last-mile distribution in smaller towns and peri-urban areas requires dense, capital-intensive low-pressure networks. Right-of-way, urban street works, and coordination with municipal authorities slow network roll-out and add costs.

### 6.2 Financial and commercial issues

#### a) High upfront capital and uncertain payback in Tier-2/3 towns.

CGD networks have high initial capex (pipelines, compression, CNG stations). In smaller markets, lower consumption density increases per-connection costs, weakening returns without cross-subsidy or viability support.

#### b) Tariff design and cost recovery.

Tariff frameworks must balance consumer affordability and investor returns. Regulatory hesitation to allow cost-reflective pass-throughs (for example, gas price pass-throughs) can deter investment or require higher exclusivity protections to ensure viability.

#### c) Access to affordable project finance.

Long-tenor, low-cost debt aligned with infrastructure project life-cycles is essential. Banks may be wary of sector-specific demand risk and commodity price exposures, constraining financing.

### 6.3 Institutional, policy and governance challenges

#### a) Exclusivity policy trade-offs.

Exclusivity gives operators temporal monopoly rights in a GA to recoup investment. However, overly long exclusivity delays competition and may reduce consumer benefits; short exclusivity may harm investment appetite. Striking the right balance is politically and technically challenging.

#### b) Coordination with urban planning and municipal regulation.

CGD roll-out requires municipal cooperation (street openings, land allotments for CNG stations), and weak coordination leads to delays and arbitrage in execution.

#### c) Standards, safety and consumer grievance mechanisms.

Ensuring consistent technical standards, safety enforcement and reliable grievance redress is necessary to build consumer trust, especially for household PNG.

## **6.4 Market transition and technology risks**

### **a) Threat from alternatives and slower-than-expected adoption.**

Electric cooking and EV adoption trajectories could reduce future demand for PNG and CNG in certain segments. While gas complements renewables, rapid electrification could alter long-term demand projections, affecting investor expectations.

### **b) Integrating low-carbon gases.**

While biomethane/RNG (CBG) and hydrogen blends are potential future feeds, nascent markets and regulatory pipelines for certification and feed-in tariffs are immature, complicating investment decisions with long horizons.

## **7. Opportunities**

Despite challenges, the CGD sector presents significant opportunities across environmental, economic and technological domains.

### **7.1 Environmental and public-health gains**

CNG for transport and PNG for cooking and small industry can substantially reduce urban air pollution by displacing diesel and kerosene. The health co-benefits in densely populated cities are substantial and support policy justification for targeted public investments and incentives.

### **7.2 Demand diversification and new markets**

#### **a) Commercial and industrial PNG.**

Small and medium enterprises (SMEs), commercial establishments, and industries in clusters can be switched to PNG for lower costs and cleaner fuel.

#### **b) Heavy transport via LNG and CNG variants.**

LNG and higher-capacity CNG/LNG fueling for freight and logistics corridors is a growing market. Private sector players are already scaling LNG autofuel outlets on highways, enabling greater decarbonisation of freight.

#### **c) Renewable natural gas (RNG)/Compressed Biogas (CBG).**

India's waste management challenge (municipal solid waste and agricultural residues) can be converted into biomethane/CBG feedstocks. Integration of CBG into

CGD networks offers decentralized renewable gas and local supply resilience; recent projects and city initiatives show pilot success.

### **7.3 Integration with broader policy goals**

CGD expansion supports India's stated goals of increasing gas share in the energy mix, lowering emissions intensity and improving urban air quality. With national and state CGD policies (some states releasing CGD policies) the sector can leverage fiscal and regulatory alignment for faster growth.

### **7.4 Technological and business model innovation**

#### **a) Small-scale LNG (SSLNG) and virtual pipelines.**

Where pipelines are not economical, SSLNG deliveries (by truck) and virtual pipelines can enable connections to industry clusters, making CGD-like services feasible in the near term.

#### **b) Digital customer acquisition and metering.**

Advanced metering, digital on boarding for PNG connections, and IoT-enabled leakage/safety monitoring reduce operational costs and improve consumer experience.

## **8. Analysis: Reconciling Growth Ambition with Commercial Reality**

To convert opportunities into realized infrastructure and consumption, the sector must address a set of core mismatches:

Supply vs. pricing transparency. Investors require visibility on long-term feedstock pricing and availability. A deepened domestic gas market (via more production, pipeline connectivity and long-term LNG contracts) can stabilise prices, but transitional policy (tariff pass-through) is needed to align risks.

Financing structures tailored to CGD. Traditional project finance is often hard to secure at acceptable costs for GA projects with demand risk. Instruments like blended finance (public viability gap funding for low density areas), long-term concessional debt, and loan aggregation vehicles (pooling multiple CGD projects) can lower cost of capital.

Regulatory predictability on exclusivity and access. A calibrated exclusivity regime (initial protection to recover sunk costs with clearly defined transition to

multiple players) combined with robust access codes can both attract investment and later foster competition for consumer benefit.

Integration of RNG and energy-transition pathways. Clear certification, pricing, and offtake mechanisms for biomethane (including blending rules and pipeline injection standards) are necessary to incentivise CBG project developers and to provide low-carbon gas options for CGD.

## **9. Policy Recommendations**

The following policy and industry measures are proposed to accelerate CGD expansion while protecting consumer interests and ensuring financial sustainability.

### **9.1 Strengthen supply security and price risk management**

**Facilitate long-term LNG and domestic production linkages:** Central and state agencies should support long-term hubbing arrangements and encourage offtake contracts between CGD entities and gas suppliers (domestic and international) to stabilise supply and manage price risk. Governments can play a role by facilitating access to strategic long-term volumes for essential public-utility infrastructure.

**Transparent pass-through mechanisms:** Regulators should allow time-bound and formula-based pass-through for commodity costs to avoid margin erosion, with consumer protection safeguards (e.g., caps and periodic review).

### **9.2 Financial instruments and targeted subsidies**

**Viability Gap Funding (VGF) for low-density areas:** Provide targeted VGF or concessional credit to CGD projects in Tier-2/3 towns to make the per-connection business case viable, contingent on project milestones and social impact metrics.

**Infrastructure bonds or pooled financing vehicles:** Encourage development finance institutions and

## **10. Tables (Data snapshots)**

commercial banks to create long-tenor debt instruments and pooled financing structures to de-risk individual GA investments.

### **9.3 Regulatory and contractual clarity**

**Calibrated exclusivity:** Maintain initial exclusivity periods adequate for cost recovery but introduce time-bound and performance-linked triggers for opening markets to competition.

**Uniform technical and safety standards with digital compliance:** Continue strengthening the PNGRB technical standards and enforce digital safety compliance, with penalties for laxity and incentives for superior safety records.

### **9.4 Promote low-carbon gas and circular economy linkages**

**CBG/RNG integration:** Create clear standards for pipeline injection, certification and carbon crediting for biomethane. Promote public procurement of CBG for municipal fleets and waste processors to create anchor demand.

**Support small-scale LNG and virtual pipeline models:** For industrial clusters and remote areas, policy support (tax incentives, streamlined clearances) for SSLNG facilities and cryogenic trucking can expand access quickly.

### **9.5 Institutional coordination and capacity building**

**One-window municipal clearances:** State governments should institute streamlined municipal clearance mechanisms for pipeline laying and CNG station siting to remove local bottlenecks.

**Capacity building:** Training for municipal engineers, first responders and CGD staff on safety, customer service, and network planning should be institutionalised.

**Table 1: Select sector indicators (latest available figures)**

Indicator	Value	Source	Year
Operational natural gas pipeline length (national)	24,945 km	MoPNG {PIB}	Year-end review (2024).
Number of authorised Geographical Areas). 12/12A bids	GAs authorised 307	Parliamentary/PNGRB annex	After (Mar 2025)
IEA projected India gas consumption (2030)	103 bcm/yr forecast scenario)		IEA India Gas Market Report (outlook to 2030).
Estimated PNG connections target (2034)	12.6 crore (126 million)	PNGRB / parliamentary data	Digital Sansad

**Table 2: Selected commercial risks and mitigation measures**

Risk	Impact on CGD projects	Mitigation measures
Gas price volatility (LNG spot exposure)	Margin compression; uncertain tariffs	Long-term supply contracts; pass-through rules; hedging instruments
Low density in Tier-2/3 towns	High per-connection cost; long payback	VGF; concessional debt; community-aggregation models
Right-of-way and municipal delays	Project delays; cost overruns	One-window municipal clearances; performance-linked penalties/incentives
Uncertainty over renewables/electrification	Demand forecasting risk	Flexible business models; focus on high-value segments (industry, transport)

**Table 3: Opportunity matrix — segments and required policy support**

Segment	Opportunity size	Required policy/industry action
Urban household PNG	High — cooking and small industries	Consumer awareness, rapid connection drives, safety assurance
Transport (CNG/LNG)	High for public transport & freight corridors	FAST track CNG/LNG station approvals; highway network fuelling
RNG/CBG	Medium–High potential	Standards for injection, buyback mechanisms, carbon finance
Industrial clusters via SSLNG	Medium	Incentives for virtual pipeline, logistics support

## 11. Findings

Policy momentum is real and large targets are in place. PNGRB authorisations and government targets signal a strong commitment to widespread CGD coverage; authorised GAs and pipeline targets indicate the sector’s strategic priority.

Demand potential exists but is concentrated. Urban centres and industrial clusters promise high utilisation; smaller towns require targeted interventions to bridge the demand gap.

Main commercial vulnerability is feedstock economics. LNG import dependence and price risk are the most immediate threats to CGD profitability;

securing long-term cheaper gas or recognition of cost pass-through is essential.

Technology & business innovation can bridge access gaps. SSLNG, virtual pipelines and RNG integration create modular options that complement traditional pipeline expansion.

## 12. Conclusion

India's CGD sector stands at an inflection point. The combined force of regulatory authorisations, ambitious coverage targets and environmental co-benefits creates an enormous opportunity to transform urban energy consumption patterns. However, commercial and institution-level frictions — principally gas supply security, tariff design, capital costs for last-mile roll-out, and municipal coordination — must be addressed to convert targets into safely delivered and affordable services.

A pragmatic policy mix — long-term supply contracts, calibrated exclusivity and access codes, targeted finance for low-density areas, and active promotion of renewable gas — can reconcile investor returns with public goals. If implemented effectively, CGD can be a core pillar of India's gas-based economy and urban decarbonisation efforts.

## 13. Policy roadmap (short-term — 1–3 years; medium-term — 3–7 years)

**Short-term (1–3 years):** expedite clearances, pilot pooled financing for Tier-2/3 projects, enable cost pass-through rules, and issue guidelines for biomethane injection and certification.

**Medium-term (3–7 years):** roll out pooled long-tenor financing, integrate CGD planning with municipal waste / transport policy for CBG and public fleet conversion, and create market mechanisms for low-carbon gas certificates.

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## 15. Annex — Suggested areas for further research

Micro-level case studies of GA rollout economics across three representative cities (Tier-1, Tier-2, and Tier-3) to refine per-connection cost estimates.

Willingness-to-pay surveys for households and transport operators to model demand elasticity under varying price scenarios.

Pilot financial mechanisms evaluation (pooled bonds, blended finance) to test bankability for low-density networks.

CBG/RNG lifecycle and carbon accounting research to develop robust protocols for pipeline injection and carbon credits.