
City Gas Distribution: A Pillar for Developing Smart Cities

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Abstract

The growing population of India is a serious issue for the country's economic and social balance. In search of employment opportunities, a better lifestyle, quality education, rural people migrate to the cities every year at a large scale. This migration leads to the unplanned urbanization that causes inappropriate consumption of the resources-natural, technical and human resource, pollution, and leads to unhygienic lifestyle. In order to govern this inadvertent urbanization, the smart city could be a probable tool. "Smart" signifies the intelligence in the planning sector of the city and also points out the useful distribution of all resources. This smartness is achieved by nurturing the basic objectives of the smart cities like good quality of life, sustainable development, economic development & job growth, flourishing social, human, infrastructural capital and most important environmental aspect. Mitigation of environmental issues like pollution, inappropriate consumption of natural resources and the waste of the resources, is one of the core values of the smart city mission. Utilization of clean energy sources is the primary step to struggle to overcome the pollution and waste of natural resources. In the traditional city lower section of the urban area uses biomass or wood as fuel and middle & upper section opts for natural gas. Smart city redefines this traditional system into an organised and well-monitored concept of "city gas distribution (CGD)" network. CGD is the booming business sector in India with a good potential market. The smart metering system to restrict over the wastage & and all time availability is the basic feature of the CGD system and this will

help to boost the usage of eco-friendly fuel publically at a large scale that will add value to the smart city concept or planned urbanization.

Keywords: *Urbanization, resources, smart city, CGD*

INTRODUCTION

Urbanization is the process by which a portion of the population shifts to the urban area from the rural sector. According to Kingsley Davis, urbanization is a change in the ratio of the population living in the urban area (Davis, 1965). Urbanization is the result of modernization and industrialization. More specifically it is a structural transformation from an agricultural society into the modern economy. This transformation happens in three stages. First workers move from the agricultural field to industrial work. Secondly, there is a shift in the informal sector into the formal sector and in the third stage, there is an expansion of the urbanization (Colmer, 2015). As of 2011, census data urbanization has been increased to 31.16% in 2011 from 27.81% in 2001. On the other hand, there is a decline in the rural population by 3.3% (Census of India, 2011) [3]. There are many micro and macro drivers that boost the level of urbanization in India; specifically modernization, socio-economic cause and industrialization these are the macro driving factors. People

migrate themselves to industrial are for better employment and commercialization in an urban area is perceived to offer more opportunities compare to a rural area. Other factors are a better standard of living, education, healthcare facilities etc. In micro factors status, food, beliefs, dressing habit etc. are influencing factors for the boom of the urban population (Pawan, 2016).

The pattern of the urbanisation in India is like continuously increasing population density and all activities are taken place in large cities (Jaysawal, Saha, 2014). In the last twenty year population of the megacities like Mumbai, Kolkata, Delhi, Bangalore [6], increased rapidly. The term “over urbanisation” used by Kingsley Davis could justify the situation of the present Indian megacities. “Over urbanisation” means where “urban misery and rural poverty exists side-by-side” (Kingsley Davis and Golden, 1954). According to Breese, this urbanization is named “pseudo urbanization” which defines that people arrive in an urban area not influenced by urban pull but

dominated by the rural push factors (Breese, 1969). The movement is not led by the migration but this is the productive effect of the demographic explosion caused by natural growth (Premi, 1991). This large population in the megacities results in functional difficulties in the urban areas. Though the poverty rate is lower in the big cities compared to a small town, heterogeneity in socio-economy is visible expressly. Rapid urbanisation causes the expansion of slums, unemployment and low quality of urban lives (Jaysawal, Saha, 2014).

This rapid urbanization invites different problems in the urban area; like slums, housing, water supply, transport sanitation, pollution etc. The megacities witness this problem more dominantly due to saturation of capacity (Jaysawal, Saha, 2014). Rapid urbanization degrades the lifestyle and standard of living in the cities. At the same time, this impacts the environment by consuming too many natural resources, energy and improper water & land usage (Pawan, 2016).

As 2011 census urban population contributes 63% of India's GDP. So the development of the physical, social, economic structure of the urban area is an essential part of government policies

making. Also, the quality of the life and living standard development is one of the fundamental activities related to the urbanisation. Development of the "smart cities" could direct the initiative of the urban development (Smart Cities, Mission Statement & Guidelines. 2015).

In general, cities take good and natural resources as input and release waste as output. This cause misbalance in the sustainability and the necessity of its people (Albino, Berardi and Dangelico, 2015). To mitigate this problem, a new kind of solution was required. In order to maintain sustainability and to protect the environmental & social interests a different city planning idea was evolved in 1990. The California Institute for Smart Communities explained how a city is designed smartly and planned an integrated IT technology & resource management to develop a better and sustainable lifestyle (Alawadhi et al., 2012). According to Thuzar, the attributes of the smart cities should include quality of life, sustainable economic development, and management of natural resources through participatory policies, the convergence of economic, social, and environmental goals (Thuzar, 2011) (Albino, Berardi and Dangelico, 2015).

Environment and natural resource management are two important aspects for developing smart cities. Proper utilization of energy is also a crucial challenge for developing smart cities and proper utilization means to restrict the waste, focus on green energy and efficient distribution & supply chain management. In ordinary or traditional cities coal, wood and CNG are used as fuel for cooking and heating. A different section of the society (upper, middle, lower) prefers varied sources of energy. But smart cities aim for cleaner fuel with appropriate distribution and supply chain management. "City Gas Distribution (CGD)" could be a probable option for developing the intelligent (smart) city in India. CGD will provide a solution for sustainability as well as an alternative fuel source (Wankhede, 2018).

SMART CITY

Almost 55% of the world's population lives in the urban area and it is expected that by 2050 the number will reach 68%. The rapid development and progress of the cities, metros, and mega-cities attract people to migrate to the urban areas for the earning & job perspective, quality of life, status and the population growth in 2018 has reached to 4.2 billion (UN DESA). In India, 33% of the country's total

population belongs to urban areas and it has increased by 2% from 2010 (worldometer). Population density in the urban areas is enhancing the development of the technology, education system and economy and metro cities are turned to be the centre of the urbanization. Cities are formed depending upon six basic core systems- people, business, transport, communication, water & energy. These systems are interconnected and information flows among them. The efficiency and effectiveness of the city totally depend on how these systems are utilized. "Smart city" is designed to coordinate these systems practically and optimize the resources usage. At the same time, the smart city works for sustainable development that includes quality of life, a better environment and economic growth (Dirks, Keeling, 2009).

What could be the specific definition of the "smart city"? The answer to this general question is a little bit tricky because there is no specific statement about the definition. The word "Smart" is related to intelligence or rational. So "smart city" could be described as the model that has the ability to weave information and technology in a realistic way that will assist sustainability and impede unorganized urbanization. In

simple this could be concluded that smart city seeks to provide smart solutions by composing information and technology (Colldahl, Frey, et al., 2013).

From last few decades, India has experienced a sharp growth in economic activities that boosted the urbanization process. This rapid development invites a few challenges related to national development. Challenges are:

Inefficient urban management system:

Indian cities lacks in the field of monitoring the progress and evaluation of the plan because of inadequate data and technology that will continuously track the progress.

Urban institution and local governments:

Training and capacity building for urban local bodies is essential for urban development. Construction of the bridge between knowledge and skill is essential for the approaching decentralization concept that helps to identify and implement city-level projects.

Environment: Energy demand, natural resource usage and waste management are the biggest issues that arrive with the population burden and normal cities have very weak capability to mitigate.

Interconnectivity: All systems are not connected with each other and information sharing system is not compact. This creates an unorganised communication system which is unable to store data and analyse the data in an efficient way (Bhattacharya, Rathi, et al. 2015).

Ministry of Urban Development (MoUD) introduced the smart city mission in India in the year 2015 with the objective to build 100 smart cities in five years (2015-2020) and to escalate economic growth, environmental issues and quality of life. Smart city mission has three components- 1. Area-based development that will restructure the existing areas including slums into a well-designed model which will improve the habitability status. 2. Greenfield project that will help to accommodate the large population and 3. Pan city develop that will assist to develop the infrastructure for a smart solution (Gupta, Hall, 2017). The fundamental infrastructure that smart city requires, are:

- i. adequate water & electricity supply,
- ii. sanitation, & waste management,
- iii. mobility and public transport,
- iv. housing facilities for everyone,
- v. information and communication connectivity,

- vi. well managed governance, especially e-Governance,
- vii. sustainable environment,
- viii. Health, education and security. (Smart City Mission, 2015).

The smart city mission is a new concept in Indian urban development and for that reason, several issues and challenges come into the picture.

- **Social context:** The perception about the smart city concept is that this model is only for the educated middle class and there is less opportunity for the marginal group.
- **The liveability and sustainability concept:** In India, the smart city concept carries an image of a highly automated and instrumented self-sufficient city. The belief is developed in such a way that explains technological develop is the main criteria of smart city development. So, concern arises with liveability, energy demand and resource utilization.
- **Funding:** Capital cost for developing a smart city is one of the biggest challenges. A budget of 2 lakh crore has been proposed for 99 smart cities (MoHUA). So the utilization of the

budget in a significant way is a concern. Till 2017, sixteen PPP models cost around 1300 crore have been implemented (Smartnet). FDI will opt for a high return on investment and this will prove costly for public service because presently, the country is not in that stage. Local bodies support is not strong financially and unattractive.

- **Roadmap:** A structure roadmap is essential to implement the strategy. A framework is needed that will work as an umbrella and under which the project will be developed. A good design framework helps in the economic, social and environmental growth. Currently, the country lacks such a framework (Bhattacharya, Rathi, et al. 2015).

Smart city will avail smart solution to urban development. The smart solution could high technology based or automated or energy efficient. On the other hand, the smart solution could make daily life easier and improve public security. Smart metering, monitoring and governance could be part of the smart solution. Basic smart solutions are enlisted below:



Source: *The Smart Liveable Cities in India report, prepared by Quercus Group and the Royal Danish Embassy [22]*

Figure:-1

City gas distribution (CGD) will help to provide a framework in the energy management sector of the smart city. CGD network will benefit residents with safe supply chain management of the cleaner fuel and better monitoring system. Not only energy management but the CGD system will add value also, in the energy policy.

CITY GAS DISTRIBUTION & SMART CITY

Energy and development are related to each other very closely. Availability of the energy contributes towards the development of the country whereas scarcity limits the prosper (Blum, Legey, 2012). The world's 2nd largest populated country and sixth largest economy, India, is highly relied on energy for its

development & growth. Also, it is the third largest energy consuming country after US & China and total primary energy consumption of the country in 2017 was 753 MTOE. The energy mix of the country is dominated by oil & coal and their respected percentages are 29% & 57%. On the other hand, the consumption of natural gas is only 6% (BP stat, 2018). The government of India plans to boost the figure (natural gas consumption) to 20% by 2030 in order to trim the dependency on oil (PNGRB, 2017). Moving towards gas based economy will support the country to stand against the CO₂ emission (Growth rate is 4.4%, BP stat 2018) and assist to meet the sustainable goal that is after Paris agreement (COP-21) India's Intended Nationally Determined Contribution (INDC), drafted India's intention of successful reduction in carbon by 33-35% as a percentage of GDP by 2030 (Ratner, 2017).

In recent years the consumption of natural gas as primary energy, has been increased by 12% from 2015 to 2017 (BP stat 2018) and the domestic consumption of the natural gas is dominated by the fertilizer industry (34%) followed by power generation industry (23%) and domestic fuel (11%) (MOSPI, energy statistics 2017). At the initial level GOI aims to

raise the percentage of natural gas in the energy mix to 15% by 2022, so government has to focus on both demand side-fertilizer industry, gas-based power generation and city gas distribution (domestic fuel & transport) and supply side-import of natural gas at a cheaper price & increase in domestic production (Cornot-Gandolphe, 2017).

City gas distribution (CGD) is the secondary distribution system of natural gas for industrial and domestically usage and it is accomplished by piped natural gas (PNG) and compressed natural gas (CNG). PNG benefits end users with safe and uninterrupted gas supply with a uniform tariff facility. On the other hand, CNG helps to reduce automobile pollution and it is lower in cost (GAIL India Ltd.). CGD is a new concept in the Indian context and it is in the developing stage. In 2007, GOI established the regulatory board the Petroleum and Natural Gas Regulatory Board (PNGRB) in order to facilitate the initiative of CGD with an organised process of bidding and licensing both private and public companies. 9th bidding round organised by PNGRB in April'18 aims to support 86 Geographical Areas (GAs) which includes 176 districts with city gas distribution facilities (PNGRB, 2018).

There always exists a trade-off between environment and economic growth. Economic growth will not be realized unless the natural resources are consumed and utilized. So the government should focus on cleaner fuel to maintain the balance between the environment and economic growth. On the other side, the economic growth has an interlink with the social life, quality of life; because the economic growth soothes to improve the technological facilities, efficient mode of work and easy accessibility & affordability. The development of a reliable and sustainable energy market is the prime point for developing the energy policy for any country. Smart city mission boosted the necessity for the city gas distribution network across the country. One of the objects of the smart city is a smart energy distribution and metering system. Also, the energy distribution should keep the concept of sustainability in mind. From this context, CGD network will help to enrich the urban life, because it restricts the wastage and provides a simple tariff system; altogether it leads the residents to adopt energy-efficient practices that will assist in the long run to lessen the urban pollution. PNG system has the competence that it is available and the usage can be monitored. Another part of the CGD system is CNG which is the

most effective way in order to provide a smart solution against pollution and fossil-fuel price hike. With low anti-knocking property CNG helps users with a small payback period and safety.

As per 2015 Ministry of Petroleum & Natural Gas data out of 98 smart cities only 35 cities are given approval for CGD. These are the cities where CGD is approved (Ministry of Petroleum & Natural Gas, 2015).

1. Chandigarh- Chandigarh, 3 Dadra & Nagar Haveli -Silvasa (Dadra & Nagar Haveli), 4. Delhi -NDMC (Delhi) 5. Goa- Panaji (North Goa) 6. Gujarat- Gandhinagar, Ahmedabad, Surat Vadodara, Rajkot Dahod 7. Haryana- Faridabad 8. Karnataka- Belagaum, Dharwad, Tumakuru 9. Kerala- Kochi (Ernakulum) 10. Madhya Pradesh- Indore including Ujjain, Gwalior, 11. Maharashtra- Navi Mumbai, Thane, Greater Mumbai, Kalyan-Dombivali, Pune 12. Punjab- Ludhiana, Jalandhar, Amritsar 13. Rajasthan- Kota 14. Telangana- Greater Hyderabad (Hyderabad) 15. Tripura- Agartala 16. Uttar Pradesh- Moradabad, Bareilly, Jhansi, Kanpur, Allahabad, Lucknow, Ghaziabad, Agra Saharanpur.

City gas distribution provides a two-dimensional solution- one solution towards developing a smart urban society and another solution to develop a gas based economy. For the first approach, CGD network will help semi-urban people to get rid of traditional “chullah” where animal waste and wood is used as fuel for cooking. Smart city mission does not construct a new urban society in India, it just re-modify the existing one (national portal of India). According to 2011 census data 2613 towns reported having slums (registered) and the total population is 60 million. Maharashtra, Andhra Pradesh, West Bengal, Uttar Pradesh, Tamil Nadu these states have the burden of the slum population (General & Census Commissioner, India, 2011). Million plus cities like Kolkata, Greater Mumbai, Chennai, and Delhi have a good number of population that belongs to the slum. Greater Mumbai has almost six million slum population, followed by Delhi (1.4M) and Kolkata (1.8M) (Ministry of Housing and Urban Poverty Alleviation, 2015). These slum population highly relies on cheap fuel source for cooking and the utilization of the natural resource is accomplished in a poor manner. Household air pollution (HAP) is a critical issue for this poorer section. A common source of this HAP is the use of the

biomass which produces carbon dioxide and oxides of sulphur. 19% of the urban households use biomass for cooking purpose that results in lung cancer, tuberculosis and other chronic diseases (Jain, Palwa, 2015). Almost 840 million people in India use biomass for cooking and 24% for primary energy demand is accounted by biomass (World Energy Outlook, 2015). Smart city mission aims to convert this slum population into a healthy urban population. If “affordable housing, especially for the poor” program (Ministry of Urban Development, 2015) is implemented successfully the CGD network will help to connect each and every family with a safe, reliable and cost-effective distribution network of natural gas.

CONCLUSION

Unorganised urbanization oppresses the socio-economic structure of the cities as well as degrades the living standard and quality. Unhealthy environment, unhygienic living condition and poverty pushes the fundamental structure of the urban society towards unsustainability. Core systems like water and energy supply, waste management, transport network etc. are agitated with this poverty-driven migration. In this scenario, the Smart city mission could be a valid

solution towards the restructuring of the urban functionality, but the question is still there “to what extent?” The smart city plan will be developed on the existing city infrastructure and from that point, is it possible to re-modify the age-old structure of the city? If the energy aspect of the smart city is considered, the energy management will be facilitated with different initiatives like the use of renewable resources, cleaner fuel, smart grid and smart monitoring & distribution. Under the energy management program, the city gas distribution (CGD) system is a pillar that yields cleaner fuel (CNG & PNG), smart monitoring & distribution.

Household air pollution (HAP) causes the death of many Indian women due to toxic gases released during the burning of biomass and leads to several diseases like tuberculosis. Growing slum population is an outcome of unplanned urbanization in India and megacities, also witness the burden of this slum population. Smart city mission will provide a low-cost house for this poorer section and help to improve the quality of life. But providing packed cylinder (LPG) for cooking to every households is little bit difficult and lengthy procedure because households have to register initially, link bank account and inform dealer while the cylinder is empty

etc. instead of that CGD system assists with piped connection and smart metering & tariff and payment depends on usage and no disruption in supply. It is obvious that CGD will help develop the habit of sustainability among the residents of the smart cities. People will become more conscious about the usage and the wastage because they can measure every unit of gas with CGD metering system. HAP could be controlled and quality of life especially for the women could be improved. City gas distribution also provides CNG that is less pollutant fuel as well as cheaper for the automobile but constraint is that CNG utilization is limited within three & four wheeler section. Use of the CNG is beneficial for the environment especially for mega cities like Delhi, Bangalore where air pollution and a number of private vehicles both are high.

Security of the natural gas supply has to be ensured for implementation city gas distribution network across the country. Low domestic gas production and fluctuating global gas price is the biggest issue for maintaining a smooth supply. The country should focus on the geopolitical issue in order to assure the natural gas supply and to make the dream of gas based economy reality.

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