Detailed Project Report for
City Gas Distribution Project

Geographical Area- Bidar

Submitted to

Bharat Gas Resources Limited

Resonance Energy

TABLE OF CONTENTS

Resonance Energy

LIST OF TABLES

LIST OF FIGURES

1. EXECUTIVE SUMMARY

1.1Introduction

Bharat Gas Resources Limited (BGRL) has assigned Resonance Energy Private Limited (REPL), for the development of Detailed Feasibility Report (DFR) for setting up CNG dispensing and City Gas Distribution Network in Bidar Geographical Area (GA).

PNGRB has awarded BGRL the work for developing City Gas Distribution Network for Geographical Area (GA), Bidar, covering 5448 Sq. km and is divided in to five charge areas CA-01 to CA-05

Table 1: Charge area

Charge Area			
Sl.No.	Particulars		
1.	CA 1	Bidar	Aurad
2.	CA 2		Basavakalyan
3.	CA 3		Bhalki
4.	CA 4		Bidar
5.	CA 5		Homnabad

1.2Projected Demand

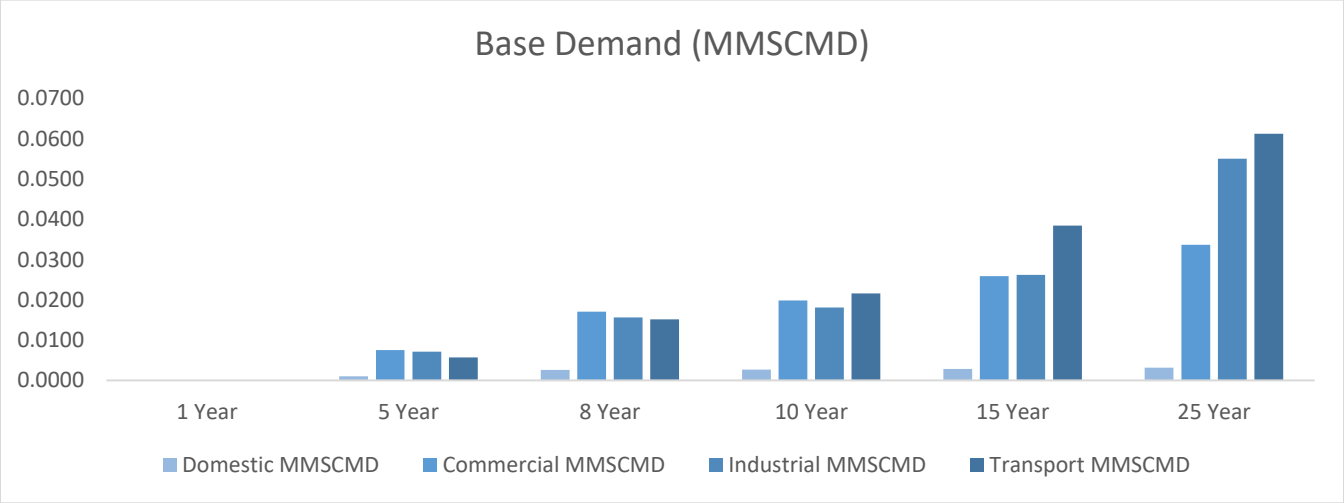
The total Realistic demand for various segments during 1st to 8th, 15th and 25th year has been indicated in the table below. This is with 2020 as the first year and 2044 as the 25th year, as considered demand projection.

Table 2: Projected Demand

Particulars (MMSCMD)	Y1	Y2	Y3	Y4	Y5
Domestic	0.000	0.000	0.001	0.001	0.001
Commercial	0.000	0.001	0.003	0.005	0.007
Industrial	0.000	0.001	0.003	0.005	0.007
Transport	0.000	0.001	0.002	0.004	0.006
Total	**0.000**	**0.004**	**0.009**	**0.014**	**0.021**

Particulars (MMSCMD)	Y6	Y7	Y8	Y15	Y25
Domestic	0.002	0.002	0.003	0.003	0.003
Commercial	0.010	0.013	0.017	0.026	0.034
Industrial	0.010	0.012	0.016	0.026	0.055
Transport	0.008	0.011	0.015	0.038	0.061
Total	**0.030**	**0.039**	**0.050**	**0.093**	**0.153**

Figure 1: Base Demand



1.3 System Design

1.3.1 Source of Gas and City Gate Station

100 % APM gas has been considered for Household & CNG usage. Industrial & Commercial segment shall be served by market driven gas to be sourced by various upstream supplier including BPCL RGTIL, East-West Pipeline has been considered as trunk line for feeding the GA demand, entity may feed this pipeline from various entry points strategically located. Tap-off has been considered at Mannaekhalli village from East West Pipeline, operated by RGTIL located in District Bidar.

1.3.2 Steel Grid,CNG and PNG facilities

- Steel Pipeline

The total Inch-KM of Steel & PE pipeline envisaged to be laid in first eight years has been planned as follows:

Table 3: Inch-Km of Pipeline

Target	Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y7	Y8	Y15	Y25
	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
Inch -Km of pipeline to be laid (Cumulative)										
As per MWP of PNGRB	7	29	57	86	114	129	143			
Planned Steel pipeline	28	104	143	232	250	268	286	304	304	304
Planned PE pipeline	-	13	25	38	51	76	76	101	126	155
Total Inch Km Planned	28	117	168	260	301	344	362	405	430	459

- District Regulating Stations (DRS)

Table 4: DRS (Cumulative Connection)

Period	DRS (Cumulative Connection)	
	1000 SCMH	2500 SCMH
1st – 8th Year	5	1
Upto 15th Year	5	1
Upto 25th Year	5	2

It is planned to have common DRSs for all domestic and commercial connections and for some of the industrial connections. In this connection DRSs of various capacities have been envisaged.

- CNG Stations &Design Parameters for CNG Stations

Table 5: CNG Stations Design and Parameters

STATIONS	Cap. of compressor in SCMH	No. of CNG Stations		Year of installation
		Upto 8th year	Upto 25th year (Cum)	
A) Mother Station - Green Field				
Steel grid network in the Charge areas	1200 SCMH-01 no for each MS	1	1	Progressively as per Bill of Material
B) Online Station – in existing Retail outlets				
Steel Grid Network in Charged area	650 SCMH- 01 no for each online	3	6	Progressively as per Bill of Material
C) DBS in existing Retail outlets				
Part of Charge Area where Steel Grid Network Is not available.	450 SCMH-01 no for each DBS	3	3	Progressively as per Bill of Material

1.4 Domestic Connections

Minimum Domestic Connections to be provided upto the 8th year and the plan is as given below:

Table 6: Domestic Connection Cumulative

Description	Bidar GA - No. of Domestic Connections (Cumulative)							
	1st year	2ndYear	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
As Per PNGRB	0	620	1240	1860	2480	3720	4960	6200
As Planned	0	620	1240	1860	2480	3720	4960	6200

1.5 Capital Cost Estimates:

1.5.1 Capital cost

It is based on the facilities envisaged for steel gridline, online stations and city gas distribution network including charges for domestic, commercial and industrial connections are estimated as INR 145 crores(including Interest during Construction) for new facilities.

PROJECT CAPITAL COST SUMMARY (Including Escalation)

Table 7: Project Capital Cost Summary

(INR Crore)

Capex Consolidated		1 Year	5 Year	8 Year	10 Year	15 Year	25 Year
Pipeline and CGS	Rs Cr.	17	75	93	94	96	101
CNG Regulated (Till Compressor D/S)	Rs Cr.	9	13	13	16	16	30
CNG unregulated (After Compressor D/S)	Rs Cr.	6	8	8	9	9	14
Total	**Rs Cr.**	**32**	**97**	**115**	**119**	**121**	**145**

1.6 Financial Analysis

The financial analysis of the project has been carried out based on the escalated capital cost and the purchase price of the gas delivered at the tap-off and finally to consumers of the gas for the project.

Gas Purchase Prices

- Domestic Segment : 14.78 INR/SCM
- CNG Segment : 14.78 INR /SCM
- Industrial Segment : 28.23 INR /SCM
- Commercial Segment: 28.23 INR/SCM

Net Selling Prices

- Domestic Consumers : 25.59 INR/SCM
- Commercial Consumers : 55.45 INR /SCM
- Industrial Consumers : 43.19 INR /SCM
- CNG Consumers : 38.60 INR/SCM, 51.34 Rs/Kg

Based on the above, the salient financial indices for the project along with capital cost & operating cost are given below.

Table 8: Financial Indices

Sl. No.	Description	Unit	Amount
1.	Total Capital Cost upto 25th Year (Escalated)	Rs Crore	145
2.	Total Operating Cost (at 25th year) (Escalated)	Rs Crore	248
3.	Post-tax IRR on Capital employed	%	13.59
4.	Post-tax IRR on Equity employed	%	16.80
5	NPV	Rs Crore	12

2. INTRODUCTION

2.1 Introduction

The Petroleum and Natural Gas Regulatory Board (PNGRB) has awarded 11 Geographical Areas (GAs) for lay, build and operate of city gas distribution (CGD) networks under the 9th round of bidding to Bharat Resources Gas Limited (BGRL). BGRL has appointed Resonance Energy Private Limited vide LOI no. BGL/DFR/BID dated 2nd November 2018 to prepare a detailed feasibility report for the geographical area (GA).

This report aims to carry out the objectives of Demand Estimates for the four CGD segments (viz. domestic, commercial, industrial and transport), Network Design, System Design, Capex-Opex phasing and Financial Feasibility for the proposed project over the period of 25 years.

2.2 Overview of the GA

Bidar is a hill top city in the north-eastern part of Karnataka state in south India. The district borders Maharashtra and Telangana. It is a rapidly urbanising city and is also well known for its many sites of architectural, historical and religious importance.

There are 5 Talukas namely Aurad, Basavakalyan, Bhalki, Bidar and Homnabad.

It is also home to many cottage industries, such as cotton and oil mills.

Kolhar is the main industrial area having pharma and chemical companies like Vivimed, Corvine pharma, Shreegen pharma, Ghadi Detergents Powder, etc. located at Bidar city.

Bidar is well connected with rail network and road network, however nearest airport is located in Hyderabad (outside the GA).

All the neighboring GAs are new in gas business as shown in table below:

Table 9: Neighboring GAs

Sl.No	Geographical Area	Entity	Status
1.	Latur	Unison Enviro	Yet to operate
2.	Medak	Torrent Gas	Yet to Operate
3.	Osmanabad	Unison Enviro	Yet to operate

2.3 City Gas Distribution project

The City gas distribution (CGD) project primarily means taking Natural Gas to the households for cooking, lighting, space heating & water heating. The project comes under utility infrastructure which is further augmented by supplying fuel to other business segments viz. commercial, industrial and NGV as CNG.

Natural gas as a fuel is extremely efficient. When the entire cycle of producing, processing, transporting and using the energy is considered, Natural gas is delivered to the consumer with a "total energy efficiency" of about 90 percent, compared with about 27 percent for electricity.

The CGD Network is classified as:

- Piped Natural Gas (PNG)
- Compressed Natural Gas (CNG)

2.3.1 PNG

Primary Network

It is that part of CGD that operates at pressure above 7 bar(g) and below 49 bar(g). However, the operating pressure at the downstream of CGS is considered as 19 bar(g)/49 bar(g) max depending on class of steel pipeline and fitting. The primary network majorly consists of steel pipeline network (300 class).

Secondary network

It is that part of CGD network that operate at a pressure below 4 to 6 bar(g) and above 0.1bar(g). Secondary network consists of Polyethylene pipe (MDPE) and fittings.

Tertiary Network

This is a part of CGD Network that operates at a pressure below 0.1 bar(g). Tertiary network mainly consists of GI Pipe, Copper Pipe and Suraksha Hose. Pipelines forming part of this network to service pressure distribution mains shall be designed to ensure uninterrupted gas supply to service lines.

2.3.2 CNG

CNG Station

A CNG station is a set of facilities consisting of interconnected equipment, which is designed to compress natural gas to a high pressure and either store the CNG (if the site is equipped with storage) or dispense it directly to a natural gas vehicle for refuelling. Following are the type of CNG stations:

CNG Mother Station

CNG Mother Stations are outlets at the CNG pipeline Network running through out in the city. These stations also provide mobile cascades filling facility (which is transmitted to Daughter Booster Stations) along with stationary cascades for dispensing CNG to automobiles.

CNG On-line Station

"On-line CNG Stations" are equipped with a compressor, which compresses low pressure pipeline gas to pressure of 220-250 bar(g). For dispensing CNG to the vehicle cylinder, On-line stations are the same as Mother Stations except that they do not have the Cascade filling facility.

CNG Daughter Booster Station

The type of CNG station where pipeline connectivity is not available, and the gas is supplied by cascades. These are generally required to penetrate in the area for better CNG network.

The predominance of natural gas, as a fuel for city energy purposes, is primarily due to three reasons.

- Natural gas as a transport fuel is more economical than traditional fuels.
- Natural gas has lower levels of emissions which make it a cleaner fuel as compared to traditional fuels.
- CNG has a considerably higher-octane no. which makes it more energy-efficient.

In OECD countries gas use through City Gas Distribution network, i.e. residential, Commercial, Industrial and Automotive sector in Cities amounts to nearly 25% of the total consumption. Even in Pakistan, this figure is as high as 25%. By contrast in India city gas contributes a meager 3% of total Gas consumption.

2.4 City Gas Networks in India

Natural Gas usage in Indian cities has been limited primarily due to the scarcity of supply and limited gas transmission network. However, this scenario is undergoing change with incorporation of PNGRB.

Post formation of PNGRB, the market for city gas distribution is also set to grow at an accelerated pace due to surge in CGD and gas transmission projects. The reason for this surge is structured regulations, Conducive govt. policies like priority gas allocation is boosting CGD Segment. The domestic segment is also expected to grow with the government's intentions to remove the subsidy on LPG cylinders in a phased manner in 3-5 years making piped gas even more economical.

2.4.1 Factors Influencing PNG Domestic Progress

1) The Market: The size and type of market do have influence on the progress of PNG domestic connections. The perception of the masses differs from place to place. The size of the population is one of the main factors for expected penetration of PNG domestic connections.

2) The scatter of the Population: The localized population in various clusters gives more economic and fast penetration as compared to the thinly scattered population. The localized population helps in reaching domestic consumers at comparatively cheaper cost than the population in Bungalows and dwelling scattered with good space between each other.

3) The Marketing Strategy: The successful marketing strategy influences the mindset of the population in positive direction with win-win situation for gas marketers/infrastructure developers and the consumers. It has been seen that the marketing efforts do have a positive impact on the penetration.

4) Financial Capability of the Project implementing entity: The entity may follow a policy of upfront capex deployment for achieving fast track development of infrastructure or it may adopt the policy of plough back the profit and develop the project with a low initial capex infusion. It is seen that the former approach is more conducive to higher PNG Domestic penetration.

5) Mix use of Gas: With the change in lifestyle witnessed by a larger population in India after the economy was opened to global participation, the PNG domestic has found much use in various applications.

We have been promoting a concept called SSS (The Single Switch Solution). This concept provides application of Natural Gas in household Segments, such as

i. Cooking
ii. Water Heating (Geysers)
iii. Space Heating
iv. Air Conditioning
v. Power Generation
vi. Refrigeration
vii. CNG for Vehicles (Fuel Maker)

Promoting such multi-functional application, is expected to increase PNG Domestic penetration, apart from larger volume of gas being picked up by domestic consumers.

6) Resource Mobilization: The PNG Domestic application is resource intensive. It needs huge efforts to mobilize.

I. Capex: finance continues to be the driving force for any project)

II. Materials: Steel Pipes, GI Pipes, PE Pipe, Pipe Fittings, Meters, Regulators, Copper tubing, Isolation Valves etc. Proper quality, quantity and phasing of the procurement is required to achieve scheduled targets effectively.

III. Manpower: With the kind of thrust India is now witnessing for CGD projects implementation, the CGD entities and GA's are going to be doubled or tripled in next 5 to 8 years. The manpower of all kind, the experienced engineers, managers, workmen and the new recruiters graduate engineers, diploma holders and ITI personnel are going to be in high demand. We have not seen such a development so far, but it is expected to pick up. This is required to be given high priority, otherwise, the CGD projects may witness poaching of such craftsman from one entity to the other, thereby, increasing the cost and decreasing the number of connections.

In our opinion, the PNG domestic growth rate is going to be decided by the availability of experienced craftsman.

7) Safety: Considering that the number of customers in domestic segments will be largest, safety considerations at all stages shall be the guiding principles for acceptance of NG as domestic fuel for SSS.

PNGRB has outlined comprehensive safety standards which shall have to be implemented in letters and sprit. Costs of such implementation are considered while calculating Capex and Opex.

In long run, these safety standards are going to help to create large number of domestic connections and their acceptability.

CNG Segment

The history of CNG in India can be traced back to 1992 – 93 when GAIL launched a pilot project in Delhi, Mumbai and Vadodara. This pilot project aimed at conversion of Taxis, Three wheelers and state-owned diesel buses to CNG. The project also aimed at identifying and resolving technical, institutional, regulatory and economic issues related to conversion to CNG. After developing the CNG projects in

these cities from 1993 onward, GAIL formed Mahanagar Gas Limited with BG in 1995 and Indraprastha Gas with BPCL in 1998 in Mumbai and Delhi respectively to implement the project on commercial scale covering all segments like Domestic, Commercial, Transport and Industrial.

Since its inception, there has been significant driving force for switchover to CNG which is considered to have 2 basic components;

(i) The economic criteria for all stakeholders along the value chain of CNG application. The value chain consists of the CNG Kit manufacture, Vehicle manufacture, Conversion workshop, Gas supplier, Vehicle owner, CNG dispensing and the local Government. As long as all stakeholders are benefited economically the conversion of existing vehicles and deployment of OEM fitted CNG vehicle will be coming up in the market. This exactly has been the case for three wheelers and taxi segment in Mumbai and private car and buses segment in Delhi.

(ii) The environmental benefit – Although the concern for environment must be from all segment of the population but this concerned is basically enforced by the Federal, State or the Local Government and the Judiciary. The introduction of CNG in India based on a PIL filed in Supreme Court in 1992 is an example of such concerns. Another driving force is the emission norms which are getting stricter and stricter year by year paving the way for application of CNG in automotive Segment.

Between CNG conversion in Delhi and Mumbai it is observed that the Supreme Court monitoring in Delhi was very severe because of its proximity, while the driving force in Mumbai has been the commercial benefits accrued to the vehicle owners in terms of saving in daily expenses on fuel. Surprisingly the conversion to CNG in Mumbai have exceeded than those in Delhi by 2.9% as of 31.3.2018.

A further comparison of the conversion to CNG or use of OMC fitted CNG vehicle, in various segments shows that the growth is basically driven by the lifestyle and economy of the city/town in which CNG is implemented. For example, the use of taxi in Mumbai is very prevalent; therefore, a growth of 538.6% has been achieved in Mumbai as compared to Delhi. Similarly, the progress in conversion of three-wheeler in Mumbai has shown 60.2% higher growth than that in Delhi with the same logic growth in bus and RTV conversion in Mumbai is less as compared to that of Delhi.

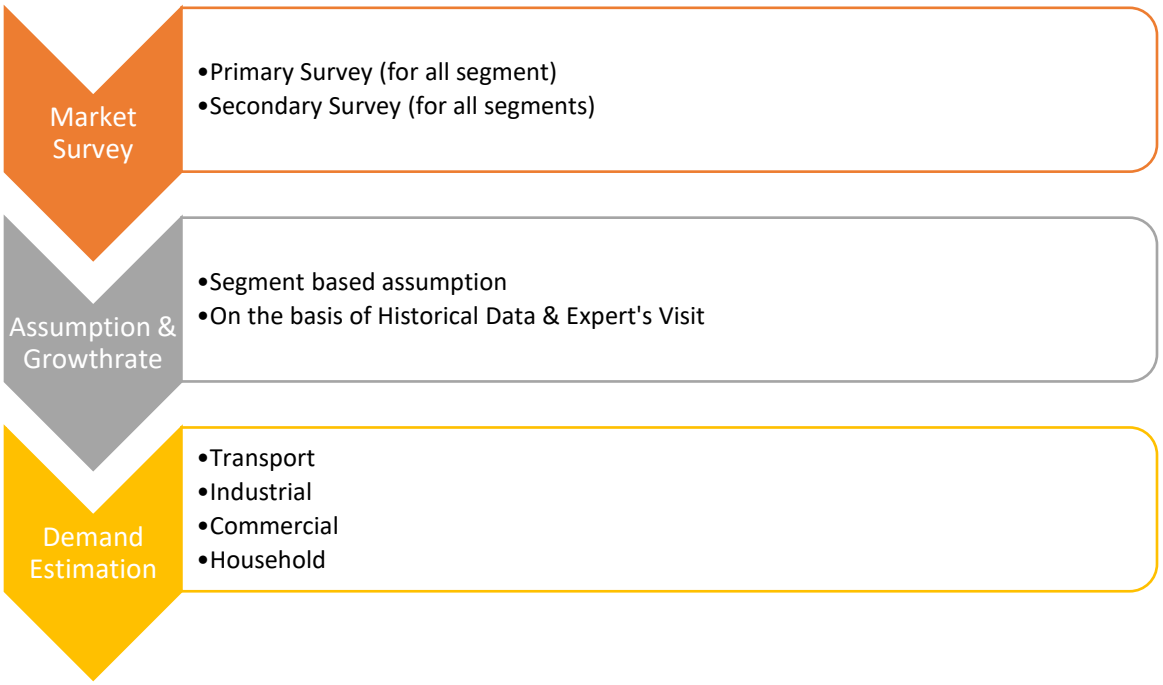
It can be reasonably said that for the application of CNG to catch up in any of the town/city is solely a function of the capability of the concerned entity to implement such a project which needs development of infrastructure especially in the congested locality where securing land for CNG retail outlet is a problem.

Apart from this, natural gas as CNG has been able to replace high priced hydrocarbon commodity like petrol and diesel. This has further helped India to reduce its Oil Import Bill. As a matter of fact, the international Gas Price is always 10-15% less as compared to crude oil price in energy terms. Diesel as an automotive fuel was very competitive with Natural Gas till the time it was subsidized. However, once the subsidy was gradually removed, a sudden surge in CNG vehicle conversion especially in commercial vehicles (Bus, 3-wheelers, Taxi) is seen in last 2 years.

3. DEMAND APPROACH AND METHODOLOGY

Approach & Methodology adopted to carry out the Natural Gas Demand Assessment for the geographical area is summarized below:

Figure 2: Methodology for Demand estimation



3.1 Survey

3.1.1 Primary Survey

Primary Field Survey is conducted for the data collection for the geographical area is done in the following ways:

I. Face to face meetings with the various Industrial communities to find out the important industrial clusters, upcoming and long-term plans in the various communities, possible Natural Gas off-takers and presence of anchor loads in the regions

II. Meeting with industrial consumers in the specified industrial clusters

III. Meeting/Interviewing the consumers to understand their energy/ fuels requirement and rationale for using any specific kind of fuels

IV. Meetings and interviews with the consumers to understand the price sensitivity of various fuels from consumer perspective and the change in technology required to switch to natural gas.

V. Understanding the dynamics of GA in term of pipeline laying

3.1.2 Secondary Survey

The secondary research is carried out for the collection of the data related to the Industrial, Commercial, Transport and Domestic Segment. Research data is also collected by making the use of the research papers, journals, reports, surfing through various websites etc. as per the requirement.

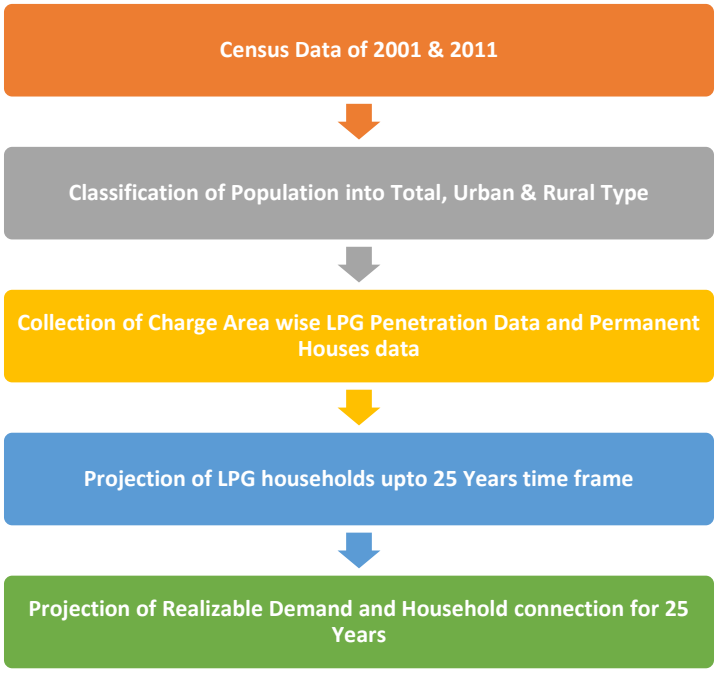
The various Segments covered for the estimation of demand in the project is pictorially represented as follows:

Figure 3: Various Segment for Demand estimation

3.2 Methodology for Segment wise demand estimation

3.2.1 Domestic Segment

Figure 4: Methodology for Domestic Demand estimation



The demand of natural gas for domestic segment is calculated by analyzing the primary data.

3.2.1.1 *Sample Plan*

An exhaustive survey of households in the GA was conducted to obtain an overview of natural gas potential in domestic segment. A total of 310 households were surveyed covering all the major residential areas in the GA. The table below shows the CA wise sample size across GA.

Table 10: Residential Sample Size

GA	Town	Sample Size
Bidar	Aurad	30
	Basavakalyan	50
	Bhalki	30
	Bidar	150
	Homnabad	50
Total		**310**

3.2.1.2 Average Family Size, Households and Growth Rate

Based on the census 2011 data, the CA average number of person (family size) per HH in the GA is shown in table below:-

Table 11: Average Family Size, Households and Growth rate

Sl.No	Charge Area No.	Charge Area Name	Total Average Family Size	Total Household	Total CAGR (2001-2011)
1.	CA 1	Aurad	5.39	51,672	2.18%
2.	CA 2	Basavakalyan	5.39	64,055	2.38%
3.	CA 3	Bhalki	5.13	54,100	2.07%
4.	CA 4	Bidar	5.27	89,172	2.80%
5.	CA 5	Homnabad	2.78	60,938	2.35%

3.2.1.3 Average Household Consumption of Natural Gas

Only Cooking application has been taken into account for domestic gas consumption. The consumption of NG per household (HH) in the GA is calculated from primary data. The table below shows the average household consumption of Natural Gas. Hence, the PNG demand estimation is done on above basis.

Table 12: Average Consumption for Domestic Segment

Equivalent Natural Gas Consumption	Value
Urban	0.46
Rural	0.35

3.2.1.4 Technically Feasible Household

On the basis of CAGR, Household as per census 2011 is extrapolated to arrive at household for 2019 and only the permanent houses as per census 2011 is considered as targeted household for PNG conversion.

Table 13: Technically Feasible Household

Sl.No	Charge Area No.	Charge Area Name	Permanent House % for Urban	Permanent House % for Rural
1.	CA 1	Aurad	73%	71%
2.	CA 2	Basavakalyan	67%	68%
3.	CA 3	Bhalki	87%	75%
4.	CA 4	Bidar	92%	79%
5.	CA 5	Homnabad	52%	69%

3.2.1.5 Conversion Factor for Urban and Rural

Conversion factor is considered on the basis of primary survey report, during primary visits residential were queried about their willingness to switch over to Piped Natural Gas for cooking purpose only.

Table 14: Conversion Factor

Sl.No	Charge Area No.	Charge Area Name	Conversion % for Urban	Conversion % for Rural
1.	CA 1	Aurad	3.48%	1.00%
2.	CA 2	Basavakalyan	3.48%	1.00%
3.	CA 3	Bhalki	3.48%	1.00%
4.	CA 4	Bidar	3.48%	1.00%
5.	CA 5	Homnabad	3.48%	1.00%

3.2.1.6 Statistical Analysis of future prospects

The target population was asked about their experience related to the use of fuel for cooking, its availability, accessibility, affordability and safety. The assessment was recorded in a likert scale of 1 to 5, 5 being highly satisfied and 1 being highly unsatisfied. The response is analyzed as under:

The data collected is analyzed for the response of the responded. The mean and the mode of the observations have been carried out for the target population from a GA. However, in a micro level analysis we can also derive response of a target population of a CA. This analysis is helpful to decide the methodology to be used for creating willingness to convert to PNG.

For the GA of Bidar, the table containing statistical detail is placed in Residential survey file. The analysis for various variables is as under:

Table 15: Residential Primary Survey Analysis

Trait	Mean	Mode	Remarks
Use of LPG	4.2	4	The responded are more or less satisfied with the use of LPG and hence change to PNG will need specific incentive
Use of Electricity	4.7	5	Respondent are satisfied with electric supply system. Domestic power generation with gas is difficult to penetrate
Use of Kerosene	2.97	3	A little knowledge about PNG makes this segment sure to convert to PNG
Use of Other fuel (Coal/Wood/Diesel)	3.03	3	A little knowledge about PNG makes this segment sure to convert to PNG
Preference for Fuel based on price	1.80	2	The respondents are unsatisfied with the present price and makes a good point for pushing for PNG application
Preference of Fuel based on safety	3.03	4	The mean is strongly moving to safety consciousness, this could be a driving factor for PNG conversion
Preference of Fuel based on ease of Availability and access	4.20	4	Easy access- this could be a driving factor for PNG conversion
Using Natural Gas for cooking	4.52	5	The mean and mode are concentrating on 5 which means people are highly interested for conversion
Using Natural Gas for Power generation	2.80	3	Strongly ignorant about this application. SSS concept marketing will be helpful
Using Natural Gas for space heating	2.74	3	Largest numbers of respondents were ignorant of this application. SSS concept marketing will be helpful

Trait	Mean	Mode	Remarks
Use Natural Gas for Vehicle	3.06	3	Largest numbers of respondents were ignorant of this application. SSS concept marketing will be helpful
Using Natural gas for clean environment	4.23	4	People have a strong like for clean environment could be a market pusher for PNG
PNG connection with initial deposit of Rs. 6000/-	1.6	2	Initial deposit concept is difficult to be push forward and entity needs to apply EMI provision
PNG connection with initial deposit in EMI	4.31	4	EMI provision could be a big pusher for PNG conversion and should be crafted on revenue neutral basis

3.2.1.7 Household Connection

Based on above facts and assumption, Cumulative household connections for the GA are calculated for 25 year and presented in the table below:

Table 16: Cumulative Connection for Domestic Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Connections	0	620	1,240	1,860	2,480

Particulars	Y6	Y7	Y8	Y15	Y25
Connections	3,720	4,960	6,200	6,784	7,617

3.2.1.8 Realisable Demand Projection

The data extrapolated to the household conversion for calculating realizable demand of natural gas (MMSCMD) in domestic segment in GA for 25 years have been projected and presented in table below:

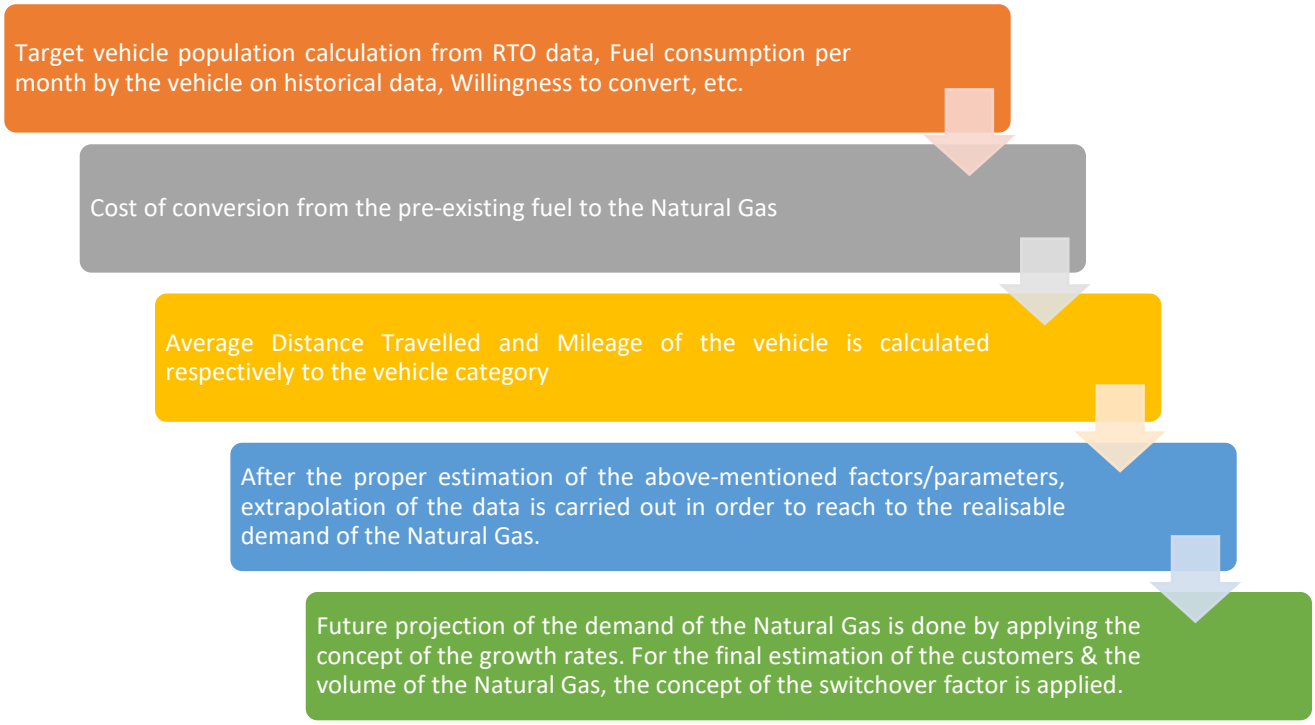
Table 17: Realizable Demand for Domestic Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Realisable Demand (MMSCMD)	0.000	0.000	0.001	0.001	0.001

Particulars	Y6	Y7	Y8	Y15	Y25
Realisable Demand (MMSCMD)	0.002	0.002	0.003	0.003	0.003

3.2.2 Transport Segment

Figure 5: Methodology for Transport Demand estimation



3.2.2.1 Target Vehicle population

RTO (Regional Transport Office) data for GA is referred for demand assessment of CNG vehicles in the geographical area. Data for 2018 is extrapolated for 2019 on the basis of CAGR 2013-2018.

Table 18: RTO Vehicles Target Population

Vehicle Categories	Vehicle Population (2013)	Vehicle Population (2018)
Private Cars	4,607	7,147
Motor Cabs	1,091	1,317
Maxi Cabs & Taxies	1,210	1,405
Light Goods Veh.- 4 wheelers	2,919	3,846
Light Goods Veh.- 3 wheelers	1,555	2,193
Stage Carriers	422	471
Contract carriages	108	112
Educational Instutuion Buses	33	170
Private Service Vehicles (Buses)	91	92
Omni Buses	1,285	1,362
Auto Rickshaws	2,934	4,178
4-6 Seaters	90	129
Other Cabs	29	53

3.2.2.2 Assumption for running factor, average consumption and daily average distance travelled of CNG

On the basis of primary survey report and expert visit the running factor is considered for each vehicle type, the daily average distance travelled is computed on the basis of RO Survey report.

Table 19: Average CNG Consumption Vehicle Wise

Vehicle Categories	Running Factor	Daily Average Distance Travelled	CNG Mileage (Km/SCM)	Consumption (kg/day)
Private Cars	60%	20	13.7	1.5
Motor Cabs	80%	50	13.7	3.7
Maxi Cabs & Taxies	50%	50	13.7	3.7
Light Goods Veh.- 4 wheelers	50%	50	6.1	8.2
Light Goods Veh.- 3 wheelers	80%	50	7.6	6.6
Stage Carriers	80%	75	3.0	24.7
Contract carriages	80%	75	3.0	24.7
Educational Institute Buses	80%	30	3.4	8.8
Private Service Vehicles (Buses)	85%	50	7.6	6.6
Omni Buses	85%	50	3.4	14.6
Auto Rickshaws	85%	50	26.6	1.9
4-6 Seaters	70%	50	22.8	2.2
Other cabs	70%	50	13.7	3.7

3.2.2.3 Growth Rate Percentage

The growth rate is computed on the basis of 5 years CAGR, maximum growth rate for vehicles is cap at 10% and after first eight year a tapering value of 3% per year has been envisaged for the life span of project.

Table 20: Growth Rate for Transport Segment

Vehicle Categories	CAGR
Private Cars	11.6%
Motor Cabs	4.8%
Maxi Cabs & Taxies	3.8%
Light Goods Veh.- 4 wheelers	7.1%
Light Goods Veh.- 3 wheelers	9.0%
Stage Carriers	2.8%
Contract carriages	2.0%
Educational Institute Buses	50.7%
Private Service Vehicles (Buses)	2.0%
Omni Buses	2.0%
Auto Rickshaws	9.2%
4-6 Seaters	9.4%
Other cabs	16.3%

Table 21: Transport Sector- Maximum CAGR-Cap and Tapering Percentage

Category of Vehicle	Maximum CAGR Cap (till 8th year)	Tapering Percentage (8th year onwards)
Value	10%	3%

3.2.2.4 Realisable Demand for CNG segment

The realizable natural gas demand in CNG segment is estimated based on above mentioned facts and assumptions for the GA and nearby areas supplied through DBS and the realizable potential demand in Transportation segment is shown in table below:

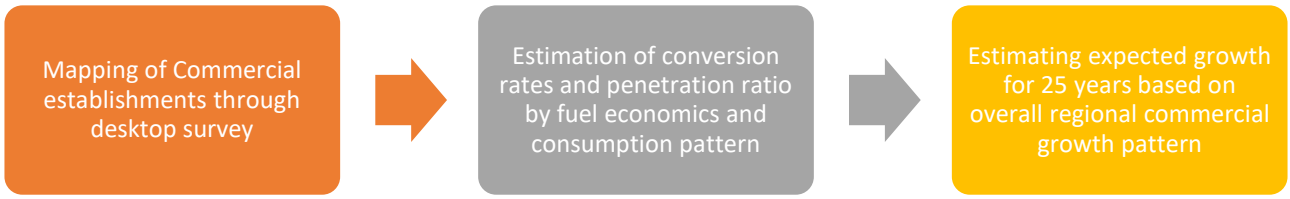
Table 22: Realizable Demand for Transport Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Realisable Demand (MMSCMD)	0.000	0.001	0.002	0.004	0.006

Particulars	Y6	Y7	Y8	Y15	Y25
Realisable Demand (MMSCMD)	0.008	0.011	0.015	0.038	0.061

3.2.3 Commercial Segment

Figure 6: Methodology for Commercial Demand estimation



To analyse the natural gas demand in commercial segment, primary survey is carried out for all the major commercial establishments, whereas secondary data is used to compute the universe of commercial establishments in the GA. Steps followed for demand estimation are as below:

3.2.3.1 Universe of Commercial Units

To estimate the universe for commercial establishments in the GA, various secondary data and information were collected from internet and confirmatory checks were conducted by survey teams doing primary data collection for commercial segment. For analysis purpose, the commercial establishment has been further categorized as presented in table below:

Table 23: Universe for Commercial Segment Categories

Commercial Categories	Unit Surveyed	Universe
Hostel, Mess and Canteen	8	190
Hotel	12	157
Restaurant	18	250

3.2.3.2 *Equivalent Demand for PNG Commercial Distribution*

Average NG equivalent consumption (SCMD) of different types of establishments is assumed and on the basis of historical data and are presented below:

Table 24: Average Consumption for Commercial Segment Categories

Commercial Categories	Average Consumption (SCMD)
Bakery	15.60
Religious Place	8.54
Hospital	120.00
Hostel	15.60
Hotel- 5 STAR	270.00
Hotel- 4 star	120.00
Hotel - 3 Star	18.00
Hotel - 2 Star	15.60
Hotel	1.18
Restaurant	1.16
School	6.00
Institute	6.00

3.2.3.3 Commercial Growth Rate

Commercial growth rate is considered in tandem with the growth rate of Karnataka for commercial at 9.17% and after first eight year a tapering value of 10% per year has been envisaged for the life span of project which is cap at minimum 2%.

3.2.3.4 Switchover to natural gas

The switchover percentage has been derived from various historical and GA specific facts at is cap at 50%. Based on the assumption cumulative commercial connections for the GA are as follows:

Table 25: Cumulative Connection for Commercial Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Connections	0	0	109	238	389

Particulars	Y6	Y7	Y8	Y15	Y25
Connections	567	774	1014	1877	2497

3.2.3.5 Realisable Demand for PNG in Commercial Segment

The average Natural Gas consumption extrapolated to the universe with suitable growth rate and conversion percentage of commercial establishments gives the realizable demand for next 25 years and is shown in table below:

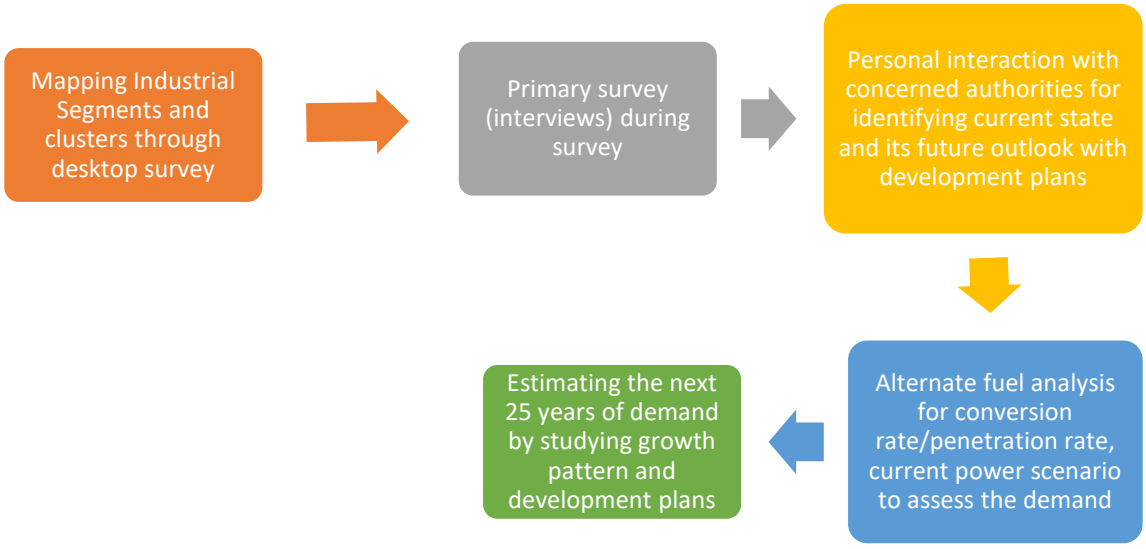
Table 26: Realizable Demand for Commercial Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Realisable Demand (MMSCMD)	0.000	0.001	0.003	0.005	0.007

Particulars	Y6	Y7	Y8	Y15	Y25
Realisable Demand (MMSCMD)	0.010	0.013	0.017	0.026	0.034

3.2.4 Industrial Segment

Figure 7: Methodology for Industrial Demand estimation



The primary survey is conducted for all type of industries, it is observed that the key industries that may switch easily to Natural Gas are Forging, Casting & Steel industries, Automobile, Engineering & Glass/Ceramics etc. First, the consumption of the different fuels used by such industries is retrieved by carrying out the primary research method. This is followed by the calculation of the equivalent Natural Gas MMSCMD for the respective industries. The base year demand of Natural Gas is projected over the period of 25 years by using suitable growth rates. The realizable demand of Natural Gas is calculated using the appropriate switchovers rates for the respective alternative fuels used in the industry.

3.2.4.1 Survey of Industries

In order to understand the economy of the GA and gauge its industrial growth an overview was obtained by consulting a wide range of secondary sources of various industries and industrial sectors in the GA, which helped in the initial profiling of the industries.

For calculation of potential demand for PNG in industrial sector, primary data collection was done in the GA.

3.2.4.2 Primary Data Collection

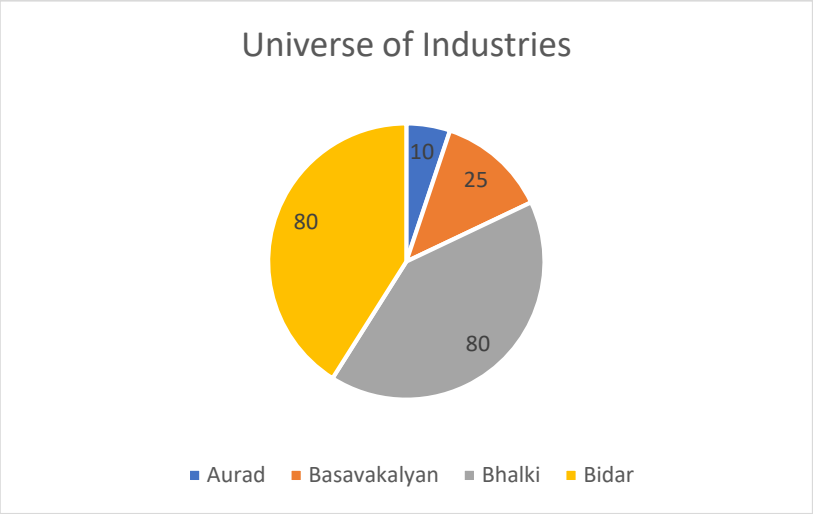
The first step in the process of primary data collection was a listing exercise to generate an exhaustive list of all the industrial units. Once the list was drawn up, systematic technique was employed to collect a representative sample of the fuel usage in the industries. The Primary survey covered 39 industries in the industrial sectors like Food Processing, Daal Manufacturing, Pharmaceuticals, Glass etc.

3.2.4.3 Universe of Industrial Units

Various secondary sources and industry associations along with the confirmatory data collection from primary data were employed to estimate the universe for total number of industrial units in GA. For analysis purpose all the industrial establishments have been further divided into large, SMEs. Only those Industrial units which are consuming hydrocarbon fuels are considered for industrial demand estimation purpose. The industrial universe consists of industrial units under the purview of CGD as per the PNGRB regulations *(The actual no. of industries is more than what has been taken into account*). Across all industrial areas in the GA the size of industrial universe is approx. 195. The universe of industrial establishments has been calculated from the secondary sources and also validated through primary survey.

Table 27: Sample Size

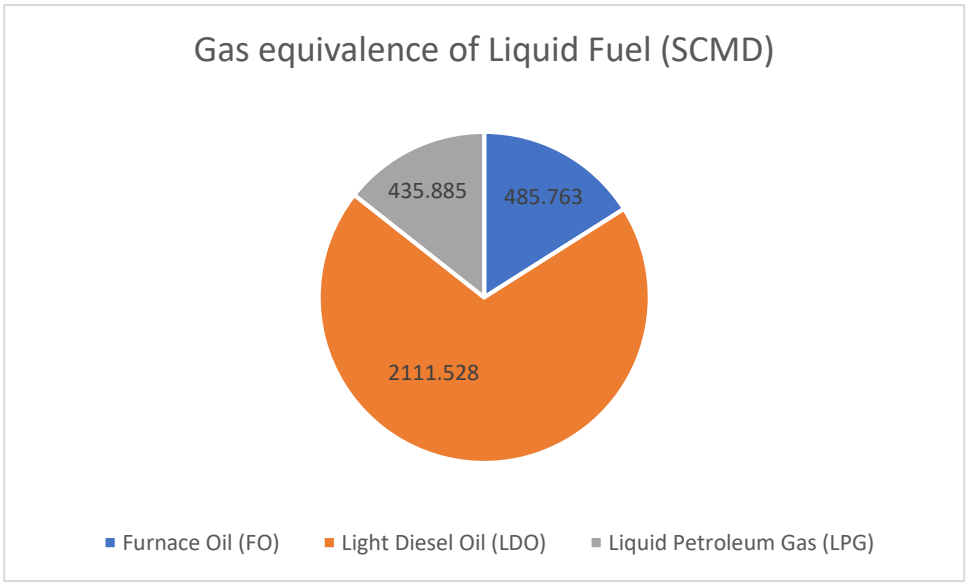
Sl.No	Charge Area No.	Charge Area Name	Unit Surveyed
1.	CA 1	Aurad	1
2.	CA 2	Basavakalyan	0
3.	CA 3	Bhalki	23
4.	CA 4	Bidar	16
5.	CA 5	Homnabad	Nil Industries
Total			**40**



3.2.4.4 Survey Findings

Generally fuels like Diesel, LPG, FO, biofuels and Coal are used in Industrial segment. Many units however use electricity for running of machinery and lighting and diesel is used by almost all the industries for backup power generation. We have considered only liquid fuel for NG conversion.

The surveyed sample of 40 Industries is extrapolated to universe. The gas equivalent for present liquid hydrocarbon fuel usage on energy equivalence basis is shown below:



3.2.4.5 Average Consumption

From the primary data analysis, the average consumption for Industries are calculated and is shown in table below:

Table 28: Average Consumption

Sl.No	Charge Area No.	Charge Area Name	Furnance Oil	Light Diesel Oil	Liquid Petroleum gas
1.	CA 1	Aurad	374.33		
2.	CA 3	Bhalki	4.84	91.81	18.45
3.	CA 4	Bidar			0.72

3.2.4.6 Realisable Demand for Industrial Segment

The average Natural Gas consumption extrapolated to the universe with suitable growth rate and conversion percentage of industrial establishments gives the realizable demand for next 25 years and is shown in table below:

Table 29: Realizable Demand for Industrial Segment

Particulars	Y1	Y2	Y3	Y4	Y5
Realisable Demand (MMSCMD)	0.000	0.001	0.003	0.005	0.007

Particulars	Y6	Y7	Y8	Y15	Y25
Realisable Demand (MMSCMD)	0.010	0.012	0.016	0.026	0.055

4. TECHNICAL DETAILS FOR CITY GAS DISTRIBUTION PROJECT

This chapter covers the design philosophy, input parameters, basic design and standards for the total system envisaged in this report.

The technical design is based on the demand assessment which has been carried out based on the primary survey / interviews in Residential, Industrial segment and NGV segment and verified with various secondary data for the complete geographical area (present and future inclusions). The demand projections have been made upto 25 year for all consumer segments namely, domestic, commercial, automobile and industrial taking 2020 as base year and FY 2020 – 21 as first year.

4.1 Design Codes & Standards

The City Gas Distribution network and associated equipment are designed as per Technical Standard T4S approved by Petroleum and Natural Gas Regulatory Board (PNGRB) and other National and International standards and Codes of practice referred therein. The city ring main is designed for the peak demand flow in the 25th year.

The principal international standards proposed for distribution network is ANSI/ASME B 31.8, 'Gas Transmission and Distribution Piping System'. Since ASME B31.8 does not adequately cover plastic pipes, for this ISO: 4431 'Buried Polyethylene (PE) pipes for the supply of gaseous fuels- Metric Services specifications' are followed.

Steel Pipes

ANSI / ASME B31.8

ANSI B31.3

API 5L

OISD: 226

MDPE Pipelines for U/G Gas Services

ANSI / ASME B31.8

IS: 14885

OISD: 220

CNG System

OISD: 110, 132, 137 & 179

CCOE & Guidelines

4.2 Gas Sourcing

100 % APM gas has been considered for Household & CNG usage. Industrial & Commercial segment shall be served by market driven gas to be sourced by various upstream supplier including BPCL RGTIL, East-West Pipeline has been considered as trunk line for feeding the GA demand, entity may feed this pipeline from various entry points strategically located. Tap-off has been considered at Mannaekhalli village from East West Pipeline, operated by RGTIL located in District Bidar.

4.3 Design Details

The design is based on a daily peak demand of various Segments. The city gas distribution system has been designed considering demand load, supply pressure and future requirements for all the consuming segments and the available pressure at tap-off point.

Based on the route survey data, demand centers analysis, the steel main skeleton is envisaged to cater to various demand centers in optimal manner.

The CGD design consists of following components;

- City Gate Station
- Steel Grid (Mains)
- District Regulating Station
- MDPE pipeline
- CNG Stations
- Last Mile Connectivity

Design of City Gate Station

The City Gate Station is designed for 25th year 0.1532 MMSCMD of gas throughput based on the total Natural Gas demand of all Segments. Design parameters considered for sizing of individual components of CGS Metering & Pressure from the Reduction Skid (MPRS) are mentioned in table below.

Table 30: Design of CGS

Description	Value
Design Pressure – In	49 - 99 bar
Design Pressure – Out	35 bar
Specific Gravity of Natural Gas	0.7
Design temperature	45°C to 65°C
Joint Factor	1
Location Class	4
Design Life	25 years
Gas Velocity	20-30 meters/sec
Odourisation Rate	12.5 PPM
Gas Filtration	50 microns

City Gas Distribution Network

The considered pressure for the system design is depicted in the table below:

Table 31: CGS Network System design

Distribution Network	Considered Pressure	Service Pipe
Main Grid Line	35 Bar(g) (High Pressure System)	Steel
Distribution/Service connection	4 Bar(g) (Medium Pressure System)	MDPE
Industrial/Large Commercial connection	2 - 4 Bar(g)	MDPE
Small Commercial connection	300 m bar	MDPE
Domestic connection	21 m bar	GI

Supply pressure to industrial/commercial consumers shall be need based.

Steel Main Design Parameters

The Steel Main is designed to carry total gas to be distributed to all the customer segments in all demand centers. The Steel main will carry gas from CGS to On-line CNG stations and DRS and Industrial Consumers. The flowing gas pressure in the Steel Main will be 35 bar at CGS to minimum of 14 bar at various planned CNG stations.

Table 32: Steel Main Design Parameter

Description	Value
Joint factor	1
Temperature factor	1
Population density factor	Class-IV
MAOP	49 bar
Minimum Pressure in Steel Mains	14 bar
Material Specification	API 5L X 52 (PSL 2)
Corrosion Allowance	0.5 mm
Minimum Wall Thickness	6.4 mm
Corrosion Protection	3-layer PE coated and Cathodic Protection
Gas Velocity	30 meter/sec (Max)

District Regulating Station (DRS)

A pressure reduction skid is a transition point from steel to MDPE where the pressure is regulated to 4 bar for PNG segment

MDPE Pipeline Design Parameters

For supplying gas to domestic, commercial and industrial Segments, the pressure of piped gas is reduced to distribution pressure in the District Regulating Station (DRS), which feeds gas to MDPE distribution network. The domestic consumers are fed from the MDPE distribution network through service lines up to the domestic premises where regulating and metering facilities are provided. Industrial and commercial consumers are also supplied gas from distribution network through service lines up to the industrial and commercial consumer's premises from where regulating and metering facilities are arranged.

In the present study, the routing of pipeline of different diameter i.e. 125 mm, 90mm, 63 mm, 32 mm of MDPE and 20mm of MDPE & GI have been considered.

Table 33: MDPE Pipeline Design Parameter

Description	Value
Max Operating Pressure	7 bar
Pipe Material	PE 80/ PE100, SDR 11.
Pipe Sizes	125 mm, 90mm, 63 mm, 32 mm, 20 mm in MDPE Network

CNG Station Design Parameters

As per the CNG demand in the 25th year of operations, the CNG demand and dispensing capacity are determined. The CNG stations are planned as per the demand growth. The design parameter for the CNG station is as follows:

Table 34: CNG Station Design Parameter

Description	Key factors
Inlet Pressure	14 bar to 35 bar
Outlet Pressure	210 bar to 255 bar
Cascade capacity Mother Station On-line Station Daughter	4500 WL
Mother Station	1200 SCMH (1 motor driven compressor of 1200 SCMH)
Online Station Capacity	650 SCMH (1 motor driven compressor of 650 SCMH)
Daughter Booster Station	450 SCMH

4.4 Network Design Map & Pressure Profiles

The proposed route is based on extensive survey keeping an approach to connect maximum charge areas while catering to the various major demand centers. Following are the points for the route selection

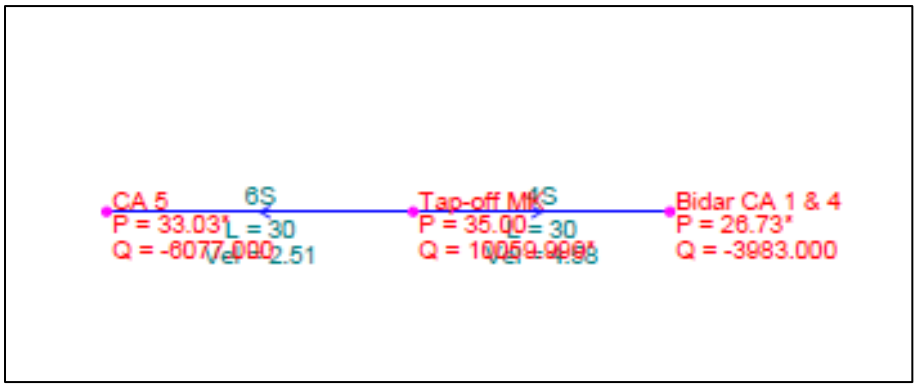
- **Route Selection Criteria**

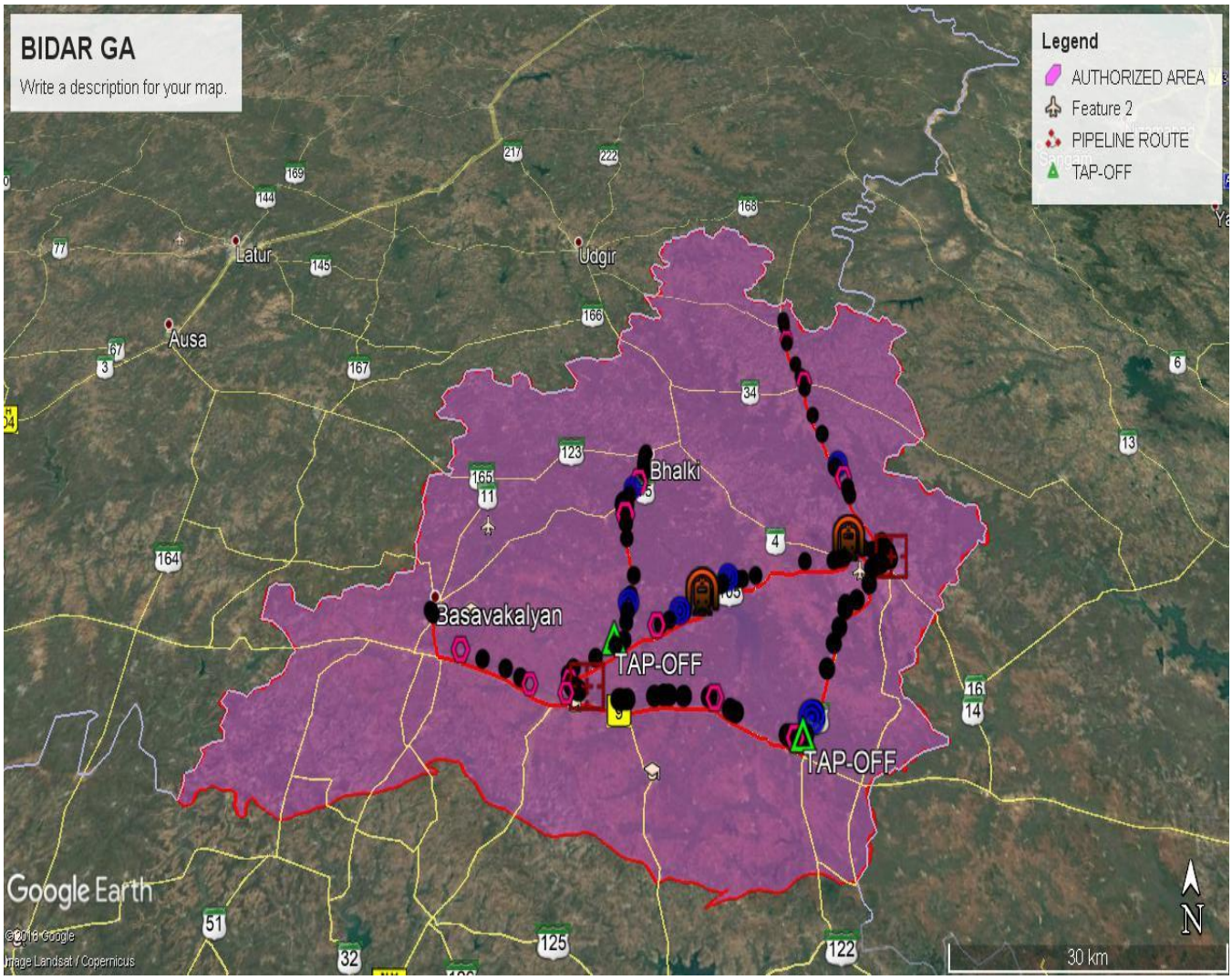
- Safety of public lives, property and safety of the pipeline from engineering and other considerations.
- Shortest pipeline Length
- Easy and favourable terrain condition free of large water bodies, low lying marshy lands, obstacle like ravines, depression, unstable grounds, meandering rivers, etc.
- Alignment in horizontal plane parallel and along the Roads/Railway, as far as possible.
- Ground profile for pipeline hydraulics and avoidance of steep rising and falling ground, hills and valleys having sloping right of way.
- Availability of infrastructure and access to the pipeline route during construction and maintenances.
- Environmental impact and avoidance of environmentally sensitive lands, such as forest, built up areas, places of worships, burial and public grounds
- Minimum crossing of existing pipelines, transmission lines, parallel alignment.
- Minimum Road, rail, river and nalas crossings.
- Avoidance of rugged and intricate grounds with hard strata, exposed rocks, boulders and queries.
- Existing and further developments in the regions, such as road, railway lines, reservoir, township, industrial units etc.

The proposed pipeline route is optimized based on GASWORKS 9.0. To obtain the desired optimum size of the pipes the input like scaled GIS map of the pipeline routing, required pressures, temperature, flow and length of the pipes have been used. Other inputs of route survey and demand pattern were employed to optimize the design.

Pressures for various sections are based on calculations from software simulations of GASWORKS 9.0. Following is the network schematic based on optimized design on Gasworks 9.0

Figure 8: Network Design Map





CGS is proposed at Manakheli village from EWPL, pipeline operated by RGTIL.This CGS will cater entire demand of the GA . The pipeline will start from Manakheli then will go to Humnabad and other side to Bidar Town , the nearest area having industrial and commercial market.

These areas have MIDC industrial area along with CNG load and Residential – commercial clusters. The lines will be laid parallel to NH & District road mainly. The line size varies telescopically from 6 inch to 4 inch based on the demand and pressure requirements.

Route Survey

The project envisage to firm up the route of primary network covering all above districts. The Transmission Line from Which Tap- Off shall be taken for this GA is identify as EWPL, from RGTIL Gas Pipe Line. The tap off location is a part of this assignment.

Scope of Work

The scope of work includes -

- ✓ To carry out the visit to SV/IP station of RGTIL transmission pipeline and to firm up the location of appropriate Tap off.
- ✓ To carry out the detailed reconnaissance survey of pre-determined stretches/selected routes with special emphasis to major crossings and turning points for assessment of the feasibility of laying the pipeline along the proposed routes.
- ✓ The reconnaissance survey includes suggestions, modification in the proposed alignment, detours/diversions and avoidance of routes due to new developments in the area, water bodies, ghat section, identifying type and number of crossings.
- ✓ Collecting information of all existing retail outlets of OMC's along the route and taking digital photographs of promising retail outlets for CNG facility.
- ✓ Preparing a drawing showing the proposed pipeline route on scaled autocad /GIS map.

- ✓ Preparing detailed report showing salient features of the corridor, crossing etc. including a schedule of crossing in tabular form mentioning suitable pipeline laying method, soil types etc.

Methodology of Survey

The methodology adopted in the reconnaissance survey includes:

- Walkover survey with the help of GPS along the possible routes and select the best fit route.
- Travers along the selected route and mark all the obligatory points on Google map based on walkover survey for various routes.
- Locating the most probable pipeline corridor on the Google map.
- Collection of all retail outlet information along various routes in the given format.
- Selection of the best fit route by Client.
- Transfer the proposed route on google map.

Route Details

Details of selected pipeline routes are given below in Table-35:

Table 35: Description of Selected Lines

Line No.	Description	Length
Line-1	Tap Off to Bidar	30 km
Line-2	Tap Off to Humnabad	30 km
Total		**60 km**

Drawings showing pipeline routes are presented in Annexure-I.

Description of Routes

Line 1 : The proposed line starts from Tap-off at Manakheli village and served to Humnabad town. The line runs parallel to National highway on the right side while facing to Humnabad. This line covers CNG, commercial and domestic demand in Humnabad. This line encounters road, canal, Railway and nala crossing. The line is mainly passing through mix land.

Line2 : The proposed line starts from Tap-off at Manakheli village and served to Bidar. This line runs parallel to Bidar Manakheli road on the right side while facing to Bidar. This line covers CNG, commercial and domestic demand in Bidar. This line encounters road, rail, canal and nala crossing. The line is mainly passing through mix land.

Crossing Details

A table showing the details of crossings for each of the line is presented in Annexure-II. Recommended type of crossing is also mentioned in that table. A summary of pipeline crossings is presented below in Table -36:

Table 36: Summary of Crossing Details

Crossing Descriptions	Line 1	Line 2
Rail Line	1	1
National Highway		
State Highway		
Bituminous Road	16	19
River		
Canal	1	
Nallah	3	
Gravel Road	3	7

Details of Retail Outlets

Data of all the existing retail outlets on each line have been collected in the prescribed format along and presented in Annexure – III along with photographs.

Subsurface Conditions along the Routes

From the visual inspection of surface exposures and based on local enquiry the subsurface materials expected to encounter along the pipeline route is given below in Table 37.

Table 37: Subsurface Material along the Pipeline Routes

Line No	Total Length (m)	Length in Soil (m)	Length in Rock (m)
Line-1	30240	21168	9072
Line-2	28795	17277	11518

4.5 Capex Assumptions

The CAPEX cost estimates are based on primary information obtained for the geographical areas and latest inputs from suppliers and / or existing recent installations in existing CGDs. The overall cost estimates include the cost of equipment, piping, , land and site development etc.

The cost escalation is taken at 1.5% for capital items. However looking at the past trend, we do not foresee much escalation. In fact, with the kind of infrastructure requirement coming in the CGD sector we foresee a much better competitive market of CGD equipment suppliers thereby further reducing the cost.

Following are the prices of various CGD facilities:

CNG Stations:

a. Online CNG Station (1200 SCMH)

Table 38: Online CNG Station (1200 SCMH)

CNG	UoM	Amount
Major Items		
Compressor, 1200 SCMH Motor Driven	Rs. Cr	1.25
Cascades (4500 WL)	Rs. Cr	0.18
Average Dispensers	Rs. Cr	0.33
Other Electricals	Rs. Cr	0.31
Piping	Rs. Cr	0.14
Fire Fighting System	Rs. Cr	0.02
Canopy and Signage	Rs. Cr	0.250
Sub Total-Supply Cost	Rs. Cr	2.48
Erection	Rs. Cr	0.10
Civil	Rs. Cr	0.250
Land	Rs. Cr	0.29
TOTAL	Rs. Cr	3.12

b. Online CNG Station (650 SCMH)-at existing RO

Table 39: Online CNG Station (650 SCMH)

CNG	UoM	Amount
Major Items		
Compressor ,650 SCMH, Motor Driven	Rs. Cr	0.81
Cascades (4500 WL.)	Rs. Cr	0.18
Average Dispensers	Rs. Cr	0.33
Other Electricals	Rs. Cr	0.31
Pipings	Rs. Cr	0.09
Fire Fighting System	Rs. Cr	0.02
Sub Total - Supply Cost	Rs. Cr	1.74
Erection & Civil	Rs. Cr	0.23
TOTAL	Rs. Cr	1.97

c. CNG Station (450 SCMH)-DBS type

Table 40: CNG Station (450 SCMH)

CNG	UoM	Amount
Major Items		
Compressor(Ex-works)	Rs. Cr	0.38
Cascades (3000 lit.)	Rs. Cr	0.18
Average Dispensers	Rs. Cr	0.25
Other Electricals	Rs. Cr	0.31
Pipings	Rs. Cr	0.09
Fire Fighting System	Rs. Cr	0.02
Sub Total - Supply Cost	Rs. Cr	1.23
Erection & Civil	Rs. Cr	0.22
TOTAL	Rs. Cr	1.45

Steel Pipeline Network (with services)

Table 41: Steel Pipeline network

Steel Pipeline	Length (Km)	Unit Rate (Rs/Mtr) Material	Unit Rate (Rs/Mtr) Services	Total (Rs/Mtr)
Steel Grid -6", API 5L X 52, 3 LPE coated	30	2,765	2,213	4978
Steel Grid -4", API 5L X 52, 3 LPE coated	31.10	1,845	3,015	4860

**Higher due to higher HDD Portion*

MDPE Pipeline Network (with services)

Table 42: MDPE pipeline network

Steel Pipeline	Length(Km)	Unit Rate (Rs/Mtr) Material	Unit Rate (Rs/Mtr) Services	Total (Rs/Mtr)
125mm MDPE Pipeline, SDR 11	9	632	414	1046
90mm MDPE Pipeline, SDR 11	9	338	414	752
63mm MDPE Pipeline, SDR 11	27	176	414	590
32mm MDPE Pipeline, SDR 11	27	60	310	370
20mm MDPE Pipeline, SDR 11	18	58	310	368

4.6 Capital items required

On the basis of demand projections made in the previous chapters above, the City Gas network is planned and facility rollout is planned. The network is in tandem with the growth in natural gas demand. Following table provides the type wise list of facilities required in the GA for the next twenty five years. The no. of CNG stations are planned in line with the demand and growth in Natural Gas Vehicles in the GA. The compressor stations are planned in a way that the overall capacity utilization should not exceed the utilization factor of 50% beyond which CNG station will witness queuing of the vehicles for CNG fill and will discourage the CNG Conversions. DBS are planned according to the use of compressors' capacity and reach to various charge areas & demand centers. Also the DBS are planned to enhance the reach of CNG network and reduce the demand load on online stations. Online Compressors are being replaced at every 15 Years.

Table 43: Facility Roll-out Plan

Sr No	Item Description	Unit	Total Qty (25 Yr)	Total Qty(1st 8 Year)								Total 8 Yr
				Yr-1	Yr-2	Yr-3	Yr-4	Yr-5	Yr-6	Yr-7	Yr-8	
Bidar												
A. CGS												
1	Metering Skid/PRS	No	1	1								
2	Odourizing Unit	No	1	1								
B. CS pipeline												
1	6"	KM	30	2	5	6	6	3	3	3	3	30
2	4"	KM	31	5	12	1	13	0	0	0	0	31
C. CNG Station												
1	1200 SCMH, Motor Driven for MS	No	1	1	0	0	0	0	0	0	0	1
2	650 SCMH, Motor Driven for Online	No	6	1	2	0	0	0	0	0	0	3
3	450 SCMH, DBS	No	3	3	0	0	0	0	0	0	0	3
4	Cascade (4500 WL)	No	16	11	2	0	0	0	0	0	0	13
5	Dispenser Bus	No	7	2	2	0	0	0	0	0	0	4
6	Dispenser Car	No	24	12	6	0	0	0	0	0	0	18
D. DRS												
1	DRS, 2500 SCMH	No	2	0	1	0	0	0	0	0	0	1
2	DRS, 1000 SCMH	No	5	0	4	0	0	0	0	0	1	5
E.MDPE												

1	125mm MDPE Pipeline	KM	9	0	1	1	1	1	1	1	1	7
2	90mm MDPE Pipeline	KM	9	0	1	1	1	1	1	1	1	7
3	63mm MDPE Pipeline	KM	27	0	2	2	2	2	4	4	4	22
4	32mm MDPE Pipeline	KM	27	0	2	2	2	2	4	4	4	22
5	20mm MDPE Pipeline	KM	18	0	1	1	1	1	3	3	3	15

Capex Consolidated		1 Year	5 Year	8 Year	10 Year	15 Year	25 Year
Pipeline and CGS	Rs Cr.	17	75	93	94	96	101
CNG Regulated (Till Compressor D/S)	Rs Cr.	9	13	13	16	16	30
CNG unregulated (after Compressor D/S)	Rs Cr.	6	8	8	9	9	14
Total	**Rs Cr.**	**32**	**97**	**115**	**119**	**121**	**145**

4.7 Last Mile Connectivity charges (LMC)

LMC is estimated based upon the actual expense of connecting a household with PNG. LMC up to 15 meters of piping is to be provided by CGD entity and beyond that actual cost is recovered from the consumer. Following is the breakup of LMC Cost.

Table 44: last mile connectivity

Item	UOM	Qty.	Total Amount
LMC Cost	No.	01	Rs. 8500
Meter G 1.6	No.	01	Rs. 1000
Regulator 21mbar	No.	01	Rs. 310
Total			**Rs. 9810**

4.8 OPEX Estimate

OPEX is estimated based upon the Manpower required for the O&M activities. Organization development at all levels will be in tune with the expansion of the network. Philosophy for O&M will essentially have the following features:

- Leanness
- Uninterrupted supply of natural gas Customer satisfaction
- Technology development / absorption for safety, service reliability and cost effectiveness
- Outsourcing bulk of the activities
- Most equipment maintenance through maintenance contracts, preferably on Original Equipment Manufacturers (OEMs)
- Maximum leveraging of technology to minimize man-power and maximize efficiency.
- Compliance with regulatory stipulations, standards and codes of practices
- Indirect Costs like insurance and unaccounted gas loss

The cost escalation is taken at 7% for Manpower. This escalation is on a higher side as per the present scenario. However, with the kind of surge coming in the CGD sector we foresee a shortage skilled manpower thereby increasing the cost escalation.

Table 45: Opex Assumptions

Description	UOM	Quantity
Annual Cost per Executive	Rs. Cr	0.280
Annual Cost per Non-Executive	Rs. Cr	0.150
Annual Cost per Contract Manpower	Rs. Cr	0.040
Annual Cost per Steel Grid Line - Contract Manpower	Rs. Cr	0.040
Annual Cost per Domestic and Commercial Connection - Contract	Rs. Cr	0.040
Annual Cost per Industrial Connection - Contract Manpower	Rs. Cr	0.040

Annual Cost per Security Guard	Rs. Cr	0.020
Dealer commission on CNG sale	Rs per kg of CNG	1.80
Insurance for CGD	% of CGD cost	0.50%
Insurance for CNG	% of CNG cost	0.50%
Unaccounted gas loss in CGD	%	0.50%
Unaccounted gas loss in CNG	%	1.00%
Administration Charges – Network	% of manpower cost	15%
Overheads – Network	% of manpower cost	5%
Administration Charges - CNG	% of manpower cost	10%
Overheads – CNG	% of manpower cost	5%
O&M of CGD network	Rs./SCM	0.03
R&M Charges - Compressors	% of CNG capex	2%
Wet leasing-HCV	Rs. Lakh/ Month/ HCV	1.2

Table 46: Opex Estimates

Opex Consolidated		1 Year	5 Year	8 Year	10 Year	15 Year	25 Year
CGS,CGD	Rs Cr.	2.12	2.98	3.63	4.15	5.57	10.35
CNG opex	Rs Cr.	1.09	1.62	2.50	3.25	5.14	8.61
Total		**3.21**	**4.6**	**6.13**	**7.4**	**10.71**	**18.96**

5. Gas Sourcing and Pricing

5.1 Gas Sourcing

100 % APM gas has been considered for Household & CNG usage. Industrial & Commercial segment shall be served by market driven gas to be sourced by various upstream supplier including BPCL.

East-West Pipeline has been considered as trunk line for feeding the GA demand, entity may feed this pipeline from various entry points strategically located. Tap-off has been considered at Mannaekhalli village from East West Pipeline, operated by RGTIL located in District Bidar.

5.2 Govt. Commitment

The existing Govt. guidelines for allocation of controlled price gas to CGD for PNG domestic and CNG (Transport) is covered under reference no. L-16013/3/2012-GP-II Dt. August 20, 2014.

Further, the controlled price gas distribution under Govt. Guidelines is to be administered by GAIL (India) Ltd. vide Govt. letter to CMD GAIL under reference no. L-16013/3/2012-GP-II Dt. August 20, 2014.

The gas quantity to be made available to CGD entities is also covered in Govt. revised guidelines.

5.3 Gas Pricing Breakup

Table 47: Gas Pricing-Domestic Gas APM

Domestic Segment (Domestic Gas)		
Component	**Units/Rate**	
Basic Price **(Domestic Gas)**	$/ MMBTU	4.39
USD to INR	INR/USD	70
MMBTU to SCM	SCM/MMBTU	26.95
Price in INR/mmBtu	INR/MMBTU	307.16
Price in INR/SCM	INR/SCM	11.40
Marketing Margin	INR/SCM	0.31
Transportation Charges	INR/SCM	3.07

Subtotal	INR/SCM	14.78
GST	18.0%	2.66
Credit differentials	INR/SCM	2.66
Domestic Gas Cost	INR/ SCM	**14.78**
Domestic Gas Cost	INR/ kg	**19.63**

Table 48: Gas Pricing-RLNG-Non APM

Industrial and Commercial (RLNG)		
Component	**Units/Rate**	
Basic Price **(Spot RLNG)**	$/ MMBTU	8.75
Basic Customs Duty	$/ MMBTU	0.24
Price in INR	INR/MMBTU	629.34
GST on DES import	0.50%	3.06
Regasification charges	INR/MMBTU	48.62
GST on regasification charges	18%	8.75
Transportation charges	INR/MMBTU	82.86
GST on Transportation	12.00%	9.94
Subtotal	INR/ SCM	29.04
GST	18.0%	4.20
Credit differentials	INR/ SCM	5.01
RLNG Gas Cost	INR/ SCM	**28.73**
RLNG Gas Cost	INR/ kg	37.51

6. Project Cost and Means of Finance

6.1 Gas Selling Price

6.1.1 Domestic (PNG) Selling Price

In case of domestic segment the alternate fuel considered is subsidized domestic LPG. The PNG price for domestic segment is arrived after converting the cost of domestic LPG in INR/Kg into INR/SCM of Natural Gas basis on the basis of calorific value. The price of PNG is fixed at a discount to LPG price. The discount is kept fixed at 7.5%.

Table 49: Domestic Selling price

Particulars	Units	Y1	Y2	Y3	Y4	Y5
Equivalent natural gas price (imputed cost)	Rs./SCM	27.67	27.67	27.67	27.67	27.67
Basic fuel price	Rs./SCM	24.37	24.37	24.37	24.37	24.37
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	1.22	1.22	1.22	1.22	1.22
Discount/ (Premium) offered	%	7.50%	7.50%	7.50%	7.50%	7.50%
Final selling price	Rs./SCM	25.59	25.59	25.59	25.59	25.59

Particulars	Units	Y6	Y7	Y8	Y15	Y25
Equivalent natural gas price (imputed cost)	Rs./SCM	27.67	27.67	27.67	27.67	27.67
Basic fuel price	Rs./SCM	24.37	24.37	24.37	24.37	24.37
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	1.22	1.22	1.22	1.22	1.22
Discount/ (Premium) offered	%	7.50%	7.50%	7.50%	7.50%	7.50%
Final selling price	Rs./SCM	25.59	25.59	25.59	25.59	25.59

6.1.2 CNG Selling Price

In case of transport segment the CNG pricing is worked out in a way that the CNG is sold at a discount to the prevailing HSD price in order to drive the conversion of vehicles and realization of the projected

demand in transport. Marketing selling price of CNG is calculated based on discount over selling price of diesel (HSD).

Table 50: CNG selling price

Particulars	Units	Y1	Y2	Y3	Y4	Y5
Equivalent natural gas price (imputed cost)	Rs./SCM	61.76	61.76	61.76	61.76	61.76
Basic fuel price	Rs./SCM	30.16	30.16	30.16	30.16	30.16
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
Transportation Tariff for CNG	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	8.44	8.44	8.44	8.44	8.44
Discount/ (Premium) offered	%	37.50%	37.50%	37.50%	37.50%	37.50%
Final selling price	Rs./SCM	38.60	38.60	38.60	38.60	38.60
Final selling price	Rs./Kg	51.29	51.29	51.29	51.29	51.29

Particulars	Units	Y6	Y7	Y8	Y15	Y25
Equivalent natural gas price (imputed cost)	Rs./SCM	61.76	61.76	61.76	61.76	61.76
Basic fuel price	Rs./SCM	30.16	30.16	30.16	30.16	30.16
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
Transportation Tariff for CNG	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	8.44	8.44	8.44	8.44	8.44
Discount/ (Premium) offered	%	37.50%	37.50%	37.50%	37.50%	37.50%
Final selling price	Rs./SCM	38.60	38.60	38.60	38.60	38.60
Final selling price	Rs./Kg	51.29	51.29	51.29	51.29	51.29

6.1.3 Commercial PNG Selling Price

In case of commercial segment, the alternate fuel is commercial LPG that is sold at a market rate. PNG offers an advantage to commercial units as it is convenient to use and availability is there round the clock, unlike LPG cylinders that are subject to availability of LPG cylinders, pilferage and disruptions

at the time of changeover. The PNG commercial price is arrived considering a discount of 5% on commercial LPG on heat equivalent basis.

Table 51: Commercial PNG Selling Price

Particulars	Units	Y1	Y2	Y3	Y4	Y5
Equivalent natural gas price (imputed cost)	Rs./SCM	61.62	61.62	61.62	61.62	61.62
Basic fuel price	Rs./SCM	47.00	47.00	47.00	47.00	47.00
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	8.46	8.46	8.46	8.46	8.46
Discount/ (Premium) offered	%	10.00%	10.00%	10.00%	10.00%	10.00%
Final selling price	Rs./SCM	55.45	55.45	55.45	55.45	55.45

Particulars	Units	Y6	Y7	Y8	Y15	Y25
Equivalent natural gas price (imputed cost)	Rs./SCM	61.62	61.62	61.62	61.62	61.62
Basic fuel price	Rs./SCM	47.00	47.00	47.00	47.00	47.00
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	8.46	8.46	8.46	8.46	8.46
Discount/ (Premium) offered	%	10.00%	10.00%	10.00%	10.00%	10.00%
Final selling price	Rs./SCM	55.45	55.45	55.45	55.45	55.45

6.1.4 Industrial NG Selling Price

In industrial segment, Furnace Oil is sold as a bulk liquid fuel and is consumed by majority of industries. Furnace Oil pricing is entirely market driven and there is a lot of competition in Furnace Oil sales among the major Oil Marketing Companies. Thus, the gas is sold to industrial consumers at the equivalent natural gas price for first five year and 7th year onwards 10% premium is offered on the NG price.

Table 52: Industrial PNG Selling Price

Particulars	Units	Y1	Y2	Y3	Y4	Y5
Equivalent natural gas price (imputed cost)	Rs./SCM	43.19	43.19	43.19	43.19	43.19
Basic fuel price	Rs./SCM	36.60	36.60	36.60	36.60	36.60
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	6.59	6.59	6.59	6.59	6.59
Discount/ (Premium) offered	%	0.00%	0.00%	0.00%	0.00%	0.00%
Final selling price	Rs./SCM	43.19	43.19	43.19	43.19	43.19

Particulars	Units	Y6	Y7	Y8	Y15	Y25
Equivalent natural gas price (imputed cost)	Rs./SCM	43.19	43.19	43.19	43.19	43.19
Basic fuel price	Rs./SCM	36.60	38.43	38.43	38.43	38.43
Transportation Tariff for CGD	Rs./SCM	0.00	0.00	0.00	0.00	0.00
GST	Rs./SCM	6.59	6.92	6.92	6.92	6.92
Discount/ (Premium) offered	%	0.00%	-5.00%	-5.00%	-5.00%	-5.00%
Final selling price	Rs./SCM	43.19	45.35	45.35	45.35	45.35

6.2 Financial Analysis

The financial analysis of the Project has been carried out based on the capital cost and operating cost and the purchase price of gas delivered at the tap-off and finally to consumers of the gas for the Project. Profit & Loss statement, Cash Flow statement and Balance Sheet have been projected for the project life of 25 years.

6.3 Methodology of Financial Feasibility

The methodology for assessment of the financial feasibility of the CGD network in the geographical area has been presented below:

- Financials of city gas distribution have the following main features:
  - Capital employed over the project life (25 years)

- Operating and maintenance cost over the estimated life of the project
- Revenues from Sales of Gas in following sectors
  - ✓ Domestic
  - ✓ Commercial
  - ✓ Industrial
  - ✓ CNG
- City gas distribution is a capital intensive business coupled with a necessity for efficient management of all safety, operation and maintenance aspects
- Capital employed in a CGD network covers feeder pipeline(s) if any, city gate station(s), gas distribution pipelines (steel and PE), district regulating station(s), distribution related equipment/facilities (for determination of network tariff) and on-line compressor together with associated metering, power standby/backup and fire-fighting equipment (for determination of Compression Charge). These assets are called 'regulated assets'.
- Investments in setting up CNG stations, which include cost of land, cascades (stationary and mobile), dispensers, instrumentation and control, power generation / back-up, civil structures, electrical installations and other miscellaneous facilities are considered as un-regulated assets
- Operation and maintenance cost of these assets are computed for the assets and includes consumables, utilities (power, fuel and water), salaries and wages, repair and maintenance, insurance premium on fixed assets and administrative overheads (commensurate with the level of operation in the CGD network)
- The business returns: Project IRR (PIRR) and Equity IRR (EIRR) are computed separately considering overall capital investment in the City Gas Project and O&M cost
- It has been assumed that supply to the geographical area would come from two sources:

- ✓ Domestic sources for CNG and domestic consumers
- ✓ RLNG for industrial and commercial consumers

6.4 Financial Statements

6.4.1 Cash Flow Statement

The Projected Cash flow statement Account for the Integrated Business Segment is tabulated below:

Table 53: Cash Flow Statement

Cash Flow	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y15	Y25
Cash from Operations										
PAT	0.00	-3.34	2.11	3.05	4.93	1.39	6.58	8.11	19.37	25.95
Security Deposit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	0.00	2.79	2.75	3.35	3.93	4.23	4.45	4.69	5.11	5.08
GST Credit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Deferred Tax	0.00	-1.91	-5.44	-4.77	-4.56	-3.73	-4.24	-1.88	0.60	1.06
Sub Total	**0.00**	**-2.46**	**-0.58**	**1.62**	**4.29**	**1.88**	**6.79**	**10.92**	**25.08**	**32.09**
Cash from Financing										
Increase in Equity	13.52	7.46	3.23	6.53	3.09	0.00	0.00	0.00	0.00	0.00
Increase in Term Loan	18.45	16.31	7.06	14.26	6.74	0.00	0.00	0.00	0.00	0.00
Bank Funding of Working Capital	0.00	0.21	0.11	0.13	0.15	0.19	0.31	0.26	0.04	-0.13
Sub Total	**31.96**	**23.98**	**10.40**	**20.91**	**9.98**	**0.19**	**0.31**	**0.26**	**0.04**	**-0.13**
Cash from Investments										
Income from Investment Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total Sources of Funds	**31.96**	**21.51**	**9.82**	**22.53**	**14.27**	**2.07**	**7.10**	**11.18**	**25.12**	**31.96**

6.4.2 Profit and Loss Account

The Projected P&L Account for the Integrated Business Segment are tabulated below:

Table 54: Profit and Loss Account

Profit and Loss Account	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y15	Y25
Revenues										
Revenues from Gas Sales - PNG	0.00	2.31	7.29	13.08	19.76	27.57	37.36	47.90	81.53	134.50
Revenues from Gas Sales - CNG	0.00	0.39	1.44	3.01	5.11	7.75	10.93	14.66	40.72	66.29
Revenue from Transportation Tariff for CGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Revenue from Transportation Tariff for CNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Security Deposit from Customer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Registration Fees	0.00	0.06	0.07	0.07	0.08	0.14	0.14	0.15	0.02	0.01
Less: UAG CNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Revenues	0.00	0.04	0.07	0.11	0.15	0.22	0.30	0.37	0.41	0.46
Total Revenues	**0.00**	**2.80**	**8.88**	**16.28**	**25.09**	**35.68**	**48.73**	**63.08**	**122.68**	**201.26**
Expenses										
Gas Purchase Cost - PNG	0.00	1.56	4.95	8.91	13.50	18.88	24.38	31.36	55.56	101.00
Gas Purchase Cost - CNG	0.00	0.20	0.72	1.50	2.54	3.85	5.43	7.29	20.25	32.97
Cost on Account of Pipeline Network	0.00	2.27	2.46	2.77	2.98	3.19	3.40	3.63	5.57	10.35

Cost on Account of Compression	0.00	1.22	1.30	1.44	1.62	1.86	2.15	2.50	5.14	8.61
Total Expenses	**0.00**	**5.24**	**9.44**	**14.62**	**20.65**	**27.78**	**35.36**	**44.78**	**86.52**	**152.92**
PBDIT	**0.00**	**-2.44**	**-0.55**	**1.66**	**4.45**	**7.89**	**13.37**	**18.30**	**36.16**	**48.34**
Depreciation	0.00	2.79	2.75	3.35	3.93	4.23	4.45	4.69	5.11	5.08
PBIT	**0.00**	**-5.23**	**-3.31**	**-1.69**	**0.52**	**3.67**	**8.92**	**13.62**	**31.05**	**43.26**
Interest Expense										
Interest on Term Loan	0.00	0.00	0.00	0.00	0.00	5.95	5.84	5.55	0.86	0.00
Interest on Working Capital	0.00	0.02	0.03	0.04	0.05	0.07	0.10	0.12	0.16	0.11
Total Interest Expense	**0.00**	**0.02**	**0.03**	**0.04**	**0.05**	**6.02**	**5.94**	**5.67**	**1.02**	**0.11**
PBT	**0.00**	**-5.25**	**-3.34**	**-1.73**	**0.47**	**-2.35**	**2.98**	**7.94**	**30.04**	**43.15**
Taxation										
Net Current Tax Liability	0.00	0.00	0.00	0.00	0.10	0.00	0.64	1.71	10.07	16.14
Deferred Tax Liability	0.00	-1.91	-5.44	-4.77	-4.56	-3.73	-4.24	-1.88	0.60	1.06
Total Taxation Expense	**0.00**	**-1.91**	**-5.44**	**-4.77**	**-4.46**	**-3.73**	**-3.60**	**-0.17**	**10.67**	**17.20**
Year	1	2	3	4	5	6	7	8	15	25
PAT	0.00	-3.34	2.11	3.05	4.93	1.39	6.58	8.11	19.37	25.95
PAT Margin	0.00%	(119.27)%	23.70%	18.72%	19.65%	3.89%	13.50%	12.86%	15.79%	12.90%

6.4.3 Balance Sheet Statement

The Projected Balance Sheet Statement for the Integrated Business Segment are tabulated below:

Table 55: Balance Sheet Statement

Balance Sheet	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y15	Y25
Assets										
Fixed Assets										
Gross Fixed Assets	31.96	55.73	66.03	86.81	96.64	102.50	108.49	115.00	121.02	145.48
(Less): Accumulated Depreciation	0.00	2.79	5.54	8.89	12.82	17.04	21.49	26.18	61.31	110.72
Net Block	**31.96**	**52.94**	**60.48**	**77.92**	**83.83**	**85.46**	**87.00**	**88.83**	**59.71**	**34.77**
Current Assets										
Receivables	0.00	0.35	0.78	1.30	1.91	2.66	3.55	4.54	7.98	12.25
Payables	0.26	0.43	0.78	1.20	1.70	2.28	2.91	3.68	7.11	12.57
Free Cash Balances (from Cash Flow)	0.26	-2.18	-2.74	-1.08	3.24	-1.33	-2.37	-2.95	74.10	352.97
Total Current Assets	**-0.00**	**-2.26**	**-2.73**	**-0.98**	**3.46**	**-0.95**	**-1.73**	**-2.09**	**74.97**	**352.65**
Total Assets	**31.96**	**50.69**	**57.75**	**76.94**	**87.29**	**84.51**	**85.27**	**86.74**	**134.68**	**387.42**
Liabilities										
Shareholders Fund										
Equity	13.52	20.98	24.21	30.74	33.82	33.82	33.82	33.82	33.82	33.82
Reserves	0.00	-3.34	-1.23	1.81	6.74	8.13	14.71	22.82	112.45	359.25
Total Shareholders Fund	**13.52**	**17.64**	**22.98**	**32.55**	**40.57**	**41.95**	**48.53**	**56.65**	**146.28**	**393.07**

Long Term Liabilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long Term Debt	18.45	34.75	41.81	56.07	62.82	62.19	60.30	55.28	0.00	0.00
Current Liabilities										
Working Capital Facility	0.00	0.21	0.32	0.44	0.60	0.79	1.10	1.36	1.75	1.24
Deferred Tax Liability	0.00	(1.91)	(7.35)	(12.13)	(16.69)	(20.42)	(24.66)	(26.55)	(13.35)	(6.89)
Total Current Liabilities	**0.00**	**(1.70)**	**(7.04)**	**(11.68)**	**(16.09)**	**(19.63)**	**(23.57)**	**(25.19)**	**(11.59)**	**(5.65)**
Total Liabilities	**31.96**	**50.69**	**57.75**	**76.94**	**87.29**	**84.51**	**85.27**	**86.74**	**134.68**	**387.42**

6.5Key Financial Indicators

Table 56: Project IRR and Equity IRR

Particulars	Value
Project IRR	**13.59%**
Equity IRR	**16.80%**
NPV	**12**
Avg DSCR	**1.93**

7. ENVIRONMENTAL ASPECTS

7.1 Environment

Distribution pipeline construction impacts greatly depend on the location of proposed pipeline installation. In already developed urban areas, environmental impacts are considerably different than in suburban or mixed use areas. Common impacts may include noise and vibration caused by the operation of earth moving and excavation equipment, and materials transport and delivery; dust emissions generated by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind; mobile emissions from exhaust of diesel engines for earth moving equipment; and hazardous materials and waste handling and fueling activities. In newly developed areas, impacts may also include soil erosion resulting from excavated areas prior to the re-establishment of vegetation. In urban areas, impacts may include noise, traffic interruption, disposal of contaminated soil, and presence of archeological artifacts.

Environmental issues that may occur during gas distribution projects include the following:

- Habitat Alteration
- Air Emissions

7.1.1 Habitat Alteration

Habitat alteration is only considered a relevant potential impact during construction of gas distribution pipeline systems in newly developed rural or urban areas. These impacts may be associated with excavation, trenching, pipe laying, backfilling, and establishment of infrastructure such as regulating stations. This may create temporary or permanent terrestrial habitat alteration depending on the characteristics of existing vegetation and topographic features along the proposed right of way. Depending on the level of existing urbanization in the proposed project area, habitat alteration from these activities for example, may include landscape fragmentation; loss of wildlife habitat, including trees for nesting; and establishment of non-native invasive plant species. In addition, construction of distribution pipelines crossing aquatic habitats may disrupt water courses and wetlands, and require the removal of riparian vegetation. Sediment and erosion from construction activities and storm water runoff may increase turbidity of surface water courses. To prevent and control impacts to terrestrial habitats,

distribution pipeline rights-of-way and regulating stations should be sited to avoid critical habitat through use of existing utility and transport corridors, whenever possible. Use of guided / directional drilling for distribution pipeline installation should be considered where feasible to reduce impacts to both terrestrial and aquatic habitats.

7.1.2 Air Emissions

Gas distribution systems may generate gas leaks as a result of normal operations, equipment venting for maintenance, and aging. Gas leakage, principally consisting of methane (CH4), a greenhouse gas, may result from corrosion & degradation of pipelines and related components over time and fugitive emissions from pipelines and regulating stations. Recommended measures to prevent and control air emissions due to leaks include:

- Gas pipelines and pipeline components, in addition to general installation and pipe joining techniques such as welding, should meet international standards for structural integrity and operational performance;
- Corrosion prevention of buried ferrous metal pipelines should be undertaken using coating or cathodic protection techniques.
- Testing of pipelines and pipeline components for pressure specifications and presence of leaks should be undertaken prior to commissioning. The system should be gas tight when tested at a higher pressure than the normal maximum operation gas pressure;
- Leak and corrosion detection programs should be undertaken, including use of appropriate leak detection assessment techniques and equipment. Maintenance programs to repair and replace infrastructure should be undertaken as indicated by detection results. Areas of gas infrastructure subject to forces from heavy load traffic or physical land shifts should also be periodically monitored for leaks and ruptures;
- Comparisons of purchased and delivered gas amounts should be periodically examined for discrepancies and unaccounted gas .This may give an indication of quantum of system leakage;

- Regulating and CNG stations contain equipment (e.g. safety valves, filters) that may emit fugitive emissions of gas. Pipelines, valves, and other component infrastructure should be regularly maintained, and ventilation and gas detection / alarm equipment should be installed in station buildings.

7.2 Performance Indicators and Monitoring

7.2.1 Occupational Health and Safety

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV), occupational exposure guidelines and Biological Exposure Indices (BEIs) published by American Conference of Governmental Industrial Hygienists (ACGIH), the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOHS), Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA), Indicative Occupational Exposure Limit Values published by European Union member states, or other similar sources.

7.2.2 Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Fatality rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources.

7.2.3 Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents.

7.2.4 Environment

7.2.5 Emissions and Effluent

Although there are no significant point source emissions or effluents for gas distribution sector, fugitive emissions (from city gate and CNG stations, underground piping, and third party damage) from gas distribution systems constitute a significant portion of the overall atmospheric losses from the natural gas transmission and distribution industry. Gas distribution system operators should conduct volume reconciliation programs as an indicator of leakages by comparing delivered gas amounts against sales to customers. Operators should also implement inspection and maintenance programs to maintain and upgrade infrastructure and minimize fugitive gas emissions.

7.2.6 Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

8. DISASTER MANAGEMENT PLAN

8.1 Emergency Response and Disaster Management Plan

General

An emergency / disaster situation may arise during the construction and / or operating phase of city gas distribution network. Besides taking steps to prevent occurrence of any emergency or disaster, it is essential to have in place an effective emergency and disaster management plan. It must be capable to safely attend to any supply or distribution emergency that could arise from the first day of network commissioning. It serves as a guide at the time of emergency to help all concerned to handle the same as quickly as possible in order to prevent or reduce suffering of consumers as well as injury to persons and / or damage to property & equipment of the company.

Emergency Response and Disaster management plan (ERDMP) is a planned, coordinated, comprehensive response to contain loss of life, property, service and environment and provide speedy and effective recovery by making the proper use of available resources should a disaster occur. Disaster management plans are established at the national level as well at each state and district levels. The disaster management plan of company should integrate with those plans as well. The agencies concerned with disaster management include municipalities, district collectorate, police, fire stations, hospitals etc.

Terminology

"Disaster" is a situation in which normal life in an industrial complex is suddenly disrupted and in certain cases affecting the neighborhood seriously as well. The people may be plunged in helplessness and suffering and may need food, clothing, shelter, medical aid and other sustaining requirements.

"Emergency" is a situation having potential to cause serious danger to persons, environment or damage to property. It may cause disruption inside and / or outside the premises and may require the help of outside resources.

"Incident" is an unplanned or unintended event having potential to cause damage to life, property and environment.

"Mutual aid industries" is a group of industries in an area, city or district which mutually agree to pool their resources to respond to an emergency / disaster in any of the member industry.

"Installation" includes, City Gas Distribution facilities and CNG stations "Hazard" means an event with a potential for human injury, damage to property, damage to the environment, or some combination thereof "On Site Emergency" means an emergency that takes place in an installation and the effects are confined to its premise's involving only the people working there.

"Off Site emergency" is an event that takes place in an installation but its effects extend beyond the premises, or it is the emergency created due to an accident, catastrophic incident, natural calamity, etc. On site / Off site no longer remains the concern of the installation management alone. It also becomes a concern for the general public living outside. It will be the responsibility of district administration to deal with such eventualities.

Objective of Plan

The main objectives of the plan are to take immediate actions to meet any emergency situation by making maximum use of combined resources for the most effective, speedy and efficient rescue and relief operations. The steps required to be taken are briefly enumerated below:

a) Cordon and isolate the affected area for smooth rescue operations,

b) Rescue and treat causalities and safeguard the rest,

c) Minimize damage to person, property and surroundings,

d) Contain and ultimately bring the situation under control,

e) Secure a safe rehabilitation of the affected area,

f) Ensure restoration of gas supply/services at the earliest possible time,

g) Provide necessary information to statutory agencies,

h) Provide Authoritative information to the news media,

i) Ward off anti-social elements and prying onlookers,

j) Counter rumor mongering and panic by providing relevant accurate information,

k) Protect the Company from adverse publicity.

Classifications of Emergency

Emergencies are categorized into three broad levels, on the basis of seriousness and response requirements;

Level 1: This is an emergency or an incident which:

i. can be effectively and safely managed, and contained within the site, location or installation by the available resources

ii. has no impact outside the site, location or installation

iii. Is unlikely to be danger to life, the environment or to company assets or reputation

Level 2: This is an emergency or an incident which:

i. cannot be effectively and safely managed or contained at the site, location or installation by available resource, and additional support is required

ii. is having, or has the potential to have an effect beyond the site, location or installation and where external support of mutual aid partner(s) may be required iii. is likely to be danger to life, the environment, company assets or reputation

Level 3: This is an emergency or an incident which:

i. is catastrophic and is likely to affect the population, property and environment inside and outside the installation. Management & control of such emergency is done by District Administration.

ii. Although the level-3 emergency falls under the purview of District Authority but till they step in, it shall be responsibility of the company to manage the emergency.

Note: Level-1 & Level-2 shall normally be grouped as on-site emergency and Level- 3 as off-site emergency.

Near Miss emergency is that which could possibly would have happened but prevented by some last minute action or providence.

Pre Emergency Planning

Potential on-site hazard of CGD network include occasional leaks, and explosions. In the individual houses and small businesses, internal leaks may cause low intensity explosions with some damage to the structures and minor to moderate injuries to people inside. Deadly explosions may occur if significant amount of gas collects inside. Considering that millions of structures use gas, individual risk of using gas is very low. Natural gas heating systems are known to cause carbon monoxide deaths. When such system malfunctions, it produces carbon monoxide. With no fumes or smoke to give a warning, people inside get asphyxiated. Carbon monoxide detectors can prevent such occurrences.

Usually gas dissipates readily outdoors being lighter than air. Sometimes, however, it may collect in dangerous quantities if "weather conditions are right for such accumulation.

World over, common threat to integrity of the CGD network is the accidental damage caused by third parties excavating in the vicinity of underground gas facilities. Such risk may attain intolerable level in case the damage is substantial.

Emergency Mitigation Measures

Basic Requirements of ERDMP These Include:

i. Layout plan of CGD network showing location of all-important equipment together with neighboring details up to a distance of 2 kms from the network in each direction.

ii. Site plan of the City Gate Station showing a complete layout of the installation indicating boundary walls, exit & entry gates and location of various facilities.

iii. Layout of Fire Water Systems and Fire Fighting Equipment details.

iv. Material Safety Data Sheet (MSDS) for all hazardous chemicals stored, handled, in the installation.

v. Internal and External Emergency contact numbers and addresses of Police, Fire Station, Hospitals, Mutual Aid Industry, Factory Inspector, PNGRB, State Pollution Control

Board, **Petroleum and Explosives Safety Organisation** (PESO), etc.

vi. Pipeline route map and details of various facilities such as District Regulating Station, Metering and Pressure regulating stations, CNG stations

vii. Addresses and Telephone numbers of Technical Support Services such as Environmental Laboratories, Fire Fighting Chemical suppliers, Public and Private Consultant associated with emergency handling.

Resource Mobilisation

Resources include manpower, fire fighting appliances or equipment, safety equipment, communication facilities , transport, emergency drugs and appliances. Information regarding the resources required and the availability of the same shall be prepared.

Incident Prevention Measures and Procedures

i. Health, safety and environment system policy and procedures shall be in place.

ii. Safety committee of the company will conduct / organize safety audits and inspections.

iii. System of work permits to the authorized personnel will be instituted.

iv. Early warning alarm systems would be monitored.

v. Fire fighting system and equipment would be in place.

vi. Regular meetings of safety committee, comprising representatives of management and staff, would review availability and adherence to HSE policy / procedures, performance of protection devices, action taken on deficiencies and shortcomings noted including those noted during the mock emergency response drills.

Emergency Preparedness Measures

Emergency Drills & Mock Exercises will be held, simulating variety of emergency scenarios to check preparedness of:

- All stakeholders to perform tasks as detailed in the ERDMP
- Warning system
- First aid,
- Evacuation procedures,
- Definitive treatment procedures
- Preparedness of outside groups such as police, fire brigade, ambulance service,

Detailed Feasibility Report for Vadodara.

Infrastructure

Emergency Control Centres (ECC)

Main Control Room located at the City Gate Station will serve as Emergency Control Center. It will be manned round the clock. Customer Care Center located in the City office, will serve as back up ECC.

Features of ECC:

(a) The ECC shall be away from potential hazards and provide maximum safety to personnel and equipment.

(b) The ECC building would be non-combustible of either steel frame or reinforced concrete construction.

(c) The ECC will have at least two exits and adequate ventilation

Following basic supplies and dedicated equipment would be made available at the ECC.

(a) A copy of the ERDMP.

(b) Maps and diagrams showing buildings, roads, underground fire mains, important hazardous material and process lines, drainage trenches, and utilities such as steam, water, natural gas and electricity.

(c) Aerial photographs, if possible and Maps showing the site, adjacent industries, the surrounding community, high-ways, rivers, etc., to determine how the disaster may affect the community, to notify concerned people, establish adequate road blocks, and advise the civil authorities.

(d) Names, addresses, and telephone numbers of employees.

(e) Updated list of names, addresses, and Telephone numbers of off-site groups and organizations that might have to be contacted.

f) Dedicated and reliable communications equipment including enough telephones and one fax line, two-way radio equipment to maintain continuity of communications when other means fail to keep in contact with field activities.

(h) Facilities for recording the sequence of events such as a pan board, logbook, a tape recorder with a person assigned to record pertinent information. Dedicated Computer with LAN / Internet Facility to access the installation data with the latest and updated soft copies of all Standard Operating Practices (SOP) etc. to be provided.

Siren Codes

The Emergency siren/s should be located suitably to cover the affected area with the operational control within the installation. These would be tested at least once in a week to keep them in working condition.

Emergency siren code should be as follows:

(a) Emergency Level – 1 & 2: A wailing siren for two minutes.

(b) Emergency Level-3 : Same type of siren as in case of Level – 1 & 2 but the same will be sounded for three times at the interval of one minutes i.e.(wailing siren 2min + gap 1 min + wailing siren 2min + gap 1min + wailing siren 2 min) Total duration of Disaster siren will be eight minutes.

(c) ALL CLEAR: Straight run siren for two minutes.

(d) TEST: Straight run siren for two minutes at frequency of at least once a week "One Call" Contact System shall establish a "One Call" telephone number at the commencement of operations. An easily remembered "Free" number should be widely advertised as the "call before you dig" This number should be used by any one wanting to

contact the gas company to report a suspected gas leak, gas escape, service difficulty, or when making a safety inquiry. All construction companies and public authorities should use this facility when making inquiries about the location of gas mains and buried apparatus, which may be present near any proposed construction site.

Emergency Organisation and Responsibilities (ERO):

It will establish an Emergency Response Organization with well defined roles and responsibilities. Various positions in the ERO will be manned by the identified manager / engineer / officer / technician of the city gas distribution organization.

Role and responsibility of various stakeholders including External Agencies such as District Authority, Police, Fire Service, Revenue Department, Health Department, Pollution Control Board, National Disaster Response Force (NDRF) and State Disaster Response Force (SDRF).

These roles & responsibilities are generally in line with National Disaster Management Guidelines on Chemical Disasters, April, 2007, brought out by National Disaster Management Authority.

Reporting of the Incident

a) All incidents covered under Level-1 and Level-2, as also near miss incidents, shall be reported to PNGRB. The above report is to be submitted within 48 hours after occurrence of the incidents.

b) Investigation report of all Major incidents shall be submitted to PNGRB. An incident shall be treated as Major if any of the following occurs;

(a) Fire for more than 15 minutes

(b) Explosion / Blowout

(c) Fatal Incident.

(d) Loss above Rs.10.0 Lac.

(e) Cumulative man hours lost more than 500 hrs. (f) Plant Shutdown / Outage due to the incident

Action after Reporting Of Incident By The Entity

After reporting of the incidents to PNGRB, Nodal officer of PNGRB (head of Technical Standards the specifications and Safety Group) shall have responsibility of informing all the Members of the Board and shall coordinate with appropriate level of National Disaster Management Authority (NDMA) until normalization of the situation.

Termination of Emergency

a) Termination activities should concentrate on giving accurate information to people who need it most..

Recovery Procedures

After the emergency, the following activities will be carried out in detail. Supply of gas will be restored first to domestic sector followed by hospitals and automobile sectors

(a) Information to Statutory Authorities.

(b) Incident Investigation.

(c) Damage Assessment.

(d) Salvage of products, de-contamination, clean-up and Restoration

9. HEALTH AND SAFETY ENVIRONMENT

9.1 General

The Health, Safety and Environment (HSE) are technical reference documents with general and industry specific. These HSE are applied as required by their respective policies and standards. The industry sector HSE are designed to be used together with the General HSE document, which provides guidance to users on common HSE issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary.

The HSE contain the performance levels and measures that are generally considered achievable in new facilities by existing technology at reasonable costs. Application of the HSE to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the HSE should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, assimilative capacity of the environment and other project factors are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When the country regulations differ from the levels and measures presented in the HSE, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these HSE are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human Health, Safety and Environment. This section provides a summary of HSE issues associated with gas distribution systems that occur during the construction and operations phases, along with recommendations for their management. Recommendations for the management of HSE issues common to most large industrial facilities during the decommissioning phase are provided in the General HSE.

Occupational Health and Safety

Occupational health and safety (OHS) issues in the construction phase include potential exposures to dust, noise, physical strain, and trenching excavation hazards. Recommendations for the management of construction phase hazards are addressed in more detail in the General HSE. Occupational health and

safety hazards associated with the construction and operation of gas distribution systems may also include:

• Occupational exposure to gas leaks and explosions

• Confined spaces

• Electrocution

Additional recommendations for operational phase OHS issues also applicable to gas distribution activities are also addressed in the General HSE.

Occupational exposure to gas leaks and explosions

Excavation, construction, and repair of gas distribution systems may result in accidental pipeline rupture or leakage and consequent exposure of workers to harmful gases and an explosive gas atmosphere. In addition, excavation by non-gas utility personnel may result in accidental ruptures and exposure of untrained workers to explosion hazards. Recommended techniques to prevent and control exposure to gases and explosive atmospheres caused by accidental gas line ruptures and / or leaks include:

• Training of employees and contractor personnel in safety procedures, together with provision of appropriate tools and equipment;

• Identification and location of existing gas and other buried utility infrastructure prior to excavation for installation or repair of gas pipelines. Installation of visual marking of gas lines as part of installation, and updating as necessary on an ongoing basis;

• Removal of sources of ignition prior to gas venting for maintenance and repair activities.

Purging of gas from pipeline or pipe components prior to welding or cutting activities;

• Installation of gas lines and components using sufficient separation distance and appropriate pipe protection layering to minimize potential interference with other underground infrastructures. Separation of plastic pipes from sources of heat;

• Odorization of gas to facilitate detection of gas leakage;

• Training of gas utility workers in procedures for emergency preparedness and response involving appropriate public authorities, in addition to emergency shutdown and pressure reduction in the pipeline system. Further recommendations for emergency preparedness and response are addressed in the General HSE.

Confined spaces

Accumulation of natural gas in a confined space is a potentially fatal condition. Entry by workers into confined spaces and the associated potential for accidents may vary among gas distribution project phases and facilities. Specific and unique areas for confined space entry may include excavation trenches during construction and regulating stations and vaults, both above and below ground which may also contain equipment (e.g. safety valves, filters) that may cause fugitive emissions of gas and create a potential for oxygen deficient and explosive atmospheres. Gas distribution companies should develop and implement confined space entry procedures as described in the General HSE which includes the following:

• Requiring work permits for all confined space entries;

• Installation of appropriate access controls for unauthorized personnel including signage to alert workers to the hazards of confined spaces;

• Use of ventilation and oxygen / explosive level detection and alarm equipment prior to access.

Electrocution

Excavation, construction, and repair of Gas Distribution Systems may result in workers' exposure to existing aboveground or underground utilities, including aerial or buried electric transmission lines. Identification and location of all relevant existing underground utilities should be undertaken prior to any construction and excavation activities.

Community Health and Safety

Community health and safety hazards associated with the construction and operation of gas distribution systems include public exposure to gas leaks and explosions. Additional recommendations for community health and safety issues common to most industry sectors are addressed in the General HSE

Public Exposure to Gas Leaks and Explosions

The presence of gas distribution systems within populated areas may expose the public to hazards from gas leaks and explosions. Gas leakage may result from accidental rupture of pipelines during installation and repair or from contact during excavation unrelated to the gas distribution system. Gas utility operators should inform and advise affected communities, schools, businesses / commercial facilities, and residents about the potential hazards presented by gas infrastructure. Gas distribution system operators should establish an emergency preparedness and response plan and communicate this plan to the public as necessary.

As part of the plan, gas system operators should implement a telephone notification system to respond to reports of leaks or questions of general safety from the affected community and other interested parties. Operators should also provide a pipe location service to assist outside contractors and the general public to determine the location of gas infrastructure prior to construction works proximate to gas pipelines. Improper operation of natural gas fueled appliances and equipment may expose the user and the public to gas leakage and explosion hazards. Gas distribution system operators should make information available to customers (e.g. through flyers and internet-based information) regarding the safe operation of gas fueled appliances and equipment. This information should address issues of proper and safe use of gas-fired appliances, which in the case of residential use, may include the following issues:

Proper location, installation, and maintenance of appliances and equipment such as natural gas fired heating units. For example, installation in areas with adequate ventilation to ensure dispersion of residual carbon monoxide. Poor combustion in a natural gas fired appliance or piece of equipment may expose the user and the public to carbon monoxide exposure, especially in confined spaces;

Recognition of potential hazards or operating problems.

For example, recognition of the hazards of poor ventilation or identification of gas surges requiring action by the gas utility operators (identifiable when flame color in natural gas burning appliances is orange or yellow rather than blue), and how to respond to possible accumulation of gas vapors when odor is detected and instructions on proper response procedures. These procedures may include avoiding

sources of ignition (e.g. electrical switches, lighters), ventilating area of gas accumulation, and calling the emergency contact number of the local gas utility from a safe location.

Environment

Distribution pipeline construction impacts greatly depend on the location of proposed pipeline installation. In already developed urban areas, environmental impacts are considerably different than in suburban or mixed use areas. Common impacts may include noise and vibration caused by the operation of earth moving and excavation equipment, and materials transport and delivery; dust emissions generated by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind; mobile emissions from exhaust of diesel engines for earth moving equipment; and hazardous materials and waste handling, including oil spills associated with heavy equipment operation and fueling activities. In newly developed areas, impacts may also include soil erosion resulting from excavated areas prior to the re-establishment of vegetation. In urban areas, impacts may include noise, traffic interruption, disposal of contaminated soil, and presence of archeological artifacts.

Recommendations for prevention and control of construction related impacts are addressed in the General HSE.

Environmental issues that may occur during gas distribution projects include the following:

- Habitat Alteration
- Air Emissions

Habitat Alteration

Habitat alteration is only considered a relevant potential impact during construction of gas distribution pipeline systems in newly developed rural or urban areas. These impacts may be associated with excavation, trenching, pipe laying, backfilling, and establishment of infrastructure such as regulating stations. This may create temporary or permanent terrestrial habitat alteration depending on the characteristics of existing vegetation and topographic features along the proposed right of way. The potential for impacts depends on the level of existing development, and will likely be less of an issue in

urbanized areas or along existing utility rights-of-way corridors. Depending on the level of existing urbanization in the proposed project area, habitat alteration from these activities for example, may include landscape fragmentation; loss of wildlife habitat, including trees for nesting; and establishment of non-native invasive plant species. In addition, construction of distribution pipelines crossing aquatic habitats may disrupt water courses and wetlands, and require the removal of riparian vegetation. Sediment and erosion from construction activities and storm water runoff may increase turbidity of surface water courses. To prevent and control impacts to terrestrial habitats, distribution pipeline rights-of-way and regulating stations should be sited to avoid critical habitat through use of existing utility and transport corridors, whenever possible. To prevent and control impacts to aquatic habitats, distribution pipeline rights-of-way should be sited to avoid critical aquatic habitat such as watercourses, wetlands, and riparian areas, as well as fish spawning habitat, and critical fish over-wintering habitat, whenever possible. Use of guided /directional drilling for distribution pipeline installation should be considered where feasible to reduce impacts to both terrestrial and aquatic habitats.

Air Emissions

- Gas distribution systems may generate gas leaks as a result of normal operations, equipment venting for maintenance, and aging. Gas leakage, principally consisting of methane (CH4), a greenhouse gas, may result from corrosion & degradation of pipelines and related components over time and fugitive emissions from pipelines and regulating stations. Recommended measures to prevent and control air emissions due to leaks include:

- Gas pipelines and pipeline components, in addition to general installation and pipe joining techniques such as welding, should meet international standards for structural integrity and operational performance;

- Corrosion prevention of buried ferrous metal pipelines should be undertaken using coating or cathodic protection techniques. For underground applications, the use of polyethylene pipes, which is not subject to corrosion, should be considered as an alternative to ferrous metal pipeline materials;

- Testing of pipelines and pipeline components for pressure specifications and presence of leaks should be undertaken prior to commissioning. The system should be gas tight when tested at a higher pressure than the normal maximum operation gas pressure;

- Leak and corrosion detection programs should be undertaken, including use of appropriate leak detection assessment techniques and equipment. Maintenance programs to repair and replace infrastructure should be undertaken as indicated by detection results. Typical urban testing sites include atmospheres in confined spaces of utility infrastructure (e.g. sewer and water system manholes), as well as at openings in pavement and on streets and walkways. Areas of gas infrastructure subject to forces from heavy load traffic or physical land shifts should also be periodically monitored for leaks and ruptures;

- Comparisons of purchased and delivered gas amounts should be periodically examined for discrepancies and unaccounted for gas which may be an indicator of excessive system leakage;

- Regulating stations and vaults, both above and below ground, may contain equipment (e.g. safety valves, filters) that may emit fugitive emissions of gas. Pipelines, valves, and other component infrastructure should be regularly maintained, and ventilation and gas detection / alarm equipment should be installed in station buildings or vault

Performance Indicator and Monitoring

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV), occupational exposure guidelines and Biological Exposure Indices (BEIs) published by American Conference of Governmental Industrial Hygienists (ACGIH), the Pocket Guide to Chemical Hazards published by the United States

National Institute for Occupational Health and Safety (NIOHS), Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA), Indicative Occupational Exposure Limit Values published by European Union member states,

or other similar sources.

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources.

Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the General HSE.

Emissions and Effluent

Although there are no significant point source emissions or effluents for the gas distribution sector, fugitive emissions (from city gate and regulating stations, underground piping, and third party damage) from gas distribution systems constitute a significant portion of the overall atmospheric losses from the natural gas transmission and distribution industry. Gas distribution system operators should conduct volume reconciliation programs as an indicator of leakages by comparing delivered gas amounts against sales to customers. Operators should also implement inspection and maintenance programs to maintain and upgrade infrastructure and minimize fugitive gas emissions.

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal

operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored.

Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the General HSE.

Risks Involved In CGD and Its Mitigation

City gas distribution business has various risks elements in it, which needs to be highlighted and appropriate risk mitigation measures, need to be worked out. A risk matrix highlighting the key risks and their possible mitigation measures are discussed in the table below.

Risk	Effect	Mitigation
Pre-Project Risk		
Delay in approvals and various permits	Cost overruns and project delay	• Appointment of manpower for the local liaison • Identification a project management team • Initiate the approval process for various permits for highway boring, railway boring, canal crossing, permits for forest and municipal corporations • As soon as the company receives the authorization letter the company shall arrange a meeting with all the administrative offices in the authorised city briefing them about the project and their involvement in the project

Delay in site acquisition	Cost overruns and project delay	• The company shall initiate the process of site acquisition post Authorization • Appropriate site for the labours and dump yards for the material shall be identified and acquisition or leasing of the same shall be done on best effort basis
Delay in Financial Closure	Project delay	• The company shall arrange for the financial tie ups with the financing agencies as soon as it receives the authorization letter from PNGRB
Delay in Gas tie up	Project delay	• The company on priority basis shall make provisions for the required amount of gas by tying up with the bulk gas supplier • The company shall, in advance finalize the Gas sales and Purchase agreements (GSPA) and the Gas transportation agreement (GTA) with the bulk gas supplier and the transporter of gas
Construction risk		
Delay in procurement of construction material	Cost overrun and delay in project	• The Company may consider advance booking for long lead items such as M.S. pipes, fittings, Metering & Reduction skids, Control valves, CNG Compressors, dispensers, etc. • The company shall initiate the process of developing the vendors list, initiate procurement activities such as preparation of Request for Qualification, Request for Proposal, etc. • The Company shall adopt adequate processes to avoid delay due to tendering process
Non availability of M.S. and P.E. contactors	Delay in project	• The company, in advance, shall identify the contractors for P.E. and M.S. • All the pre-hiring activities for the contractors shall be initiated well in advance.
Non availability of GI plumbing contractors (Skilled in gas connection)	Delay in domestic connection which in turn leads to bid compliance failure	• The company, in advance, shall identify the contractors for plumbing contractors • All the pre-hiring activities for the contractors shall be initiated well in advance
Non availability of PE fittings and special critical items	Delay in project	• The company shall, in advance indicate the number of fittings that may be required while construction phase • If needed the company shall purchase the long lead critical/consumable items in advance
Supply related risk		
Delay in gas supply from	Project delay	The company shall have adequate clause in the GSPA and GTA in order to mitigate this risk

the transmission line		• The company shall take adequate insurance coverage as per the industry practice •
Gas curtailment	Short gas supplies to the CGD customers.	• The company shall to the extent possible make provisions for alternate gas supply • The company shall have adequate clause in its GSPA with the industrial customers to cover this risk • The company should tie up with more than one sources for gas supplies
Damage to the transmission line	Cost impact and delay in project	• The company in its GTA shall have adequate clause to mitigate this risk • The company shall have adequate clause in its GSPA with the industrial customers to cover this risk
Pressure related risks	Customer displeasure	• The company in its GSPA with the bulk supplier shall have adequate clause to mitigate this risk
Cost risk		
Increase in capital cost	Impact on profitability	• The company shall purchase all the major components on rate contract basis
Increase in Operating cost	Impact on profitability	• The company shall give contract for O&M on yearly rate contract basis
Increase in Interest rate	Impact on profitability	• The company shall from its banker take fixed rate loan as per the company policy to the extent possible
Increase in gas purchase cost	Impact on profitability	• The company in its GSA with the bulk supplier shall have adequate clause to mitigate this risk • Similarly the company in its GSA with the industrial customers shall have adequate clause to cover this risk
Increase in overhead cost	Impact on profitability	• The company shall deploy agency staff for the O&M of equipment such as CGS, DRS, Service regulators, Metering, Billing and Collection, housekeeping, Emergency vehicles, transportation, catering, etc.
Market risk		
Demand risk	Underutilization of the network	• The company shall adopt an aggressive marketing strategy and attractive pricing policy
Competition risk		
Aggressive competition after the marketing exclusivity	Reduction in market share and impact on profitability	• The company shall endeavour to provide "best of the class" service to its customers • The company shall introduce loyalty schemes and shall periodically conduct customer retention drive specially in the CNG segment • It is envisaged that the competition will be interested in the industrial and CNG segments

		owing to less investments and higher returns. So the company shall introduce special schemes in order to retain customers from these segments
Regulatory risk		
Number of domestic connection stated in the bid	Bid compliance failure	• An aggressive marketing strategy shall be adopted to reach to all the charge areas • Special efforts shall be made to connect the high rise buildings to increase the penetration level
Operational risk		
Damage to the Ring mains, Low pressure and medium pressure network	Impact on operations	• The company shall take educate the local agencies like the municipal corporation, water department, sewage department regarding the hazard and proper route map shall be provided to these authorities • Adequate signboards shall be used at right places to indicate the actual route of the pipeline • The warning tape over the pipeline shall have the permanent number of the emergency department of the CGD company
Natural calamity like floods etc	Impact on operations	• Proper action plan need to be formulated to mitigate this risk • The ground staff shall be given adequate training
Accidental damage to life/property	Impact on reputation	• The Company shall have adequate third party insurance as per Hazardous commodity Act

ANNEXURES

CODES AND STANDARDS FOR VARIOUS ITEMS IN CGD NETWORK

Description	Items List	Codes
Steel	Pipe	ASME B 31.8
Steel Pipes HP & Medium Pressure		API 5L
		ASTM A 106
		ASTM A 333
	Coating	DIN 30670
Valves	Ball valves	API 6D
		ASME B 16.34
		BS 5352 BS 5351 BS 1873
Steel	Flanges and blanks	ASME B 16.5
		ASME B 16.36
		MSS SP 44
		API 590
Steel	Fittings	ASME B 16.9
		MSS SP 75
		MSS SP 97
		IS 1239 part-2
Steel	Stud bolts and nuts	ASTM A 194
		ASTM A 193
		ASTM A 153
		ASME B 18.2.1
		ASME B 18.2.2
	Gaskets	ASME B 16.20
Erection work		ASME B31.8 & OISD 141
Regulator		EN 334
Shut-off Device		EN 14382
Gas supply system network up to 16 bar		
Part 1 : General functional		EN 120007-1
recommendations		
Part 2: Specific functional recommendations for PE-MOP upto 10 bar		EN 12007-2
Part 3: Specific functional recommendations for Steel-MOP up to 16 bar		EN 12007-3
Part 4: Specific functional recommendations for renovation- MOP up to 16 bar		EN 12007-4
PE network		
	Code of practice for design, handling & installation	ISO/TS 10839

	Long term hydrostatic strength of thermoplastics pipe material	ISO/DIS 9080
	Overall service design coefficient	EN ISO 12162
	PE compounds (pipe / access)	prEN 1555-1 ISO 4437, ISO 4437
	Pipes PE 100	prEN 1555-2, ISO 14885
	PE Fittings. (PE / steel combined fittings are excluded)	prEN 1555-3
	PE valves	prEN 1555-4 ISO 4437, ASME B
	PE fitness system	prEN 1555-5
	Quality control of pipes/fittings and material conformity	prEN 1555-7
	MP steel valves	API 6D
	Valves coating	DIN 30 671 DIN 30 677 Part 2
	Butt welding machines	ISO 12176-1
	Electro fusion machines	ISO 12176-2
	Welders qualification spec/badge	ISO DIS19480 ISO 12176-3 pr EN 13067
	Welders training	ISO/TC138/SC4 n1033
	Traceability	ISO 12176-4 not available
	Gas pipe work for buildings functional	EN 1775
	Accessories (other than PE fittings)	ISO 10838-1/2 ASME B16.5
	Transition fittings (steel/PE)	
	Couplers/union couplers	
	Galvanised pipe (interface between PE	IS 1239 P 1
	PE Material	IS 14885
Erection work		EN 12007-1-2-3-4
Testing		EN 12327
City Gates		EN 12186 EN 1776
	Filter Skid	
	Heat exchanger / Pressure letdown Skid	
	Valves	
	Shut-off valve	
	Safety valve	
	Relief Valves	
	Monitor	

	Regulator	
	Metering Station with rotary meter	EN 1776 prEN 12480
	Accessories & Instrumentation	
	Chromatograph	
	Odorisation	
Transition box		
	Metal box concept	
	Regulator/Filter/Relief	
	valve/Valves/Shut-off valves/Transition fitting PE/steel	
Main consumer (SC) >10m3/h		EN 12279
	Metering& Regulating Box	
	Regulator/Relief valve/Shut-off Valve/Transition fitting PE/steel	
	Rotary meter	prEN 12480
Small consumer (SC) >10m3/h		EN 12279
	Metering & Regulating Box	
	Pressure limiter-Transition fitting PE/steel	
	Diaphragm meter	EN 1359
Testing/Commissioning		EN 12327
Design & Construction	Natural Gas Transmission Pipelines & City Gas Distribution Networks	OISD-226
Copper	Tubes	BS EN 1057
	Fittings	BS EN 1254 part-1