AN ANALYSIS TO IDENTIFY PROJECT IMPLEMENTATION MODEL FOR DISTRIBUTION OF COMPRESSED NATURAL GAS (CNG) ALONG THE NATIONAL HIGHWAY

By

SHIVARAJ BHOR

SUBMITTED

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

DEHRADUN

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March, 2011

This Thesis is Dedicated

to

My Parents Aaiee & Aappa,

My wife Vishakha

and

My Son Ameya

UNIVERSITY OF PETROLEUM & ENERGY STUDIES
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THESIS COMPLETION CERTIFICATE

This is to certify that the thesis on **'An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway'** by **Mr. Shivaraj Bhor** in Partial completion of the requirement for the award of the Degree of Doctor of Philosophy (Management) is an original work carried out by him under my supervision and guidance. It is certified that the work has not been submitted anywhere else for the award of any other diploma or degree of this or any other University.

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GAIL (India) Limited

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DECLARATION

I, Shivaraj Bhor, hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

(Shivaraj Bhor)

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The Natural Gas infrastructure plays a significant role in serving the nation by facilitating equitable geographical distribution of economic benefits. It provides access to the domestic gas producers, making gas available to the customers including those who are remotely located, facilitating monetization and development of gas fields which are otherwise scattered and devoid of market access. The pipeline network has created choice for customers by providing cheaper, environment-friendly alternative fuel and has reduced import-dependency as natural gas has substituted liquid fuels such as Naphtha, Fuel Oil, etc.

Natural Gas infrastructure developed over the years has touched the life of common man in many ways, be it social, economic or environmental aspects. The development has not only supported various industrial segments like power and fertilizer, but also helped to further expand and meet the demand in these sectors. It has also helped in improving the quality of life in the alarmingly polluted major cities like Delhi, Mumbai, Pune etc.

Compressed Natural Gas (CNG) network in the country which helps, in bringing down pollution levels in metros such as Delhi and Mumbai and the other major cities in the states of Gujarat, Maharashtra, Madhya Pradesh, Haryana, Uttar Pradesh, Andhra Pradesh and Tripura. However, distribution of CNG is limited to these cities only. But now there is need to connect the cities through Natural Gas Highways so that long range transport can be made on clean, green and economical fuel across cities.

It is observed that till date, the initiatives taken by Ministry, Regulatory bodies, other government agencies, Public Sector, Private Public Sector in the field of Compressed Natural Gas

Distribution is limited to particular city. However, the Nationwide long distance travel beyond the city is not been considered by these agencies.

Now India witnessed increased availability of Natural gas from 2009 onwards due to significant Natural Gas availability from Reliance and Petronet LNG. Thus there would be an opportunity for the Investment in Natural Gas Highway. The setup model for execution of this investment in Natural Gas Highway is studied among Government, Public Private Partnership (PPP) & Private. The sample case of Delhi Mumbai National Highway for distribution of CNG is considered here.

The proposed analysis to Identify Setup for Project Execution Model among Government, Public Private Partnership (PPP) & Private for Distribution of Compressed Natural Gas (CNG) along the Delhi-Mumbai National Highway (NH8).

Delhi & Mumbai are the biggest metro cities in India. This national highway is important link of Golden Quadrilateral Highway identified by National Highway Authority. Also, NH8 is the most dense tariff highway for the vehicular movement. Further, Delhi & Mumbai both the cities have independent companies operating CNG network. These are Indraprastha Gas Ltd & Mahanagar Gas Ltd for Delhi & Mumbai city respectively. Currently there is no CNG corridor present except above mentioned to cities. Therefore, it become appropriate to provide the CNG along NH8, and such project here termed as Natural Gas Highway.

Considering the coverage of this research, a detailed review of existing literature has been conducted. It covers the academic research done by previous researchers, research or investigation done in Oil & Gas industry by Government Agencies, Research Analysts, Investment Bankers and also Indian Corporate and Consulting Firms with specific reference to the Oil & Gas industry.

Analysis and Conclusion has been made by the researcher from the Primary and Secondary Data collected for the Study. Primary data was collected by developing the Survey Questionnaire and Secondary data analysis is made from the Excel Based complex Financial Model developed for the study.

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LIST OF ABBREVIATIONS

AD	Aerobic Digestion
ADB	Asian Development Bank
AGL	Adani Gas Limited
APM	Administered Price Mechanism
BCM	Billion Cubic Meter
BOOT	Built Own Operate Transfer
BOT	Built Operate Transfer
BPCL	Bharat Petroleum Corporation Ltd
BTU	British Thermal Unit
CAGR	Compounded Annual Growth Rate
CCEA	Cabinet Committee on Economic Affairs
CGD	City Gas Distribution
CH4	Methane
CIS	Commonwealth of Independent States
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CP	Commercial Paper
CRT	Continuously Regenerating Trap
CSIRO	Commonwealth Scientific and Industrial Research Organization
DBFO	Design Build Finance and Operate
DCF	Discounted Cash Flow
DFR	Detailed Feasibility Report
DGH	Director General of Hydrocarbon
DOC	Diesel Oxidation Catalyst
DVPL	Dahej Vijaipur Pipeline

E&P	Exploration & Production
EGOM	Empowered Group of Ministers
EOI	Expression of Interest
EPCA	Environment Pollution Control Authority
ERG	Expert Reference Group
FII / FI	Foreign Institutional Investors
FOB	Free on Board
FSU	Former Soviet Union
GAFI	General Authority for Investment
GDP	Gross Domestic Product
GGL	GAIL Gas Ltd
GNCTD	Government Of National Capital Territory Of Delhi
GoI	Government of India
GREP	Gas Rehabilitation & Expansion Project
GSPA	Gas Sales Purchase Agreement
GSPC	Gujrat State Petroleum Corporation
GSPC	Gujarat State Petroleum Corporation
HC	Hydrocarbons
HPCL	Hindustan Petroleum Corporation Ltd
HVJ	Hajira Vijaipur Jagdishpur
IARC	International Agency For Research On Cancer
IDCOL	The Industrial Development Corporation Of Orissa Limited
IFC	International Finance Corporation
IFCO	Iranian Fuel Conservation Organization
IGL	Indraprashta Gas Ltd
INR	Indian Rupee
IOCL	Indian Oil Corporation Ltd
IRR	Internal Rate of Return

JCC	Japanese Crude Cocktail
JV	Joint Venture
KG	Krishna Godavari
Kg	Kilogram
LD / MD/ HD	Low / Medium / High Density
LFG	Landfill Gas / Boigas
LNG	Liquefied Natural Gas
LoI	Letter of Intent
LPG	Liquefied Petroleum Gas
MDQ	Minimum Discharge Quantity
MGL	Mahanager Gas Ltd
MMBTU	Million British Thermal Unit
MMSCMD	Million Standard Cubic Meter per Day
MMTPA	Million tons per Annum
MOP&NG	Ministry of Petroleum & Natural Gas
MoU	Memorandum of Understanding
MSCM	Million standard Cubic Meter
MSEB	Maharashtra State Electricity Board
MTOE	Million Ton Oil Equivalent
MW	Mega watt
NAAGS	National Ambient Air Quality Standards
NCR	National Capital Region
NCT	National Capital Territory
NELP	New Exploration Licensing Policy
NGV	Natural Gas Vehicle
NH8	National Highway number 8
NHAI	National Highway Authority of India
NIOPPC	National Iranian Oil Products Distribution Company

NOx	Nitrogen Oxides
NSA	National Security Advisor
NTPA	National Thermal Power Corporation
OEM	Original Equipment Manufacturers
OIDB	Oil Industry Development Board
OMC	Oil Marketing Companies
ONGC	Oil & Natural Gas Corporation Ltd
PAH	Polynuclear Aromatic Hydrocarbons
PMT	Panna Mukta Tapti
PNG	Piped Natural Gas
PNGRB	Petroleum & Natural Gas Regulatory Authority
PPAC	Petroleum Planning and Analysis Cell
PPM	Parts Per Million
PPP	Public Private Partnership
PSC	Production Sharing Contract
PSU	Public Sector Undertaking
PTT	Petroleum Authority of Thailand
QVM	Qualified Vehicle Monitor
R&D	Research & Development
RGPPL	Ratnagiri Gas and Power Private Limited
RIL	Reliance Industries Ltd
RLNG	Regassified LNG
RRVUNL	Rajasthan Rajya Vidyut Utpadan Nigam Limited
RSPM	Respirable Suspended Particulate Matter
SC	Supreme Court
SCM	Standard Cubic Meter
SCMH	Standard Cubic Meter per Hour
SPA	Sales - Purchase Agreement

SPV	Special Purpose Vehicles
SWOT	Strength Weakness Opportunities & Threat
TC	Tariff Commission
TERI	The Energy and Resources Institute
Tpt	Transportation
UK	United Kingdom
USEPA	United States Environmental Protection Agency
VAT	Value Added Tax
VRA	Vehicle Refueling Appliances

1. INTRODUCTION TO CNG BUSINESS

1.1 Overview of Natural Gas Business

Natural Gas is an important source of energy in the world. It is combustible in nature which results in emission of a great amount of energy when burned. Natural Gas is combustible as it is a mixture of hydrocarbon gases. Any organic compound consisting only of carbon and hydrogen is known as a Hydrocarbon. Hydrocarbons generate heat when burnt.

Hydrocarbon reserves evolve naturally and are derived from decomposition of organic matter, algae and bacteria trapped and preserved in sedimentary deposits. The burial of these deposits and the corresponding increase in heat and pressure decomposes the organic matter. This breaks down the complex hydrogen and carbon molecules and converts them into solid, liquid or gaseous hydrocarbons known as fossil fuels. Natural Gas is a mixture of these gaseous hydrocarbons. It is obtained either as an associated gas along with crude oil or as free gas from independent gas fields. Crude oil and coal are the other forms of hydrocarbons.

The primary constituent of Natural Gas is Methane (70-90 per cent) along with other gases like Ethane, Propane, Butane and Pentane. Natural Gas is considered to be a 'Clean Fuel' in comparison with alternatives such as Petrol, Diesel and Coal due to limited or non-existent ash and sulphur content. The composition of Natural Gas differs from one gas field to another.

Natural Gas is a vital component of the world's supply of energy. It is one of the cleanest, safest, and most useful of all energy sources. Natural Gas occupies about 8.5% of the total energy basket of the India. This is much lesser than the world average of 24%. However,

the scenario is fast changing in the country, largely because of the expected increase in the availability of Natural Gas in the country. The increased availability of Natural Gas will have a positive impact on the economic growth of the country. Additional availability of this resource should be used in a judicious manner. The necessary infrastructure for transportation of gas from production centres to different consumption centres is also being put in place by different agencies. There is a need to closely monitor the firming up of demand estimates by various sectors, so that the available gas is used as per the production plan in a timely manner.

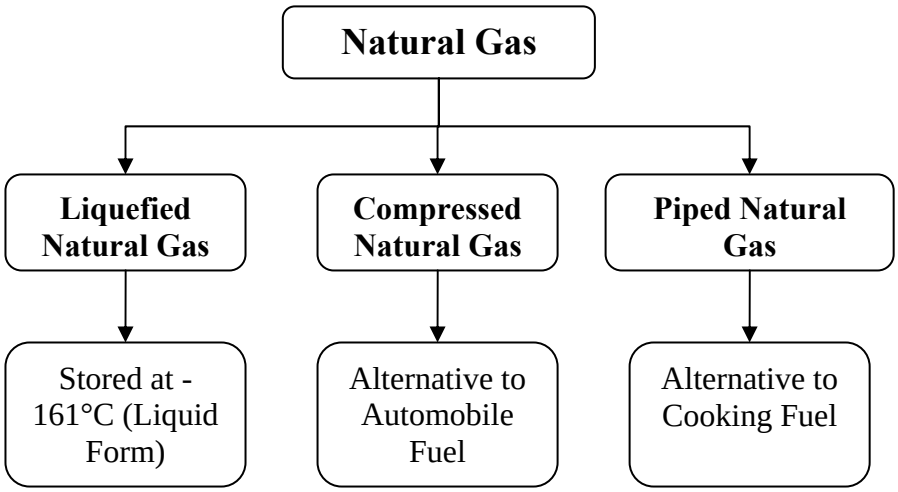
As per the Natural Gas Utilization Policy, existing Fertilizer (urea) plants would be accorded first priority, second to existing LPG extraction plants, third to existing gas-based Power plants, fourth to transport sector & fifth to captive liquid fuel consumption by PSU refineries.

As per 11th plan period working group report, use of Natural Gas for transport sector has a high growth potential. World-wide, city gas distribution has grown hand in hand with the Natural Gas sector development in terms of supply infrastructure and transmission infrastructure. With the expected growth in the gas supply and the simultaneous creation of gas inter-state transmission infrastructure in India, this sector has very high growth potential. With the emphasis on clean environment, transport sector would get the necessary thrust in the coming years. In line with this, various players, primarily led by GAIL, have drawn up ambitious plans to roll out city gas infrastructure across a number of cities in the country.

Types and Forms of Natural Gas:

There are 3 types/forms of Natural Gas based on their usages/physical parameter:

Figure 1.1-1 Types and Forms of Natural Gas



Liquefied Natural Gas (LNG) is Natural Gas in liquid form. Natural Gas is liquefied by cooling it to around minus 161°C. The conversion of Natural Gas into LNG reduces its volume by 600 times. Hence, large quantities of Natural Gas can be easily transported over long distances or where pipelines cannot be laid due to difficult terrain through specially designed cryogenic carriers. The liquefied gas then needs to be regasified before it can be used.

Piped Natural Gas: Natural Gas can also be supplied through pipes as Piped Natural Gas (PNG) to domestic users as an alternative to cooking gas. Commercial and Industrial players also source PNG as an alternative fuel or feedstock. Here, point may be noted that, LPG the most popular cooking fuel in India, which is a composition of Propane (C_3) and Butane (C_4) by 50:50 in volume. However, the PNG in a Natural Gas predominately consisting of Methane (C_1).

Compressed Natural Gas (CNG) is Natural Gas in compressed form (but still in gaseous state), which is achieved by applying pressure of up to 200-250 kg per cm^2. In this form, it can be transported through cryogenic ships and also can be stored at CNG dispensing stations.

Compressed Natural Gas (CNG) is a clean and safe fuel that can be used as a substitute for petroleum fuels like Petrol, Diesel and Kerosene. It is called as CNG because Natural Gas is compressed at high pressure to enhance the storage capacity of the on-board cylinders that can be mounted on vehicles. CNG is lighter than air and disperses faster in to the atmosphere thus minimizing the risk of fire or explosion. *The level of polluting emissions and carbon residue from CNG is minimal thus reducing the maintenance cost of the engine and enhancing the active life of the vehicle. Exhaust emissions from Natural Gas Vehicles are much lower than those from gasoline-powered vehicles.*

1.2 CNG: International Perspective

After understanding the basics about Natural Gas in general and CNG in specific, the researcher has tried to look into the International presence of CNG. This can be understood in the following paras:

Malaysia[1] has an abundant local Natural Gas reserves. Currently country has 39 CNG refuelling stations and 14,700 CNG vehicles. Further, they are running heavy duty programs currently under development for role out of CNG awareness. The CNG is made available at the half the price of petrol. This is the main driver for them drive CNG business.

CNG vehicles in **Italy**[2] are rising continuously. Here, the Automobile manufacturers are very actively participating in the development of CNG market. In the year 2005, around 370,000 CNG vehicles are running in the country. And roads of Italy are serviced by 510 refuelling stations. The orders placed for CNG buses by this

[1] Source : NGV Country Report of Malaysia - May 4, 2005
[2] Source: NGV Country Report of Italy - April 5, 2005

time have surpassed the diesel buses. Government is also continuously supporting the CNG activities in the country.

A first CNG vehicle in **South Korea**[3] was introduced in 1992. The main fleet of CNG includes Buses and trucks. The CNG business is significantly influenced by it's pricing. Further, Government has been very active for supporting the CNG development in the country.

Brazil[4] has close to 1 million CNG vehicles and over 1,000 CNG serving stations as on 2005. Almost 140 cities served by Natural Gas. Government has also undertaken the significant steps for replacing diesel from Metropolitan buses.

In **Former Soviet Union (FSU)**[5]**,** the First Natural Gas Vehicle (NGV) in the country was launched in 1939. However, large scale programs for phasing out Diesel vehicles were commenced from the year 1980. Ukraine, Russian and Armenian NGV markets are expanding. The fuel market of Former Soviet Union, was also price driven. The CNG price drives the Commonwealth of Independent States (CIS) markets. The FSU is planning to cross 1,000,000 vehicles, 1,000 fueling stations by 2020.

The number of NGVs in **Moldova** and volumes of consumed CNG has been found diving since 1991 through 2000. Increasing prices of oil have made Natural Gas more attractive. The price differential between Gasoline, Diesel Fuel and Natural Gas is the major driving force. There is no dedicated NGV legislation in Moldova.

Since 1991, **Belarus** has built five new CNG filling stations. All compressor stations belong to the 'Beltransgaz' company, which is responsible for gas transportation, underground storage and supply

[3] Source: NGV Country Report of South Korea June 1, 2005
[4] Source: NGV Country Report of Brazil July 6, 2005
[5] Source: Country Report – Commonwealth of Independent States (Former Soviet Union) August 3, 2005 and September 6, 2005

to the local distribution companies. All Byelorussian CNG filling stations are linked in to a single computerized data collection system.

Unlike Moldova and Belarus the NGV market in **Tajikistan** is growing very fast. The CNG filling station in Tajikistan has grown from 3 in 1991 to 53 in 2004. This shows the tremendous increasing scope of CNG in the country.

In the recent past years the **Armenian** NGV market has increased by about 4.5 times. Today every 10th vehicle in Armenia runs on Natural Gas. In 2005, there was consumption of 110 MCM of Natural Gas, approximately 4,000 MCM per vehicle. Armenia does not produce oil or gas. All mineral fuel is imported. Nevertheless, CNG prices stimulate the market: 0.26 €/ncm, which is 61% of diesel and 53% of gasoline. Since 1991 Armenia has built 42 CNG filling stations and today there are 47 CNG stations in that country.

Russia is the second CIS country in terms of sales of Natural Gas and NGV population. In 1998, a renaissance on the Russian NGV market began. The sales of compressed Natural Gas for vehicles grow about 20% every year. In 2004, 45 thousand Russian NGVs consumed 173 MCM.

Ukraine is the NGV leader in the former Soviet Union in 2005. There are 145 CNG filling stations and 67,000 NGVs in the country. Ukraine holds the 5th place in the world in terms of CNG sales. In 2004, Ukrainian NGVs have consumed 550 million m^3 which is more than in Germany or even in Italy.

Czech Republic[6] has 0% excise and road tax rates for CNG. This has promoted the use of CNG over other fuel. Monthly gas pricing reviews to ensure price advantage over Diesel. In the year 2008,

[6] Source - CNG in the Czech Republic September 23, 2008 from http://www.ngvglobal.com/cng-in-the-czech-republic- 0923

there were 1,153 Natural Gas vehicles and growing exponentially and 17 CNG fuelling stations operational, further 8 more were built in 2009.

Egypt[7] is considered as the leading country in the NGV industry in Middle East and Africa. It is ranked as one of the first ten countries, in the number of CNG converted cars all around the world. In 2006, there were 65,432 CNG cars on the road now with 99 fuelling stations and 22 conversion stations. Nine refuelling station were under construction and average monthly gas sales was 22.290 million m^3, At that time, there were six companies working in this industry.

In **Japan**[8], The Japan Gas Association is supporting the diffusion of environment-friendly Natural Gas vehicles. In Japan, Natural Gas vehicles started to penetrate the market in the second half of the 1980s. Since then, the number of Natural Gas vehicles in Japan has increased steadily, reaching the number of 10,000 by the end of November 2001 and 20,000 by the end of March 2004. By the end of December 2006, the number of Natural Gas vehicles in Japan exceeded 30,000 with that number since growing to 31,462 vehicles and 324 refuelling stations operational.

The NGV industry in **Latin America**[9] is continuously growing, especially in the South portion of the region. The Latin American region has, approximately 48% of the global NGV fleet. There can be significant increase in the NGV industry, in the next some years. Latin America's gas demand is expected to more than double until 2030.

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[7] Source - NGV Industry in Egypt July 5, 2006 from http://www.ngvglobal.com/ngv-industry-in-egypt-0705
[8] Source - Japan NGV Numbers Break 30,000 Mark May 2, 2007 from http://www.ngvglobal.com/japan-ngv-numbers-break-30000-mark-0502
[9] Source: Latin America NGVs: An Update Report, August 20, 2008

As per the report of 2009, **Singapore's Land Transport Authority**, the growth in numbers of CNG-fuelled taxis and cars in the country has increased from 977 to 1656 fuelled taxis in the year 2008, which show almost 70% increase. The increase in availability of CNG-fuelling stations is likely to stimulate a new growth phase.

As per the News report of Gasorama, the number of gas-powered vehicles in **Switzerland**[10] rose in the year 2009 from 5830 to 7163. There are 5408 cars, 1541 passenger vans and small buses, 159 buses and 55 trucks running on CNG. The filling station network in Switzerland includes 110 refuelling facilities. There are 27 different models of Natural Gas vehicle passenger cars and 7 models of vans and small buses in Switzerland.

In the year 2009, **Bulgaria**[11] has increased the number of Natural Gas vehicles (NGVs) in the country by 33%. According to a report released by Overgas Inc, which is a domestic Natural Gas infrastructure provider, the count for vehicles powered by compressed Natural Gas (CNG) now stands at 60,000. There has been expanding the CNG refuelling facilities to 77 in number. A negotiated gas price reduction from 1st July 2009, making CNG the best value as well as the most environmental friendly fuel as compared to other fuels available in the country. This should help to further stimulate growth of CNG business.

CNG-powered public transport has increased in popularity. As of June 2009, there are 67 vehicles on CNG in Sofia, 23 in Varna, and 12 in Burgas.

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[10] Source: Switzerland's NGVs exceed 7,000 April 8, 2009 from http://www.ngvglobal.com/switzerlands-ngvs-exceed-7000-0408

[11] Source: Overgas , Bulgaria's Natural Gas Vehicles Increase 33% in One Year June 28, 2009, Bulgaria, Sofia Source

Iran[12] in the year 2010 has more than 2 million Natural Gas vehicles (NGVs) on the roads, serviced by 1474 CNG fuelling stations. This makes them world's second largest users of NGVs after their next door neighbour, Pakistan.

The Petroleum Authority of Thailand[13], has reported that, in the year 2009, there were now about 155,000 cars running on engines powered by Compressed Natural Gas in Thailand and sales of Natural Gas have increased upto 3,900 tonnes a day. Everyday in Thailand about 100 vehicles are installed with NGV engines which are mostly in trucks and new cars. With increasing number of NGVs, the Bangkok Mass Transit Authority (BMTA) is trying to expedite the creation of 14 new NGV filling stations.

1.3 CNG Evolution in India

The gas retail business is as old as of 1880s when Calcutta Gas Company (formerly Oriental Gas) and Bombay Gas Company commenced operations in Kolkata and Mumbai respectively, with coal gas as their primary input. .

In Mumbai, Coal Gas which is also known as Synthesis Gas did not find a commercial business model and was abandoned with the Bombay Gas Company closing operations in 1980. In Kolkata this concept is still working after the original company, Oriental Gas was succeeded by Greater Calcutta Gas Supply Corporation in 1987 which is operational even today, albeit in losses.

Subsequently, however, the industry remained by and large dormant, with a few initiatives being started on an experimental basis, primarily to utilize locally produced gas. The formation of Assam

[12] Source: Iranian CNG Program at Crossroads, October 20, 2010 from http://www.ngvglobal.com/iranian-cng-program-at-crossroads- 1020
[13] Source: Thailand NGV Numbers Grow October 8, 2009 from http://www.ngvglobal.com/thailand-ngv-numbers-grow-1008

Gas Company in 1962 and Vadodara Municipal Corporation supplying coal gas in Vadodara in 1972 were the only developments.

However, with Oil and Natural Gas Corporation Limited (ONGC) and Assam Gas Company Limited (AGCL) entering the business in the mid- to late-1980s, the structured development of CNG in the country started. ONGC started Natural Gas based city gas in its townships (Mehsana, Hazira, etc.). Similarly, AGCL launched an initiative to supply gas in Sibsagar and Duliajan.

The establishment of Gujarat Gas Company Limited (GGCL), Mahanagar Gas Limited (MGL), and Indraprastha Gas Limited (IGL), which began operations in the late 1980s to mid-1990s, gave another thrust to the sector. In fact, in 1989, in a key development, the Government of India (GoI) allocated gas to GGCL which launched a PNG network for industrial supply in Ankleshwar and Bharuch and extended the network to Surat in 1991. In 1992, GAIL had launched a pilot study for the introduction of Natural Gas as an alternate commercial fuel in Delhi, Mumbai and Vadodara.

In 1998, regulatory intervention in the form of a Supreme Court directive (in response to Public Interest Litigation) to GAIL to expand the CNG network and increase the number of stations from 9 to 80 by March 2000 gave a further impetus to CNG networks in the country

The CNG business got another shot in the arm with a second Supreme Court directive issued in 2003 to the Union Government of India and the state governments to draw plans to introduce clean fuels an 11 Cities apart from the existing cites of Delhi and Mumbai, as these cites were the most polluted because of vehicular emissions and clean fuels were urgently needed to be introduced. These cities includes Agra, Lucknow, Kanpur, Pune, Faridabad, Patna, Ahmedabad, Hyderabad, Bangalore, Kolkata and Chennai.

In the latter half of this decade, the CNG business in the country has gained considerable momentum, City gas networks (PNG and CNG) have been operative in multiple locations including Delhi, Mumbai, Vadodara, Surat, Ankleshwar, Ahmedabad and Kanpur since 2006. Companies engaged in the CNG business witnessed commercial success and gas supplies for this segment improved. Consequently a number of new entrants have made a foray into this space in the recent past

With the industry witnessing growth in October 2007, the Government of India, set up Petroleum and Natural Gas Regulatory Board (PNGRB), along with mandate of hydrocarbon sector, the mandate of regulating the CNG business. The details about PNGRB have been discussed in the subsequent part of this chapter.

1.3.1 CNG Evolution in India : Key Milestones

The following table, in nut shell indicates the big milestones in the evolution of CNG in India till formation of PNGRB:

Table 1.3.1-1 CNG Evolution in India

Year	Particulars about the event	CNG Development Phase
1880-1900	Coal gas supplied un Kolkata and Mumbai	Few initiatives largely dormant phase
1962	AGCL established	
1972	Vadodara Municipal Corporation supplies coal gas in Vadodara	
1982-86	Legacy systems operated by ONGC and AGCL Gas in Assam and Tripura	
1989-91	GGCL launches PNG supply for industrial customers in Surat, Ankleshwar and Bharuch	Structured development
1992	GAIL conducted a pilot study for use of Natural Gas as an 1992 alternate commercial fuel in Dellhi Mumbai and Vadodara	
1998	Supreme Court directive to expand CNG network	Gains momentum
2003	Supreme Court directive to introduce clean fuels in 11 cities other than Delhi and Mumbai	
2006	CNG networks (PNG and CNG) operational in multiple locations including Delhi, Mumbai, Gujarat (Surat, Vadodara), Ahmedabad and Kanpur	Becomes a reality
2007	Formation of PNGRB	

1.4 CNG – Indian Scene

The City Gas Distribution (CGD) business till as recently as 2007 was driven largely by the judiciary, and was dominated by a handful of entities that had not made adequate investments in reaching out to all potential consumers. This sector has gained considerable ground over the last two-three years with the landscape for city gas undergoing a complete sea change.

CNG networks are now operational in 42 Geographical Areas (GAs) and are under implementation in about 20 more GAs. This business has also attracted significant Private Participation and ambitious plans are on the drawing board for the large scale expansion of CNG networks.

City gas consumption as a proportion of total gas consumption has risen from a mere 1 per cent in 2000 to about 8.5 per cent currently with much of the increase in consumption taking place in the latter half of the decade, and particularly over the last two years.

Much of this progress has been driven by a **conducive regulatory regime**. In less than three years of its formation, the Petroleum and Natural Gas Regulatory Board (PNGRB) has played a pivotal role in the development of the CNG sector. While the progress in CNG network development was stalled for nearly a year, work has restarted after the notification of Section 16 of the PNGRB Act in July 2010.

In addition, with the expected increase in gas supply, expanding pipeline infrastructure, favorable economics of gas and a growing concern over pollution in cities due to the use of traditional fossil fuels, CNG projects present a good investment opportunity to prospective investors provided they have a well thought out strategy for dealing with supply and policy risks.

1.5 CNG Network and Distribution Process

CNG represents the last mile in the gas value chain and entails gas supplies at variable pressures to residential and commercial consumers in the form of PNG for cooking, commercial and industrial purpose and CNG for automobile purpose.

A CNG network entails movement of small volumes of gas through small diameter medium to low pressure distribution pipelines by a local distribution company to a large number of retail consumers. It

is an integrated network of Steel, Poly Ethylene pipelines, and comprises CNG dispensing stations that supply Natural Gas for automotive use and a piped gas network that provides Natural Gas as a fuel for commercial, industrial and residential purposes.

Steel grid pipelines City Gate Stations (CGS), District Regulating Stations (DRS) CNG stations and Service Regulators (SR) are essential elements of the network. CGSs measures the amount (volume) of incoming gas through orifice meters and reduce the pressure of the gas which is to be sent for distribution, as the distribution system requires considerably lesser Gas at high pressure (above 26 bar) from the steel grid is reduced to about 15 bar by means of pressure regulators which also help to control the flow rate to maintain the desired pressure level throughout the distribution system.

With the reduction in pressure, the Natural Gas becomes cooler and therefore, it has to be heated up in order to maintain the flow in the pipeline. In regions where the temperature is below zero degree, Odorisation of Natural Gas is also done at the CGS. This serves as a warning bell before the gas accumulates to hazardous levels. Since a mixture of Air and Natural Gas are explosive over the range of 5 to 15 per cent of Natural Gas, in order to ensure safety, odorized Natural Gas is detectable at concentrations of just 1 percent.

Therefore, gas is then transferred through steel pipelines to the DRS which is installed where the distribution is to be done. Alike the industrial areas and domestic/commercial segments, Natural Gas to the various consumers is transferred after being maintained at a pressure of about 45 bar.

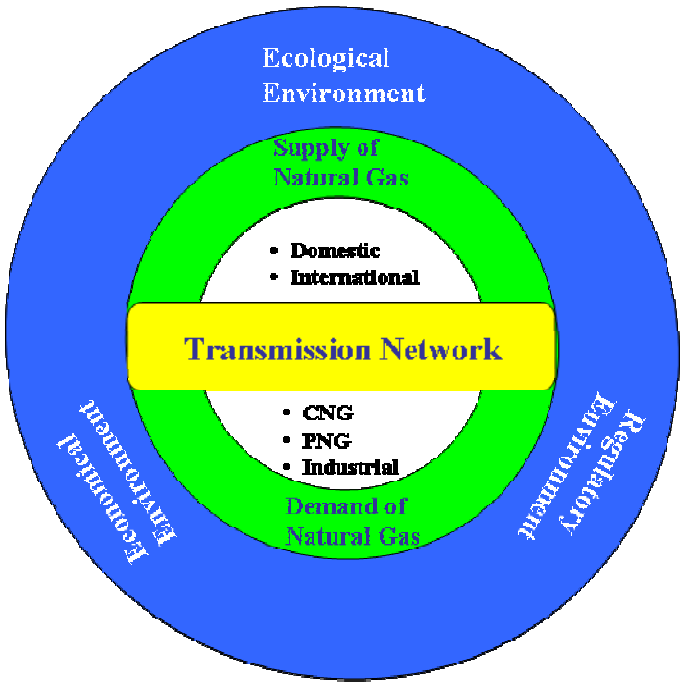
Then the gas is transmitted to the SR through 4 bar Polyethylene pipelines which increase the safety due to its high flexibility. SR further reduces the pressure from 4 bar to 100 Millibar, from where the gas is supplied to the end user.

1.6 Key Growth Drivers for CNG Business

Over the last few years the CNG business in the country has gained significant scale and momentum which is driven primarily by an increase in domestic gas supplies, A conducive regulatory roadmap propelling the growth of CNG networks and the attractive economics of Natural Gas against other fuels like Petrol, Diesel and Liquefied petroleum gas (LPG).

In the following part of the chapter, the researcher has made an attempt to identify the factors which directly or indirectly affects the CNG business and its feasibility in a country at macro economic level. Not only this, an effort has been made to establish an inter relation among these factors. The major factor affecting the CNG business at macro level can be understood by the following chart:

Figure 1.6-1 Chart of CNG Business



Supply of Natural Gas: The Ministry of Petroleum and Natural Gas (MoPNG) accorded CNG as high priority while making the

allocation of new gas (from the Krishna Godavari {KG} basin). Recently, after the significant new domestic gas finds by Reliance (already started production), Gujarat State Petroleum Corporation (GSPC) and ONGC as well as Liquefied Natural Gas (LNG) sources, CNG development in the country is on a strong growth path.

Trunk line connectivity: For affecting the delivery of gas, expansion of transmission networks is a key criterion for CNG growth. Efforts are being undertaken aggressively by GAIL and Reliance Gas Transportation Infrastructure Limited (RGTIL) to complete the National Gas Grid which circumnavigates and criss-crosses the country. While GAIL has completed over 7,200 km and is targeting 13,000 km by 2012, Reliance has completed 1,400 km and is waiting for authorization from PNGRB for another 3,000 km.

Regulatory Environment: The creation of PNGRB in 2007 paved the way for growth in the CNG segment. The regulations that have been put in place by the Board over the past year provide a level playing field to serious bidders with adequate provisions for fair returns and a competitive landscape that protects the interest of both developers and consumers thereby catalyzing interest in new investments by existing as well as new developers. More recently with the Section 16 notification coming through, CNG infrastructure expansion will get a further impetus, as according to PNGRB; there is technically no hurdle left.

Usage Economy: Natural Gas is a more economic than any other alternative. According to industry experts, while CNG is almost three times as economical as traditional fuels, for industrial consumers, Natural Gas offers a 20 per cent cost benefit in energy terms. For the domestic segment as well, PNG presents a savings opportunity of almost 17 per cent on the monthly bill. The cost competitiveness of Natural Gas is likely to improve as the prices of

Petrol/Diesel increase and the government phases out subsidies for liquefied petroleum gas (LPG).

Environment Aspect: The environmental conscious related initiatives have deliberated to further boost the market attractiveness of CNG business. India has declared a target of reducing the amount of carbon dioxide (CO_2) emissions per unit of GDP by 20-25 per cent between 2005 and 2020. This will lead to greater emphasis on Natural Gas as it produces lesser CO_2 for the same amount of heat as against liquid fuels (30 per cent lesser) and coal (45 per cent lesser). The following table shows the emission of pollutants by various fuels:

Environmental Comparison of Fuels[14]

	Natural Gas	Diesel	Oil	Coal	Petrol
Carbon dioxide	117,00	135,250	164,000	208,000	285,700
Nitrogen oxide	92	1,632	448	457	4,081
Sulphur oxide	0.6	1,121	1,122	2,591	204
Particulates	7	1,021	8.4	2,744	40.8

Table 1.3.1-1 Environmental Comparison of Fuels

(Pounds of air pollutants produced per billion British thermal units of energy)

From the above table, it can be seen that all types of fuel generates much higher pollution than Natural Gas. Hence the scope of Natural Gas from Environmental point of view is also very high.

[14] Source: Energy information Administration

Demand side: On the demand side, as gas supply increases and distribution infrastructure (cross-country pipelines) falls in place, India will transit from an oil-based economy to a gas-based one. The development of gas-based home appliances has gained attraction. For instance, industries are exploring the possibility of using Natural Gas for air-conditioning, geysers and other appliances. The proposed CNG projects are also likely to benefit from the large investments currently being made in the setting up of Special Economic Zones (SEZs), which are likely to offer a balanced customer mix consisting of automobiles, domestic, industrial and commercial users.

1.7 Current CNG Status in India

After studying the factors affecting CNG business, it will be worth understanding, the present status of CNG in terms of operations, consumptions and economics related thereto. Such study can be done in two phases i.e. pre PNGRB era and post PNGRB formation period. In pre PNGRB period, the CNG companies which were authorized by MOPNG and were in under their purview till 1st October 2007. Thereafter, PNGRB was established which took all existing companies in its purview. The new entities which have entered in this segment in post establishment are intending to make a foray in this segment. In order to understand the current CNG status, the researcher discussed it in the following segments:

1.7.1 Operations

Till as recently as 2008, the development of CNG networks was limited and had been primarily confined to only a few cities due to the limited availability of Natural Gas in India and the relatively small pipeline network (7,000 km).

There were a few CNGs in operation: New Delhi (IGL); Surat, Ankaleshwar and Bharuch in Gujarat (GGCL), Mumbai and surrounding areas (MGL); Upper Assam (Assam Gas Company

Limited) and Vadodara, Gujarat (Vadodara Municipal Corporation); etc. These catered to a domestic customer base of about 4,50,000 of which the CNG customer base addressed by about 350 CNG stations was approximately 3,40,000 (the fifth largest in the world).

But over the last two years, projects have been under implementation in more than half-a-dozen states, including Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra, Karnataka, Kerala, Andhra Pradesh and West Bengal. Consequently, CNG networks have developed in about 42 cities and CNG development is under-way in about 20 cities. There are 23 entities in operation catering to about 1.2 million domestic, 2,795 industrial and 8,831 commercial consumers, and about 7,97,169 CNG vehicles in the country as of March 2010.

The rapid CNG network development notwithstanding, there is clearly a huge potential for growth in this segment as most of the development has taken place in areas that are in proximity to the existing pipeline network. The pipeline network is currently mainly in the western, central and northern parts which together account for over 70 per cent of the total pipeline network in the country. Even within these regions, there are several states like Goa, Jammu & Kashmir and Chhattisgarh that are yet to be connected.

To accelerate CNG network deployment across the country, PNGRB, in recent past has invited bids (in 2009) for 13 cities in two rounds. Licences have been awarded for six new GAs in the first round under the new CNG regulations. In the case of Round 2, while the bidding process has been completed, the awarding of licenses has got stalled due to a restraining order by the Delhi High Court.

Bidding Results of PNGRB 1st & 2nd Round of CNG Authorization[15]

Bidding Round	Cities	Companies
Round I	Sonepat	GAIL Gas
	Kakinada	Bhagyanagar Gas
	Devas	GAIL Gas
	Meerut	GAIL Gas
	Mathura	DSM Infratech
	Kota	GAIL Gas
Round II	Allahabad	IOC-Adani
	Chandigarh	IOC-Adani
	Ghaziabad	IOC-Adani
	Jhansi	Central UP gas Limited
	Rajamundry	Reliance Gas Corp. Limited (RGCL)
	Shahdol	RGCL
	Yanam	RGCL

Table 1.7.1-1Bidding Results of PNGRB 1st & 2nd Round

In line with its expansion plan, in July 2010, PNGRB invited bids to develop CNG networks in eight new cities in West Bengal, Gujarat, Punjab and Haryana (Asansol-Durgapur in West Bengal; Bhavnagar, Gandhidham-Anjar, Bhuj-Mundra and Jamnagar in Gujarat; Ludhiana and Jalandhar in Punjab; and Panipat in Haryana). More recently, in September 2010, PNGRB has invited bids for another eight GAs, These are Ernakulum in Kerala, Rangareddy and Medak, Nalgonda and Khammam districts in Andhra Pradesh, Alibagh/Pen and Lonavla/Khopoli in Maharashtra, Guna in Madhya Pradesh and Shahjahanpur in Uttar Pradesh. The process was expected to be completed by January 2011. The same has now been extended further.

These projects entail an investment in the range of Rs 80-120 billion which will be spread over five years. The average investment is estimated to be Rs 15 billion in each area as these are considerably larger areas. The sale of bid documents started from July 30, 2010

[15] Source: Petroleum and Natural Gas Regulatory Board; India

and was closed on November 12, 2010. While in the earlier rounds (I and II), PNGRB had demarcated the GAs to include urban areas and other growth areas including highways, that system did not take into account rural and low demand areas. Consequently, states including Gujarat, Kerala and Andhra Pradesh had suggested considering the entire district as a GA. This may be implemented from the third round of bidding which depends on a number of factors.

Going forward, PNGRB has planned the development of CNG networks in various phases in 313 GAs in the country of which 243 GAs, identified on a suo-motu basis, are primarily located near existing, under implementation or Natural Gas pipelines approved by the Central Government.

Given PNGRB's ambitious plans, investment in this space is likely to accelerate. With an average investment of Rs 3 billion per city this translates into investments of Rs 1,200 billion in the sector in the long run (10-15-year time frame).

1.7.2 Competitive Landscape

While the sector is primarily dominated by the early entrants (MGL, IGL and GGCL), which together account for over 75 per cent of the total CNG volumes in the country, it is currently in the process of transitioning to a Competitive, Transparent and Regulated Era.

It has been witnessing increased private participation over the last few years as a number of companies like Adani Gas, Sabarmati Gas and GSPC as well as the joint venture companies of GAIL and Oil Marketing Companies (OMCs) have forayed into the segment.

Among the new entrants, GAIL (apart from its role as a joint venture partner in MGL and IGL) formed a holding company, GAIL Gas Limited in 2008, through which it is investing either directly or through independent Special Purpose Vehicles (SPVs) for each city or a cluster of cities by way of joint ventures with strategic partners.

Reliance Industries Limited (RIL) through its subsidiary Reliance Gas Corporation Limited (RGCL) is also firming up plans to enter the CNG business, almost on a pan India basis. Then, British Gas (BG) also has plans to diversify into other cities, notably in Southern States. Engineers India Limited (EIL) is yet another company that is looking to play a key role in the sector and is considering picking up equity in various companies like the Adani Group and GAIL.

1.7.3 Consumption

As per estimated of India Infrastructure Research, CNG gas consumption has increased from 5.5 MMSCMD in 2006-07 to about 13.81 MMSCMD currently and accounts for about 8.5 per cent of the total gas consumption in the country as of March 2010.

While the volumes of CNG gas consumption have increased in absolute terms by 30 per cent, CNG gas consumption as a proportion of total gas consumed declined in 2009-10. This may be attributed to the increased gas availability in the country and the slow pace of development of CNG networks because of lack of clarity on PNGRB's authority to issue licenses. In addition, demand from industrial consumers had been impacted due to the economic slowdown in global markets, and the development of trunk line infrastructure did not proceed as anticipated.

Natural Gas Consumption Pattern[16]

(in MMSCMD)

Year	CNG Consumption	Total Gas Consumption	CNG as % of Total Gas Consumption (in %)
2006-07	4.51	112.85	4
2007-08	8.44	120.63	7
2008-09	11.35	120.17	9.4
2009-10	13.81	162.64	8.5

Table 1.7.3-1 Natural Gas Consumption Pattern

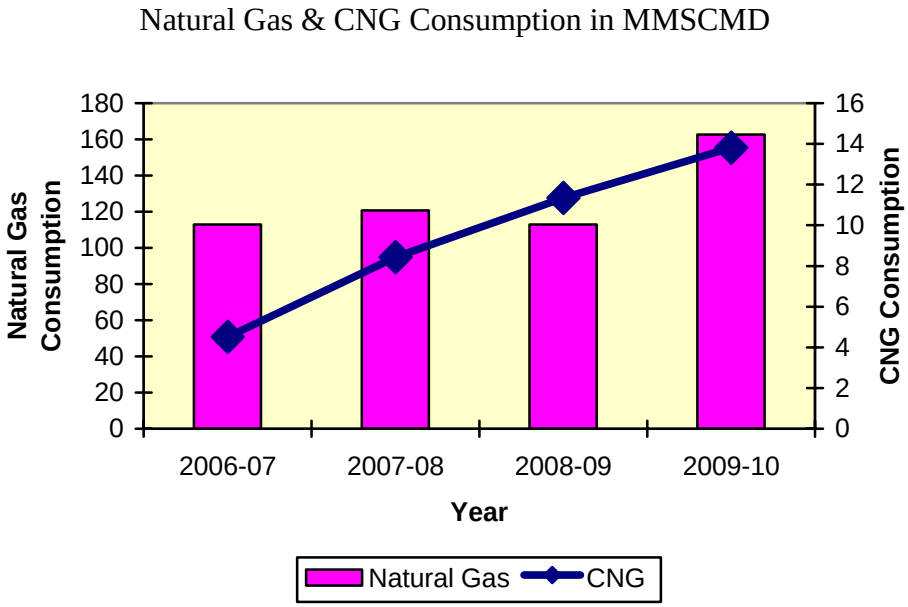


Figure 1.7-1 Natural Gas Consumption Pattern

State governments have now become proactive in developing gas markets and are interacting with the PNGRB. This is a welcome development as their proactive facilitation is a precondition to the development of gas markets in their state and many states have committed their cooperation.

On a state wise basis, Gujarat leads in terms of gas consumption and accounts for over 50 per cent of the total CNG consumption primarily due to extensive pipeline infrastructure (developed in the

[16] Source: Petroleum and Natural Gas Regulatory Board, India

1960s and 1970s to capitalize on the locally produced gas) and gas availability in the state. Amongst the other states, Andhra Pradesh has been very active and intends to build similar gas networks covering the entire state. Similarly Kerala, where the Kochi terminal is expected to come up in March 2012, is also proactively facilitating the development of the CNG network which is likely to be in place by 2012. On a city wise basis, Mumbai and Delhi, with consumption volumes of over 2 MMSCMD are the largest consumers of gas. These are followed by Surat, Ankleshwar and Bharuch in Gujarat.

1.7.4 Demand

Driven by the economic benefits of conversion from expensive alternate fuels, the industrial and commercial segments form the anchor demand for CNG and account for over 80 per cent of the total volume in a typical CNG. This demand can be captured in a shorter time frame. However, in the household segment which is characterized by high Capex, demand build-up is slow with a higher gestation period (typically 5-6 years for penetration levels of 50-60 per cent).

In terms of profitability, demand from the commercial and industrial segments provides better margins. *CNG operators make no profits from domestic supplies as the volumes are very low (often about 0.2 MMSCMD) with moderate profits from CNG sales. For instance, MGL, which has high exposure to the domestic and transport sector, despite being allocated APM gas, took 5-7 years to be profitable.*

1.7.5 Supply

CNG incumbents have not been able to grow their business because of the shortage of gas. With gas supply in the country increasing by over 30 per cent with the commencement of production from RIL's KG D6 basin and expected to increase further as new discoveries from GSPC and ONGC come online, gas allocation to CNG projects

is not likely to be a key concern. However, government policies related to gas utilization by various consumer segments and gas pricing policy remain a key bottleneck for the industry.

Importantly, while the sector was in the fourth position in the pecking order among existing users in the government's gas utilization policy, in March 2009, the government shifted the sector to second priority after the fertilizer segment. Consequently, while previously the sector was getting only small quantities or no gas from the New Exploration Licensing Policy (NELP) finds, because unmet demand from fertilizers, LPG and petrochemicals, and power plants took precedence over CNG, this scenario has changed now.

The Empowered Group of Minister (EGOM) has allocated 0.83 MMSCMD of gas to the sector from Reliance Industries D6 block in the KG basin for domestic and CNG segments. An additional 2 MMSCMD on a fallback basis for industrial and commercial segments has also been allocated. However, this is subject to RIL scaling up production from the current levels of 60 MMSCMD.

CNG operators are also sourcing gas from imported LNG available in the spot market as these are affordable currently. This is because international LNG prices have reduced in recent years because of the global economic downturn as well as large-scale production of shale gas in the US.

However, the LNG market is prone to volatility as it closely follows the crude oil market and LNG prices are also likely to start hardening on the back of global economic recovery. Moreover, LNG is more expensive; and while the CNG segment can absorb expensive LNG where it competes against high-cost fuels like Petrol and Naphtha, the Return on Investment (RoI) for CNG operators is likely to decline. **Cheaper sources of gas like the KG D6 gas are required for the CNG and domestic segment to be viable as LNG cannot be the base fuel for these segments.**

CNG companies like GGCL are building redundancies in their systems and opting for diverse sources of supply, and are procuring gas for the industrial and commercial consumer category from the open market. The existence of gas networks passing by or in proximity of the supply sources from the city limit plays a key role in reducing the capital and input gas costs and thereby enhances the project feasibility. Moreover, companies with strong parents involved in the Production and/or marketing of gas are better placed to source gas at competitive rates.

1.7.6 Pricing

The CNG segment offers significant opportunity for market play as commodity prices can be set relative to alternative fuels and competition in the industrial segment is primarily from liquid fuel (fuel oil) set at international prices CNG pricing is benchmarked to the fuel that it is substituting these alternative fuels. For instance domestic consumers switching from LPG cylinders to PNG will expect a commensurate drop in tariff just as vehicles moving from diesel and petrol to CNG need an incentive.

In fact with the declining share of APM gas, commercially discovered value based pricing has now become an industry norm. Market driven prices and high RLNG prices started finding buyers in the market from 2008 onwards, For instance GGCL (which has been dependent mainly on non-APM gas due to its focus on industrial and commercial customers) primarily relies on market driven gas pricing and has been successful

The final selling price of CNG and PNG is arrived at by taking into consideration the gas purchase price for the company and adding to it the royalty payments local taxes and transportation charges The CNG and PNG prices for three cities (Delhi Mumbai and Surat) are given in Table below.

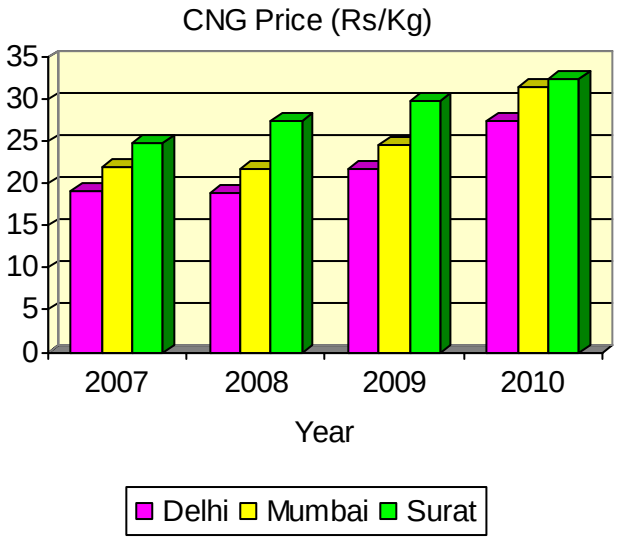
Both in the case of Delhi as well as Mumbai the CNG price declines in 2008 and rose afterwards while in Surat it has been continuously rising. Of the three cities mentioned in the table the CNG price is the highest in Surat followed by Mumbai.

City-wise CNG Prices[17]

	CNG (Rs/Kg)			
	2007	2008	2009	2010
Delhi (IGL)	19.20	18.90	21.90	27.50
Mumbai (MGL)	22.06	21.70	24.65	31.47
Surat (GGCL)	24.80	27.50	29.96	32.45

Table 1.7.6-1 City-wise CNG Prices

Figure 1.7-2 City-wise CNG Prices



1.7.7 Financing

On the financing side as the business is lucrative and has tremendous potential the equity and debt appetite seems to be big particularly in the case of Gujarat. Financial Institutions (FIs) and Private Equity funds like IDFC and IL&FS have invested in CNG companies and almost all emerging CNG companies have FIs on

[17] Source: India infrastructure Research Report

board. Moreover companies like GGCL, IGL and GSPL have successfully raised funds through Initial Public Offerings (IPOs) and more companies including MGL are likely to take this route. With the Reserve Bank of India granting infrastructure lending status to any borrowings made by companies laying down and/or maintaining pipelines for gas, crude oil, petroleum, minerals including CNG networks, availability of loan funds to CNG operators has become easy and competitive.

1.8 Regulatory Framework

The regulations governing this business are by and large conducive to the development of CNG networks and include competitive bidding for laying the pipeline along with a 25-year exclusivity for the infrastructure, *14 per cent post-tax return on capital employed (RoCE) and a tariff fixed on the basis of competitive bidding.*

Competitive bidding for new cities: The regulations envision selection of a CNG entity for any new city on the basis of competitive bidding. Apart from certain qualifying technical and financial criteria, the successful bidder will be evaluated on certain pre-defined parameters, which include the network tariff and the compression charge bid during the economic life of the pipeline (25 years), inch-kilometers of steel pipeline, and the number of domestic households planned to be connected during the marketing exclusivity period.

Network exclusivity: The regulations provide for 25-year network exclusivity for new entrants from the date of authorization. Assuming that pipeline lying would take around two years; the authorized entity would be the monopoly network provider for around 23 years.

Limited marketing exclusivity period: The regulations provide for marketing exclusivity of five years and three years for new and

existing players, respectively. Beyond this period, the pipeline will become a common carrier and open access has to be given to third parties. The regulations imply that incumbents such as GGCL, MGL and IGL will enjoy only a three-year marketing exclusivity and will be open to competition 2011-12 onwards.

Attractive assured returns: According to the PNGRB regulations, the consumer is to be billed separately for network tariff and cost of gas The network tariff will consist of normative operating costs, depreciation and assured returns CNG consumers will pay additional compression charges, as the capital cost of compressors are not loaded onto the network capital cost The regulations provide for a 14 per cent (post tax) RoCE, with actual leveraging ratio left to the investor.

Service obligations: The new regulations specify certain minimum levels of service obligations and service standards on matters relating to safety, readressal of customer complaints, and quality of Natural Gas, issue of new connections, billing, and emergency response.

1.9 Issues and Concerns

Inspite of the clear trajectory witnessed by the Natural Gas Business, scenario and ambitious game plan for future, there are still some grey areas which may impede the growth and here are the matters of concern. The researcher has tried to peep in these areas in the following part of thesis chapter:

- **Gas Sourcing:** Despite the increase in domestic supplies, gas sourcing continues to be a key concern for the CNG industry as it has to compete with bulk consumers (the fertilizer industries) and Government policies on gas utilization by various consumer segments, further gas pricing policy also remain a key bottleneck for the industry. The operators will also need to ensure multiple

gas sourcing options for flexibility in supplies and redundancy. In addition, access to gas at competitive rates will be critical, since the price realized by the companies on CNG and PNG will be a function of the price of alternative fuels.

- **Regulatory Hurdles:** With the notification under Section 16 of PNGRB Act, 2007 and uncertainty over the gas allocation policy coming to an end, regulatory issues have been addressed for most of the part. *However, to expedite CNG network development, the government needs to facilitate local approvals (single window clearances against the current system of getting permissions from multiple agencies)* and ensure that the gas pipeline infrastructure is not limited to isolated pockets and that even villages have access to gas. But, the service obligations and tariff considerations are not very encouraging and need to be reviewed.

- **Slow Demand Build-up:** The CNG business is capital intensive. While a typical CNG network costs around Rs 3-4 billion to service volumes of a level of around 1.5 MMSCMD, *the long gestation period coupled with low volume off-take can adversely impact the CNG business. In order to counter the low demand,* the CNG operator may consider linking with a bulk existing customer in the region.

The feasibility of a city gas project is highly sensitive to the demand the company is able to capture, and is thus exposed to demand risk. The project is also exposed to price risk due to the probable mismatch in the movement of input gas price and selling price. The project could also be exposed to the residual risk created by the difference in the terms and conditions of contracts with suppliers and buyers.

In addition, managing gas prices as against other competing fuels is also a area of concern. For instance, *the high prices of LNG are likely to have an adverse impact on the conversion economics from*

heavy fuel oil to Natural Gas for any industrial application. Similarly, in the case of LPG, the price differential is sensitive to gas prices and also accounting of subsidies for LPG.

For CNG networks to accelerate, it is imperative to include CNG networks in city development plans and give it the status of an essential utilities service.

1.10 Future Outlook and Projections

The CNG segment is poised for strong growth in the future with 42 GAs already in operation, another 20 under development and a third round of bidding underway.

With the notification of Section 16 of the PNGRB Act 2007, their plans are on track for the network to expand to over 200 cities in the next five to seven years at an investment of over Rs 600 billion.

However, according to sector experts while CNG network deployment will accelerate its pace and is not likely to be as rapid as is being envisaged by the PNGRB. The industry is of the view that CNG networks are likely to be in place in only about 100 cities in the time frame of about five to seven years as laying of the transmission pipelines is likely to progress at a slower pace.

Most of the demand for the Industrial and Commercial segments is likely to be met by RLNG, as a result of which the margins of CNG companies are likely to reduce. While the possibility of new discoveries is likely to make more gas available for cities, there is still no indication that companies will be free to market their own gas after the expiry of the Gas Utilization Policy in 2012. The uncertainty in gas availability for CNG networks will be a major risk for new entrants.

On the demand side, while the increase has so far been driven because of an increase in the number of cities coming under the CNG umbrella. As customer penetration reaches levels of over 50

per cent for most companies, a more realistic pattern in demand is likely to emerge. According to GAIL's estimates, the demand is expected to rise to 31 MMSCMD by 2016-17.

Industrial clusters in states like Andhra Pradesh, Karnataka and Madhya Pradesh are expected to drive a large part of the demand similar to Gujarat. In addition demand from the transport and residential segments will also drive growth for the CNG companies Demand for each city is expected to be between 0.5 to 4 MMSCMD depending on the population vehicle density, and extent of industrialization.

As the sector witnesses the entry of new players and a further rationalisation of gas prices, the profitability levels of the incumbents may decline. However, the profit margins of these companies are still likely to be adequate in absolute terms and these companies are likely to continue to have a dominant market share in gas marketing, in addition to their monopoly as network providers. This is because, incumbents with a sizeable CNG and piped gas customer base will be protected by the entry barriers they have built up in the form of relationships with oil marketing PSUs, network exclusivity and the number of CNG stations owned by them.

Service offerings of CNG operators are likely to evolve as companies in this segment start offering bundled energy solutions to consumers that are likely to include emerging technologies such as gas engines, vapor absorption chillers, waste heat recovery systems, fuel cells and micro-turbines.

Clearly on the back of a formidable pipeline network and players with ambitious investment plans, cities and towns across the country are likely to use more of this fuel. With such ambitious plans on the anvil, the sector offers a good opportunity for investment and immense scope for existing and private players.

2. RESEARCH METHODOLOGY

2.1 Introduction

This chapter is concerned with the research methodology adopted for achievement of the objectives of the study undertaken. This explains the rationale of the study followed by the statement of the research problem, scope of the study, objectives of the study further explaining the research design and sampling process and its selection. It further explains procedure of data collection and development of questionnaire and then concludes with explanation of the procedure of analysis & its presentation and discussing the limitation of the study.

2.2 Rationale of the Study

Rational for the instant study is derivation of literature review and information analysis from secondary data. In India, currently CNG is available to particular cities only. The details of these cities are discussed in-depth in the Literature Review chapter.

Because of high environmental pollutants there was increase in pollution of Indian metro cities like Mumbai, Delhi and Kolkata. The emission level from the vehicle specifically commercial vehicle became so high that it became difficult for gentry to breathe. The increasing asthmatic and other lungs related diseases drive the attention of some responsible citizens towards the infringement of fundamental right under the article 21 of the constitution viz Right to Life and Personal Liberty. This resulted in brining of Public Interest Litigation in Supreme Court of India in 1998. As a result of it, the apex court directed the respective Government to instantly introduce CNG as an alternative automobile fuel.

Researcher named this phase as ‘Indian Fuel Revolution’ (IFR). As a result, of IFR, CNG was made available as an alternative ‘Clean

Fuel' in metro cites. This brought a comma in increasing pollution in metro cities of India. In order to, implement the orders given by Apex Court, the government subsidies the conversion of engines of Diesel commercial engines and also made an attempt to establish CNG fuelling stations to prominent location so that whole city can be served with lesser waiting time for refueling the CNG vehicle.

CNG as a fuel was also at much cheaper rate than the traditional pollution creating fuels. This invocation of IFR made a successful attempt to make the metro cities 'Clean Fuel Sufficient'

The reduction in pollution and economic advantage made CNG popular in other parts of the country, as an another attempt, Government of other States also become interested in introduction of CNG as a fuel in replacement of high pollution creating & comparatively disadvantageous fuel like Petrol, Diesel & Kerosene.

In an Opinion of Researcher, it is needless to doubt that the Natural Gas distribution Infrastructure will facilitate equitable geographic distribution for economic benefit arising out of the utilization of 'Clean and Cheap' fuel viz. CNG. This will also make the Gas available to customers who are remotely located and were helping, facilitating monetization and development of Gas field which may otherwise remain scattered and devoid of market access. The pipeline network, if created will provide the cheaper and environment friendly alternative fuel and would also attempt to reduce Import Dependency of Petrol/Diesel as Natural Gas is a good substitute.

Till now, CNG is made available by 22 entities in 76 cities of India. These cities of India though are connected through various National Highways, but then has a disconnect from the point of view of clean and Cheap Fuel availability.

This invoked the Researcher to conduct a Research Survey along with analyzing the Financial Feasibility of making the CNG available on National Highways.

As highway connecting the National Capital and Commercial Capital (viz Delhi and Mumbai respectively) is National Highway number 8, which is also an arm of Golden Quadrilateral of Highways as indentified by National Highway Authority of India (NHAI). The researcher found it most suitable for studying the feasibility model of CNG Distribution. Moreover, CNG is easily available in Delhi, Mumbai and the cities of Gujrat which lies on NH8. Therefore, the probability of availability of CNG along NH8 is more than any other road network. This became another important reason for choice of NH8 for doing the feasibility study.

Meanwhile, the Ministry of Petroleum and Natural Gas, Government of India was processing the plan of developing the National Gas Highway Development Authority, inline with NHAI. For which it has circulated a draft note to seek comments from the various Ministries in the year 2009. The proposed authority had to undertake the issues related to planning and funding of Gas Highways. The idea was to cover the entire country with pipelines network so that, the Gas as and when available from various sources can be made available to end consumers.

Unfortunately, no action plan has been laid down till date, regarding the mode of finalizing the same. But the survey of literature, throws some light on what can be the possible alternatives available.

Therefore, an attempt has been made by the researcher to study and analyze the suitable project implementation model among the Private, Government and Public Private Partnership for distribution of CNG along National Highways.

2.3 Statement of the Problem

Sustainable Development is the burning issue of time and when it comes to question of environmental protection, it is immense concern not only by a country but at world level.

CNG is on one hand environmental friendly but also on other hand ensures economic advantage. Most of the public & commercial transport is done through roads via National Highways. These National Highways connects the almost all and every major cities of the country. The fleets on the highway today are fuelled using diesel, which is not only costly but also a reason for increasing pollution as compared with CNG.

Against this backdrop, the present study explains the feasible project execution model for implementation of CNG distribution along National Highways. The statement of research is as follow:

'An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway'

The purpose of the research is to suggest best Project Execution Model among the following three:

1. The whole project be executed and implemented by PSUs or is funded by the Government i.e. **Government Model**

OR

2. The project cost may be shared among the Public and Private Entities i.e. **Public Private Partnership (PPP) Model**

OR

3. The project cost to be borne wholly by one or more private players i.e. **Private Model**

2.4 Scope of the Study

Every research must identify its scope of study. Much wider scope may lead to failure and narrow scope would not solve the purpose of research. Therefore, an appropriate well defined and clear scope will result in fruitful implementation of the conclusive & suggestive framework of the research. The researcher has divided the scope of the present study into two following Parts:

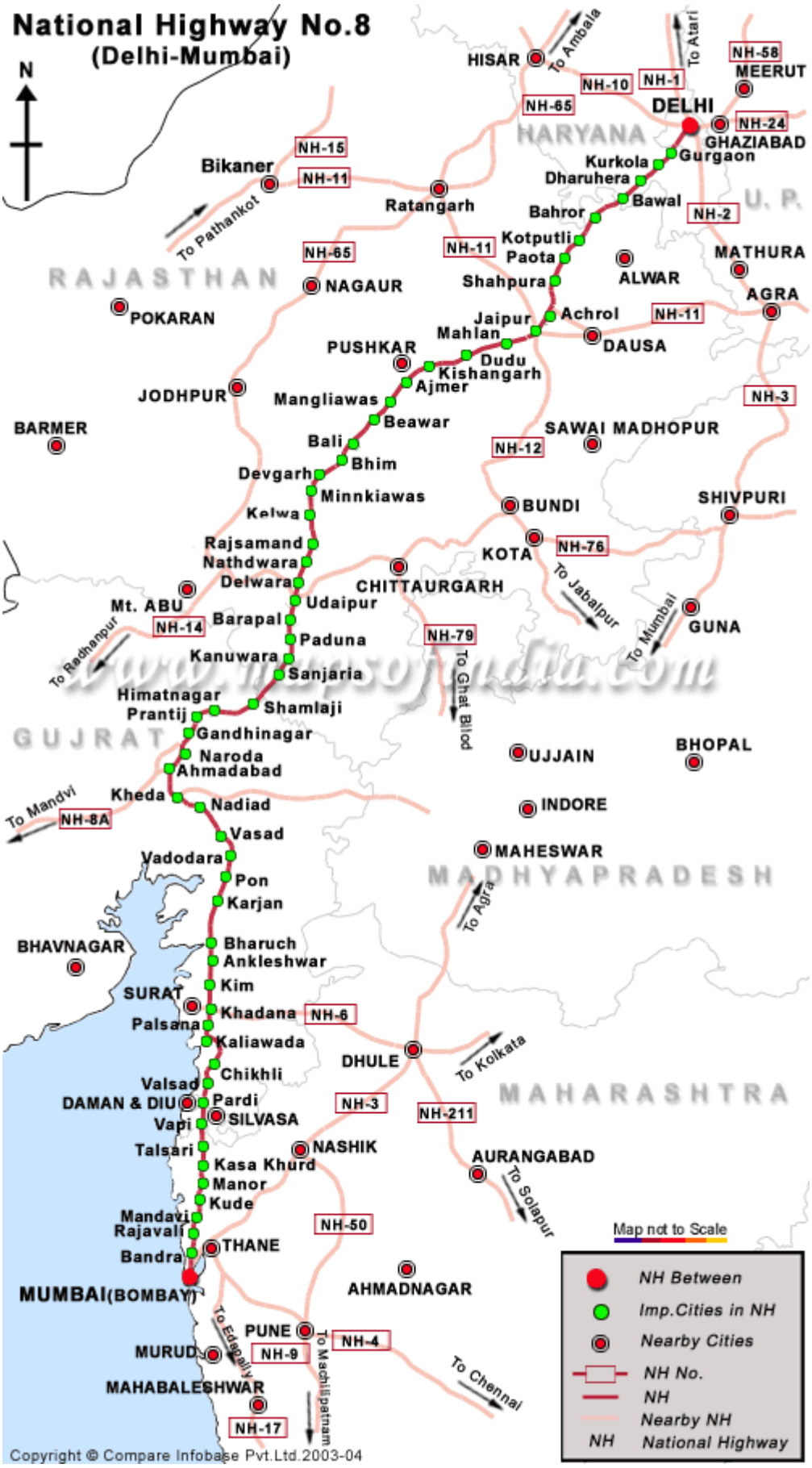
2.4.1 Geographical Scope

The present research case is based on National Highway No. 8 (NH8). NH8 runs from Delhi in the Northern part of India to Mumbai in the western part of the country. Both are biggest metro cities of India. Therefore, highways connecting to these cities have been considered for the study. The total length of NH8 1428 Km. This National highway cut through the states of Delhi, Haryana, Rajasthan, Gujrat and Maharashtra. The ***researcher has made an attempt to study the feasibility model for distribution of CNG along NH8 so that commercial and other automobile vehicle may travel on clean, green and economic fuel.***

The map of National Highway number 8[18], showing the major cities is placed below:

Figure 2.4-1 Map of National Highway number 8

[18] Source: http://www.mapsofindia.com/driving-directions-maps/nh8-driving-directions-map.html


National Highway No.8
(Delhi-Mumbai)
N
HISAR
To Ambala
To Atari
NH-58
MEERUT
NH-10
NH-1
NH-65
DELHI
NH-24
GHAZIABAD
HARYANA
Gurgaon
Kurkola
Dharuhera
Bawal
Bahror
NH-2
U. P.
Bikaner
NH-15
NH-11
Ratangarh
To Pathankot
Kotputli
NH-11
Paota
MATHURA
NH-65
RAJASTHAN
NAGAUR
ALWAR
Shahpura
AGRA
POKARAN
Jaipur
Achrol
NH-11
Mahlan
DAUSA
PUSHKAR
Dudu
Kishangarh
Ajmer
JODHPUR
Mangliawas
NH-3
Beawar
BARMER
Bali
SAWAI MADHOPUR
NH-12
Bhim
Devgarh
Minnkiawas
Kelwa
BUNDI
SHIVPURI
Rajsamand
Nathdwara
KOTA
NH-76
Delwara
CHITTAURGARH
To Jabalpur
Mt. ABU
Udaipur
To Mumbai
GUNA
NH-14
Barapal
To Radhanpur
Paduna
NH-79
Kanuwara
Sanjaria
To Ghat Bilod
Himatnagar
Prantij
Shamlaji
Gandhinagar
GUJRAT
Naroda
Ahmadabad
UJJAIN
BHOPAL
Kheda
Nadiad
To Mandvi
NH-8A
INDORE
Vasad
Vadodara
MAHESWAR
Pon
MADHYAPRADESH
Karjan
To Agra
BHAVNAGAR
Bharuch
Ankleshwar
Kim
SURAT
Khadana
NH-6
Palsana
Kaliawada
DHULE
To Kolkata
Chikhli
Valsad
MAHARASHTRA
DAMAN & DIU
Pardi
NH-3
NH-211
SILVASA
Vapi
Talsari
NASHIK
AURANGABAD
Kasa Khurd
Manor
To Solapur
Kude
Mandavi
Rajavali
NH-50
Map not to Scale
THANE
Bandra
NH Between
Imp.Cities in NH
AHMADNAGAR
MUMBAI(BOMBAY)
Nearby Cities
PUNE
To Machilipatnam
NH-4
NH No.
To Edgaon
MURUD
NH-9
NH
To Chennai
Nearby NH
MAHABALESHWAR
NH
National Highway
NH-17
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2.4.2 Operational Scope

The instant research is based on analyzing the implementation of CNG distribution model along National Highways; it is very heavy capital intensive project with low gestation period. ***The operational scope of the project lies in Identification of appropriate and feasible project execution model among the Private, Government, and Public Private Partnership with respect to ownership and execution.***

2.5 Objectives of the Study

Following are the complied objectives of the study:

- To determine the **Current Status of CNG Distribution** systems in India
- To determine the **factors affecting CNG distribution business** in India
- To evaluate the project ownership and execution **Feasibility Model** for CNG Distribution along NH8 among Private, Government, and Public Private Partnership model
- To form the **Suggestive Framework** for implementation of CNG Distribution Project along NH8

2.6 Review of Literature

The Literature review is an in-depth evaluation of the research already done and helps in collection of certain information which can be used in the present research. It is one of the most important tools of identifying that, what has already been considered in similar research problems.

An immense Literature Review in the present research has been done keeping in mind, the coverage of the present research which not only covers the academician research done by the previous researcher but also the investigation done in Oil and Gas Industry by Government agencies like Ministry of Petroleum and Natural Gas (MOPNG),

Petroleum Planning and Analysis Cell (PPAC), Planning commission etc. Further, researcher has also gone through, the work done and published by Research Analysts, International Bankers, Indian Corporate and Consulting firms with specific reference to Oil and Gas Industry.

Through Literature Review, an attempt has been made by the researcher in accomplishing the second objective of determining the various factors affecting the CNG distribution business and also gives an idea about ownership model which can be used in such type of Projects. Further it was then analysed to what extent the factors so identified are concerned with Indian Scenario.

Moreover, the Literature Review has framed the base of inputs for the construction of Questionnaire by which collection of Primary Data has been done.

Following are the areas on which review of Literature has been done:

- Natural Gas Industry
- City Gas Distribution
- Public Private Partnership
- Project Finance & Risk Management in Infrastructure Projects

2.7 Research Design

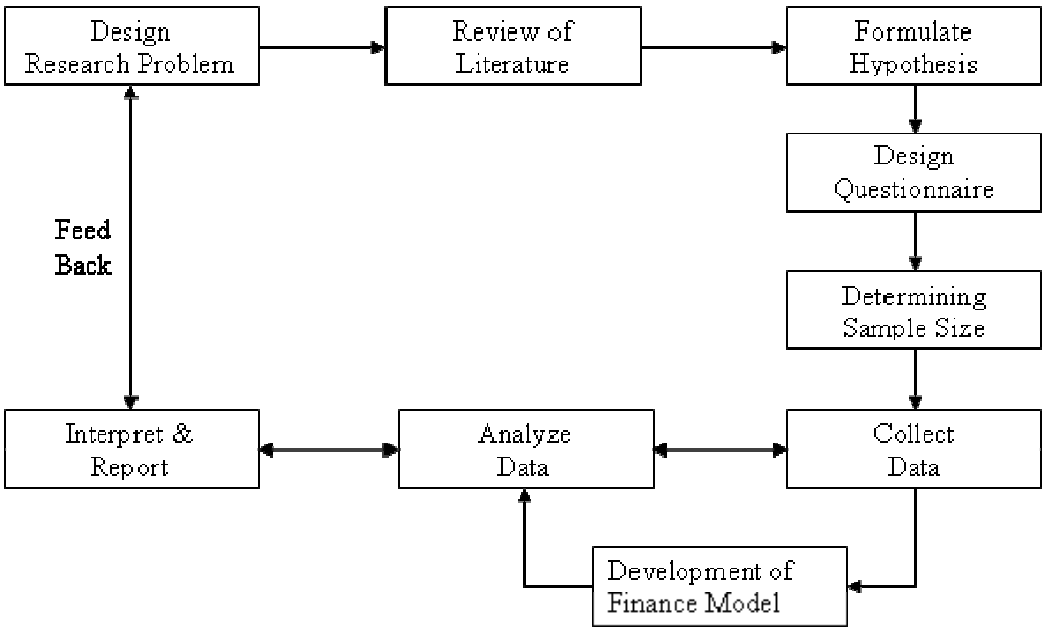
The research design chosen to undertake the present study is exploratory research. The rationale for choosing Exploratory Research is to get insights into, and develop understanding of the problem, to define it more precisely before identifying the relevant course of action and developing an approach.

The present research design aim at, Identification of Project Implementation Model for Distribution of CNG along National Highway which are a Capital Intensive with a high gestation period.

The motivation behind doing this research has already been stated in the above paras. A research design is a framework or a blue print for conducting the research project which specifies details of procedure necessary for the obtaining information needed to structure and solve the research problem.

In the present study, the researcher defines the problem, collect and organize the data through various tools of Research Methodology and analyze them to get results. In order to carry out the present research work, a systematic 8 step research process has been followed which has been shown as a flow chart in the following figure.

Figure 2.7-1 Research Process



For achievement of first and second objective, the researcher under gone the immense review of literature. The first objective has been accomplished vide chapter number one i.e. Introduction to CNG distribution in India.

The identification of factors affecting the CNG distribution in India can be obtained by chapter number three of Review of Literature, which has also formed the base for preparing the Questionnaire for

collection of Primary Data. The Questionnaire has been divided in four parts:

a. Demographic Information

b. Attributes of CNG distribution business in India

c. Distribution of CNG along NH8

d. Project Ownership and Execution Model for CNG distribution

The analysis of Questionnaire fulfills the third objective, which involves the feasibility of CNG distribution on NH8. As per the opinion of top executives of Domain corporate which are in similar or allied business. The analysis of primary data is supported with Financial Feasibility of project execution model using the tools of Financial Management. This part of research work is the most important and Quantifiable, as the results are coming out with the financial model. For this, the researcher has tried to collect the relevant secondary data from various sources like research journals, annual reports and various websites. The secondary data is used to develop the complex Excel based model which will evaluate the optimal project model for CNG distribution among Government, Private and PPP.

A Suggestive framework can be framed for the Government to implement the said project on the basis of various conclusions made which comes out as a fulfillment of fourth objective of the research.

2.8 Sampling Procedure

Sampling is that part of statistical practice concerned with the selection of a subset of individual observations within a population of individuals intended to yield some knowledge about the population of concern, especially for the purposes of making predictions based on statistical inference.

In the present study, the researcher has used Judgmental Sampling method, which is a Non-Probabilistic technique of sampling. In this technique, the population elements are selected based on the Judgment of the researcher. The researcher has chosen the individuals to be included in the sample because it is believed that they are the representatives of the industry or allied sector of similar Nature.

As the study is confined to analysis of Implementation of CNG distribution project, it is only the Judgment Sampling which is the most appropriate technique.

2.9 Procedure for Data Collection

In order to achieve the objectives of the present research, data was collected through Secondary and Primary sources.

2.9.1 Secondary Data

The first source of data for this study was secondary source from which theoretical background, conceptual framework and statistical data on Natural Gas and CNG industry were obtained. For secondary data, researcher visited to different libraries and collected material on the topic. Specific being: Library of University of Petroleum and Energy Studies, GAIL (India) Limited Corporate office Library, GAIL (India) Limited Noida Training Center Library, GAIL (India) Limited Jaipur Training Center Library, All India Institute of Management Studies Library, Library of Delhi University and ICFAI National School Library, Delhi.

The use of internet was also of great help to the researcher as the various search engines namely, google.com, yahoo.com, exp.com, respond.com, indiatimes.com, altavista.com and others. The website ssrn.com also proved very helpful where researcher found good repository of international research papers.

The websites of magazines, such as DEW journal, Business World, Business Week, and Business Line were also used in collecting data. Website of a number of government and non government such as Ministry of Finance, Ministry of Petroleum and Natural Gas, Petroleum Planning and Analysis Cell, Petroleum and Natural Gas Regulatory Board, Indian Petro, Infraline, Energy line etc also helped in collection of many relevant information.

The financial data and study of future CNG distribution which were used to fulfill first and third objectives were collected from the annual reports of several Oil and Gas companies, Research Reports of Analysts etc. The huge amount of matter collected from various websites was sorted out and scrutinized as relevant to the study. The exhaustive list of websites visited during the research phase by researcher is made as a part of Bibliography.

Newspapers always have been a very important secondary information source for the researcher. The researcher used the Economic Times, Business Line, DNA, Hindustan Time, Times of India and Mint as a source for secondary data.

2.9.2 Primary Data

For partial fulfillment of the third objective, primary data was required. It has been discussed in earlier that for Data collection four parts of Questionnaire has been designed. First comprise of the Demographic aspect of the respondents, second helps in studying the attributes of existing distribution of CNG, third generated the idea about distribution of CNG along Delhi Mumbai National Highway, and fourth, attempt to take opinion of the feasible project execution and ownership model among the Private, Government and PPP model.

The Questionnaire for the purpose comprises of 73 questions in all and is designed in such a manner that a respondent is required to

simply put a tick (✓) mark or rank from 1 to 5 as a part of response (and nothing to elaborate / essay type to be written).

It was endeavour that questions do not seek any specific details about business, however at the same time research objective is to be met. This exercise of submitting Questionnaire took 15-25 minutes of the respondent's precious time. The Questionnaire was made available online. All the 67 participants filled the questionnaire online.

2.10 Formulation of Hypothesis

Research hypothesis was formed to conduct the research work, which was based on the following Research Questions:

1. Whether Indian Economic and Infrastructure Strength is efficient enough for distribution of CNG or Not?
2. Whether it is possible to distribute the CNG along NH8 or not?
3. Which of the Project execution and ownership model will be most appropriate for CNG distribution project along National Highways?

On the basis of above, following research hypothesis can be framed:

> 'The distribution of CNG along NH8 depends on Infrastructural & Economic Strength, using one of the execution and ownership models'

2.10.1 Analysis and Interpretation

The Filled up questionnaire formed the base generating master data sheet. The data was then tabulated classified and analyzed using ratios and percentages. Then same was presented graphically following the interpretation of the same.

The detailed analysis, interpretation and discussion of Primary and Secondary data have been presented separately in chapter no.5 and 6 respectively.

In order to support the analysis of primary data, secondary data was also put into the Financial Model to arrive at a conclusive and suggestive framework. The tools of Financial Management like Payback period, Discounted Payback period, NPV, IRR was used in complex excel based model further, sensitivity analysis was also done to check the effect of changes in fixed and assumed figures. The excel sheet of the calculations are annexed for reference.

2.11 Chapterisation

The proposed chapter scheme for the thesis is as given below:

1. **Introduction:** This chapter briefly covers Backdrop for the Study covering the overview of Natural Gas business. The details of CNG Business covering first International Perspective and followed by CNG evolution in India. This chapter also briefly covers the current status of CNG distribution in the country. The status mainly includes Operations, Competitive Landscape, Consumption, Demand, Supply, Pricing and Financing. Further, Researcher in this chapter also explained the Regulatory Framework, Issues, Concerns and future outlook and projection.
2. **Research Methodology:** The researcher has state the conceptual structure within which the research was conducted. This chapter broadly covers Rationale of the Study, Statement of the Problem, Scope of the Study, amount of Review of Literature, Research Design, Sampling Procedure, Formulation of Hypothesis, Analysis and Interpretation and Limitation of the Study.
3. **Literature Review:** This chapter was foundation laying stone for the thesis and it strongly covers the Natural Gas Industry

Review from Global and domestic perspective. The review not only limited to Natural Gas but also covers the CNG distribution in India and Abroad. Review of Regulatory frame work for Natural Gas industry in India is also been reviewed.

4. **Primary Data Analysis:** Analysis of Survey Questionnaire is elaborates in this chapter.
5. **Analysis of Financial Model :** Financial Analysis along with Sensitivity to Identify Appropriate Project Execution Model among Government, Public Private Partnership (PPP) & Private for Distribution of Compressed Natural Gas (CNG) along the Delhi-Mumbai National Highway (NH8) is covered in this chapter.
6. **Natural Gas Highway & its implementation:** This chapter covers the study of important aspect of '**An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway**'. This chapter specifically elaborated the rationale for Highway wide CNG distribution and selection of Delhi Mumbai (NH8) for the instant research case and other relevant areas of study like Gas availability along NH8, CNG distribution requirement along NH8. This chapter also covers the Operation and Management aspect of CNG distribution requirement along NH8 covering CNG locations and its spread, CNG station ownership, standardisation of CNG layout & design, CNG equipment Supply and its maintenance, CNG vehicle financing, CNG Kit supplier and its installation, monitoring of CNG conversion centre etc.
7. **Conclusion & Suggestions**

2.12 Limitation of the Study

No research is complete without mentioning the limitations. These limitations arise due to inherent flaws in any given method. Application of any research work without considering its limitations

may give wrong results and the wholesome purpose of the research gets distorted.

In this research the following limitations have been mentioned by the researcher.

1. This research is limited to CNG distribution only.
2. The geographical coverage has been confined to the Delhi Mumbai National Highway.
3. Only three project execution model are considered while working out the feasibility of distribution of CNG. The three models considered here are Government, Public Private Partnership and Private model only.
4. The responses were taken from the executives of Oil & Gas Companies, Oil & Gas Research Analyst, Oil & Gas Consultant and PPP Companies other than Oil & Gas. The majority of the respondents are from the same sector in which study is being carried out.
5. As the research is carried only on Delhi Mumbai National Highway only, therefore the interpretation and analysis may be considered for the rest of the National Highways of India, but may not be feasible for city specific distribution project.
6. The appropriate implementing model for CNG distribution along NH8 has been analyzed using financial ratios and some key performance indicators like NPV, IRR and payback periods.
7. The data taken for analysis are based on the information in annual accounts of the company which sometimes may not give true and fair view and may also be affected by window dressing.

8. Although the sample size was sufficient in terms of survey research, a larger response would have increased the power of statistics and brought greater confidence to the results. In Indian Oil and Gas industry, the population is evenly scattered and therefore data collection has been done in such a manner so as to meet this limitation.

3. REVIEW OF LITERATURE

The topic for the instant study is '**An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway**'. Considering the coverage of this research, a detailed review of existing literature has been conducted which not only covers the academic research done by previous researchers but also the research or investigation done in Oil & Gas industry by Government Agencies like Petroleum Planning & Analysis Cell (PPAC), Ministry of Petroleum & Natural Gas (MOP&NG), Research Analysts, Investment Bankers and also Indian Corporate and Consulting Firms with specific reference to the Oil & Gas industry. Accordingly, the Researcher has bone through the following Literature:

- Natural Gas Industry
- City Gas Distribution
- Public Private Partnership
- Project Finance & Risk Management in Infrastructure Projects

3.1 Natural Gas Industry

3.1.1 Natural Gas Basics

Natural gas is an important source of energy in the world. It is combustible in nature which results in emission of a great amount of energy when burned. Natural gas is combustible as it is a mixture of hydrocarbon gases. Any organic compound consisting only of carbon and hydrogen is known as a hydrocarbon. Hydrocarbons generate heat when burnt.

Hydrocarbon reserves evolve naturally and are derived from decomposition of organic matter, algae and bacteria trapped and

preserved in sedimentary deposits. The burial of these deposits and the corresponding increase in heat and pressure decomposes the organic matter. This breaks down the complex hydrogen and carbon molecules and converts them into solid, liquid or gaseous hydrocarbons known as fossil fuels. Natural gas is a mixture of these gaseous hydrocarbons. It is obtained either as an associated gas along with crude oil or as free gas from independent gas fields. Crude oil and coal are the other forms of hydrocarbons.

3.1.2 Global & Domestic Natural gas resources and trade

Internationally, high concentrations of natural gas reserves are found in Eastern Europe, Commonwealth of Independent States (CIS) and the Middle East. In the Middle East and Africa, large quantities of natural gas reserves have been discovered over the past 15-20 years. On a country level, the Russian Federation (24 per cent) and Iran (16 per cent) have the largest share of natural gas reserves. In terms of production, the US is the largest producer with 20 per cent share, followed by the Russian Federation, with 18 per cent.

Figure 3.1-1 Proven Global Natural Gas Reserves

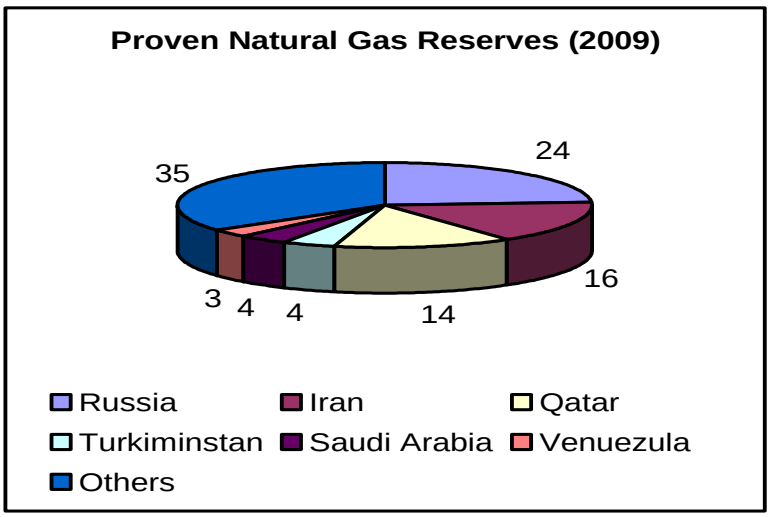
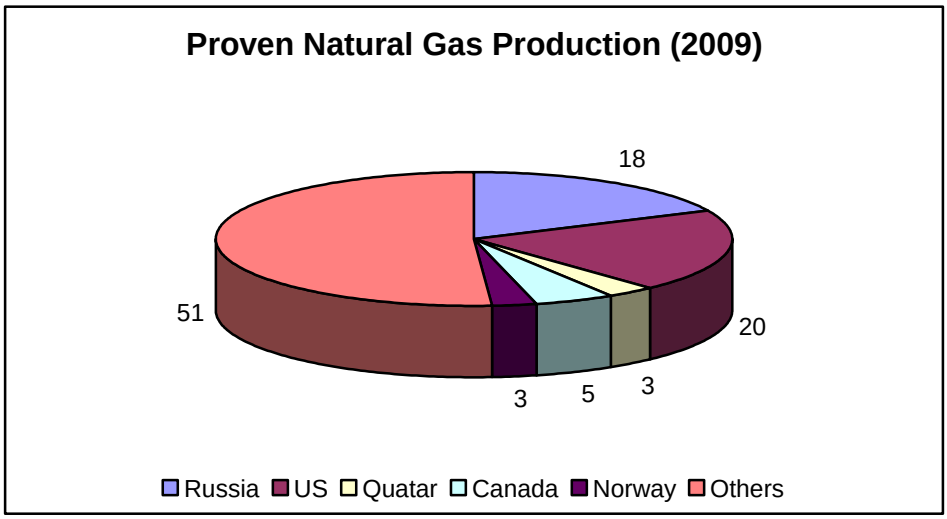


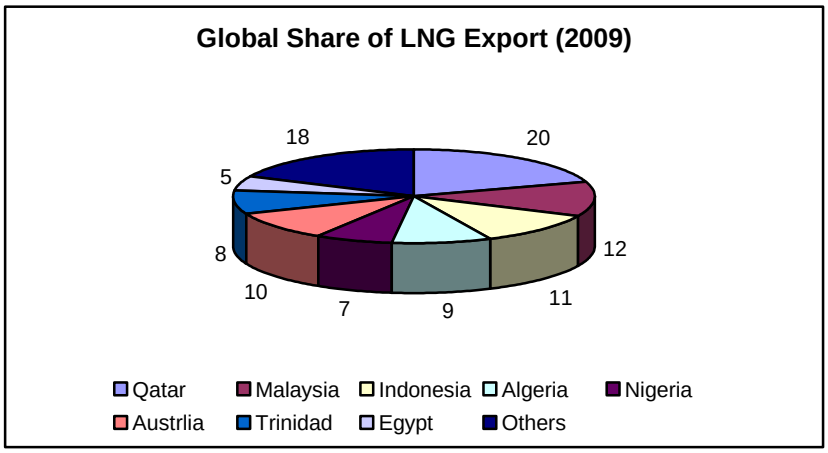
Figure 3.1-2 Proven Global Natural Gas Production



Source: BP Statstical Review of World energy

Globally, natural gas production has been increasing steadily from 1,970.4 bcm in 1990 to 2,987.0 bcm in 2009. Between 2004 and 2009, the production of natural gas increased at a CAGR of 2.1 per cent. Similarly, there has been a steady increase in global trade of natural gas (pipeline and LNG imports). The global trade in natural gas in 2009 amounted to around 633.7 bcm, with 390.9 bcm coming from pipelines. LNG trade accounts for a considerable portion of this increased natural gas trade due to the emergence of large gas markets in Japan and South Korea, where natural gas cannot be supplied through pipelines due to topographical constraints. Between 2004 and 2009, LNG trade rose at a CAGR of around 6.1 per cent to 242.8 bcm. In 2009, LNG trade accounted for around 38.3 per cent of world trade in natural gas.

Figure 3.1-3 Global Share of LNG Export



Source: BP Statstical Review of World energy

Domestic reserves: India's total proven reserves of natural gas, as of 2008-09, was around 1,074 bcm. This was marginally higher as compared to reserves of 1,050 bcm in 2007-08. In 2009, the country's total gas production was around 39.3 bcm, as compared to 13.4 bcm in 1991. At this production rate, India's reserves are likely to last for 34-36 years, as compared to oil reserves of 18-21 years.

Earlier, the majority of domestic natural gas reserves were concentrated in the offshore gas fields at Mumbai High. However, huge finds have been made by RIL, ONGC and Gujarat State Petroleum Corporation Ltd (GSPC) in the offshore KG basin area of Andhra Pradesh. Onshore reserves are primarily located in Rajasthan and the north-eastern states of Assam, Nagaland, Arunachal Pradesh and Tripura.

3.1.3 Natural Gas Consumption: Global & India Scenario

Trend in global natural gas consumption

Globally, Natural Gas consumption has shown an increasing trend over the years. Of the total world Primary Energy consumption, the share of Natural Gas increased from 20.2 per cent in 1982 to 23.7 per cent in 2009. Global consumption increased from 650.9 bcm in

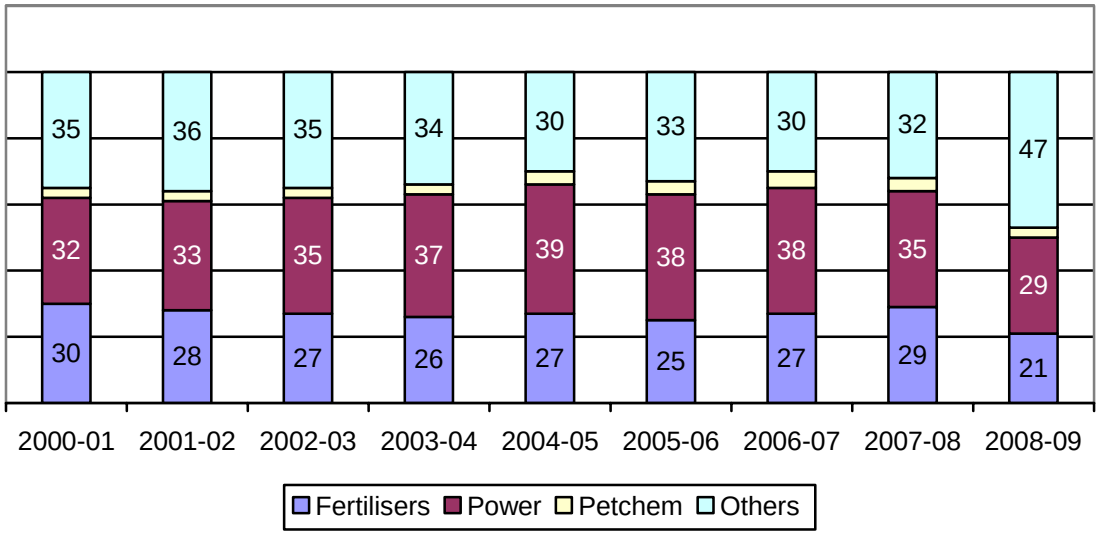
1965 to 2,940.4 bcm in 2009 a compounded growth rate of 3.4 per cent. The US, Russia, Iran, Canada and the UK are the key consumers, accounting for over 46 per cent of global consumption in 2009.

Trend in domestic natural gas consumption

Domestic consumption of natural gas has shown a rising trend increasing from 2.2 bcm in 1981-82 to 43.0 bcm in 2008-09– a compounded annual growth rate of 11.2 per cent. The primary consumers of natural gas are sectors like power, fertilisers and petrochemicals.

Domestic natural gas consumption is driven by the fertilisers and power sectors, which together accounted for over 50 per cent of India's domestic natural gas consumption in 2008-09. Fertilizers[19] accounted for 21.1 per cent while power accounted for 29.3 per cent of total gas consumption of 43.0 bcm in 2008-09.

Figure 3.1-4 Domestic natural gas consumption



[19] Source: MOPNG web site

Researcher has summarized the current sources of Natural Gas in the following table:

Current availability[20] of Gas

Source	Daily Average Availability of Gas (MMSCMD)
ONGC	52.83
OIL	5.19
PMT	14.59
Other JV	2.84
KG-D6	60.00
R-LNG	32.35
Total	**167.80**

Table 3.1.3-1 Current Domestic Natural Gas availability

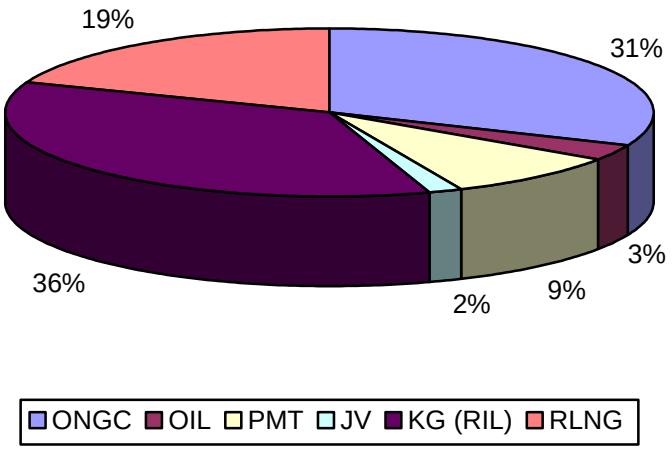


Figure 3.1-5 Current Domestic Natural Gas availability

Similarly, an attempt is made by the Researcher to collect the current customers profile for Natural Gas. The same is given in the following table:

[20] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

Present Daily supply[21] of Natural Gas

Sector	Daily average Supply (MMSCMD)
Power Sector	69.22
Fertilizers	38.50
Refineries	16.61
Petrochemicals	7.75
Sponge Iron	8.00
City or Local Natural Gas Distribution Network	9.23
Internal Consumption - pipeline system	2.36
Shrinkage for Liquid extraction - LPG etc.	6.01
Others	10.13
Total	**167.80**

Table 3.1.3-2 Present Daily supply of Natural Gas

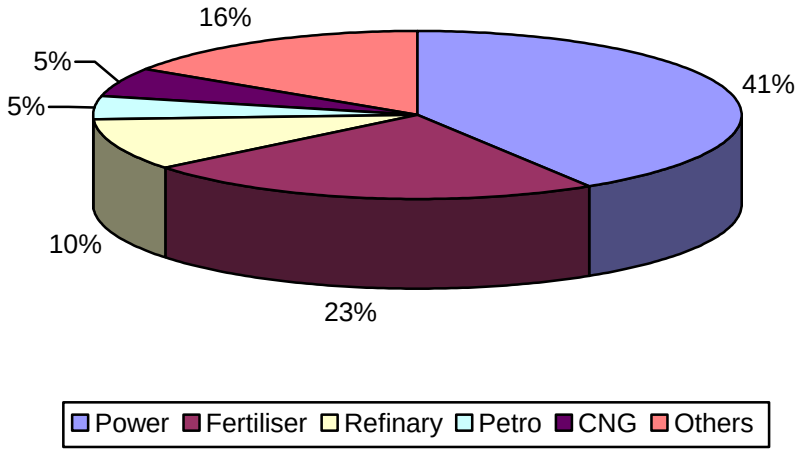


Figure 3.1-6 Present Daily supply of Natural Gas

3.1.4 LNG

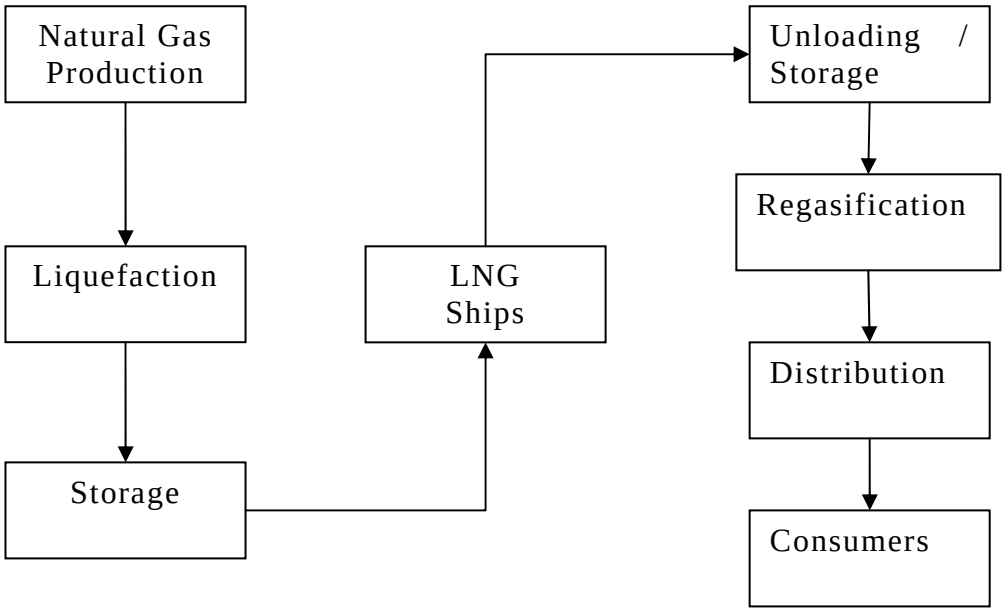
Natural gas can be converted into liquid form which reduces its volume by around 600 times. This form is known as liquefied natural gas (LNG). This property helps in cost-effective transportation of natural gas over long distances. Demand for natural

[21] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

gas has increased over the years. As the key producing countries and the key consuming countries are geographically wide apart, demand for LNG has increased. LNG is transported through ships from the producing countries to the consuming countries, where it is re-gasified and distributed. The chart given below explains the LNG chain.

LNG chain[22]

Figure 3.1-7 LNG Chain



Commercial aspects of LNG

Based on the specific needs of each transaction, contract structures can also evolve into the following three types:

» Integrated agreements: The fields, terminals and, at times, ships (e.g. RasGas, Qatar) are owned jointly.

[22] Source: Crisil Research Report published in September 2010

» Transfer pricing agreements: The fields and terminals are owned by different parties (for instance, Malaysian LNG Dua). This involves transfer-pricing agreements, and adds to the complexity of coordinating price movements.
» Throughput agreements: In this case, the owner of the gas field pays a tolling fee to the LNG plant and markets the LNG (e.g. Atlantic LNG).

Broadly, a Greenfield LNG project involves:

» Licence or lease agreements: Specifying the area of the gas fields, terms of lease and payment of royalty.
» Operating, joint venture (JV) agreements and production-sharing contracts (PSC).
» Data acquisition and exploration agreements: For the technical data pertaining to the area.
» Front-end engineering and design (FEED) contract: For the initial engineering and design of the LNG plant. Engineering, procurement and construction (EPC) contract: For technology licensing, long lead time equipment and insurance arrangements.
» LNG sale and purchase agreement with the regasification terminal.

A regasification entity also enters into:

» A gas sale agreement with the end-consumer or marketer of the gas.
» Gas transportation agreement.

LNG sale and purchase agreement

The sale and purchase agreement (SPA) is the most important agreement while setting up an LNG project. The EPC contract is awarded only after firm LNG sales commitments are obtained. Sellers cannot obtain firm financing commitments from lenders prior to the execution of an SPA and related EPC contracts.

The broad steps involved prior to signing an SPA are:

» Identification of buyer: The development of the project is justified if there are one or more buyers with an identified need for LNG in adequate quantity for a pre-determined time period.
» Signing of the memorandum of understanding (MoU)/letter of intent (LoI): This has a limited duration and is not legally binding.
» Confidentiality agreement: This is required, as parties reveal information about themselves, their marketing strategies and the terms on which they would be willing to sell or purchase LNG.

LNG pricing

LNG prices vary by region, depending on the price of competing fuels in the region. The LNG contract price (stated in $ per mmbtu) reflects a number of elements.

» The energy element is determined with reference to energy values of competing LNG trades and/or competing fuels. A premium over the value of the competing fuels could be included due to the environmental benefits of natural gas.
» Adjustments are made for boil-off (that portion of LNG which vapourises during transportation) and transportation costs. A transportation allowance is necessary to ensure that the landed cost to the buyer is not substantially higher than the cost of purchase from a nearby source. The transportation element is either the seller's actual cost of transportation or a pre-determined value per million metric British thermal units (mmbtu), based on the estimated transportation costs.
» In the case of FoB sale, the invoice price is adjusted to compensate the buyer for that portion of LNG which vapourises during transportation (boil-off) and cannot be used to power the vessel. At the unloading port, the quantity of LNG (in BTU)

received by a buyer would be less than that invoiced by the seller, which would not be the case in an ex-ship sale.

- In order to maintain the cost-competitiveness of LNG with respect to alternate energy sources, all or a portion of the energy element is adjusted on the basis of a formula, which maintains the relative prices of LNG and the reference fuel (usually crude oil).
- In order to offset the effect of inflation, a portion of the energy element is subject to an annual upward adjustment.
- The minimum or floor price is established based on the historical price of LNG in the buyer's market, and is subject to escalation in order to maintain the floor price in real terms. For each cargo, the price of the energy element (after adjustments) is compared with the escalated minimum price, and the higher of the two prices is taken into account for invoicing. This ensures a minimum acceptable rate of return to the seller, even in the event of a significant decline in energy prices. In addition, the floor price would result in steady cash flows and an adequate debt-service coverage ratio, thereby providing a level of security to lenders.
- A ceiling price is also fixed to protect buyers against any significant increase in energy prices.

3.1.5 Natural Gas Pricing in India

The natural gas pricing scenario in India is complex and heterogeneous in nature. There are wide varieties of gas price in the country. At present, there are broadly two pricing regimes for gas in the country - gas priced under APM and non-APM or free market gas. The price of APM gas is set by the Government. As regards non-APM/free market gas, this could also be broadly divided into two categories, namely, domestically produced gas from JV fields and imported LNG. The pricing of JV gas is governed in terms of the PSC provisions. It is expected that substantial gas production

would commence from the gas fields awarded by the Government under the New Exploration Licensing Policy (NELP). As regards LNG, while the price of LNG imported under term contracts is governed by the SPA between the LNG seller and the buyer, the spot cargoes are purchased on mutually agreeable commercial terms.

APM Gas Pricing:

APM gas refers to gas produced by entities awarded gas fields prior to the PSC regime. The prices of gas from these fields are administered by GoI. The Government raised the consumer price be revised from Rs.2,800/MSCM to Rs.3,200/MSCM with effective from July 1st 2005 for the following categories of consumers. It was also decided that all the APM gas will be supplied to only these categories.

» Power sector consumers
» Fertilizers sector consumers
» Consumers covered under court orders
» Consumers having allocations of less than 0.05 MMSCMD

This increase was on an adhoc basis and it was decided that the Tariff Commission would examine the issue of producer price of natural gas. The Tariff Commission (TC) has since submitted its report and has recommended Producer price of Rs.3710/MSCM and Rs.4150/MSCM for ONGC and OIL respectively. TC has also recommended that the consumer price should be somewhat higher than the producer price, considering the substantial difference between the recommended producer price and the price of market gas/alternative fuels.

GoI also decided that the price of gas supplied to small consumers and transport sector (CNG) would be increased over the next 3 to 5 years to the level of the market price. With effect from May 6th 2005, the APM gas price to small consumers and CNG sector has been increased by 20%, to bring it to Rs.3840 / MSCM.

The price of natural gas for customers in the North-East has been kept at 60% of the price in the rest of the country. Accordingly, the price for power and fertilizers sector in the North-East is Rs.1920/MSCM and that for court-mandated and small scale consumers in the region is Rs.2304/MSCM.

Pricing Of Gas Under Pre-NELP Production Sharing Contracts

Production Sharing Contracts (PSCs) were executed by GoI with Ravva consortium and PMT consortium on October 28, 1994 and December 12, 1994 respectively. The price of natural gas is determined by the provisions of PSC signed by the consortium with GoI. Around 17.3 MMSCMD, 1 MMSCMD and 0.9 MMSCMD are supplied from PMT fields, Ravva fields and Ravva Satellite fields respectively under the pre-NELP PSCs. Out of this, GAIL supplies 5 MMSCMD from PMT fields and the production (1 MMSCMD) from Ravva fields at APM rate to APM consumers; the difference between PSC price and APM price is being made up through the gas pool account mechanism.

Pricing Of Gas With Reference to NELP Provisions

As regards the gas from NELP fields, the Government constituted an Empowered Group of Ministers to consider inter alia issues relating to pricing of natural gas, produced under the NELP regime. It has been decided therein that the provisions of the NELP PSC should be honoured. The following price basis/formula for the purpose of valuation of natural gas has been approved by the Government in case of KG-D6 Block of RIL/Niko.

Selling price (in US $/MMBTU) = 2.5 + (CP-25)0.15 (in US$/MMBTU),

where CP=crude price in US$/barrel, with cap of CP=US $60/barrel.

The price basis/formula comes to US$4.2/MMBTU for crude price greater or equal to US $60/barrel. It was decided that price discovery process on arm's length basis will be adopted in the future NELP contracts, only after the approval of the price basis/formula by the Government. It was also decided that the price discovered through this process would be uniformly applicable to all the sectors.

Imported Gas (LNG) Pricing

A contract was signed with RasGas, Qatar for supply of 5 MMTPA LNG (equivalent to about 18 MMSCMD) by Petronet LNG Limited (PLL) and supplies commenced from April 2004. This quantity has subsequently increased to 7.5 MMTPA wef January 2010. The price for LNG has been linked to JCC crude oil under an agreed formula. However, the FOB price for the period up to December 2008 has been agreed at a constant price of $2.53/MMBTU. This price translates to RLNG price of $3.63/MMBTU ex-Dahej terminal. The price would vary on monthly basis from January 2009.

Further, in July 2007, PLL has signed another contract with RasGas, Qatar for supply of 1.25 MMTPA LNG from July 2007 to September 2009 to meet the requirement of Ratnagiri Power Project in Maharashtra.

In order to make the price of spot RLNG affordable, EGoM has decided in the meeting held on January 11th 2007 for pooling of prices of spot cargoes with LNG being imported on term contract basis. This Ministry accordingly issued orders on March 6th 2007 in compliance with the decision of EGoM. In addition to the above term contracts, LNG is also being sourced from spot market by PLL and Hazira LNG Pvt. Ltd. During 2007-08, an average quantity of about 5.7 mmscmd was brought into the country as spot cargoes.

The summary of Natural Gas prices[23] are presented below:

Table 3.1.5-1 Summary of Natural Gas Prices in India

Gas Source	Price ($/MMBTU)	Gas Source	Price ($/MMBTU)
PMT - RRVUNL	4.60	APM North East at market price	1.79
PMT Torrent	4.75	APM Power	1.79
PMT others	5.65	APM Fertilizer	1.79
Rava	3.50	APM City Gas	2.15
Rava Satellite	4.30	CB/OS -2 Cairn GPEC	4.75
KG D6	4.20	CB/OS – 2 Cairn GTCL	4.60
APM North	1.08	Olpad (NSA) Niko	5.50

The large variation in prices of a largely similar commodity supplied from various sources results in significant distortions in the end use markets. While a certain degree of differences in prices of supplies to consumers is inevitable, the wide variations have significant ramifications for customers. The impact is manifested in several ways. Producers with tthe controlled gas price have little incentive to optimise production profile and costs. At the consumer end, wide divergence in prices make certain producers uncompetitive vis-à-vis others within the same industry. Artificially controlled and uneven price signals also distort price benchmarks for introducing new supplies, thus making sourcing and investment decisions more difficult and contentious. All of these have very significant impact on the economy, which is severely hampered on account of the constrained access to energy sources.

Need for Price Pooling

The Indian gas market needs to match customer expectations, and gas infrastructure expansion with providing flexibility for new and

[23] Source: From the Study on Common Pool Price Mechanism for Natural Gas submitted to MOPNG by Mercados Energy Markets India Private Limited on 28th January 2010

marginal suppliers to enter the market. Price pooling is a mechanism where the potential for balancing the customer and developer expectation with that of suppliers.

The need and benefits of pooling the gas price, for the Indian gas markets is to be considered in the context of the market development objectives. These could be summarized as follows:

» Introducing new gas sources in the market;
» Ensuring stable price signals for long gestation investments based on gas;
» Deepening the pipeline network to expand the gas markets geographically;
» Sending appropriate price signals for efficient use of gas;

.

The Indian gas markets are relatively small as compared to the size of the economy, but are expanding rapidly. However, as commented earlier by the Researcher, the expansion has not kept pace with the demand. Domestic gas finds, while substantial, are inadequate to meet the burgeoning demand for gas. In particular, the demand from bulk consuming sectors like power and fertiliser is growing at a rapid pace. At the other end, the demand from city gas is also expected to increase rapidly in the coming years. As a result of this expansion of demand, the country is looking seriously at LNG as a potential source of supply expansion.

LNG, as an internationally traded commodity presents two challenges. Firstly, the price of LNG is generally linked to the price of crude oil, especially for long term supplies. The resultant prices of RLNG are typically significantly higher than the prices of domestic gas, including from the NELP fields. Secondly, the prices of such supplies being linked to crude are inherently volatile. The combination of relatively high prices and high volatility make it

difficult for user industries like power and fertiliser to plan investments based on LNG.

Price pooling can serve the objective of introducing substantial quantities of new LNG supplies. The existing base of the pool would serve to reduce the price volatility, and given the impetus for infrastructure development.

3.1.6 Gas Utilisation Policy

Since natural gas is a core energy sector, the government has brought out a gas utilisation policy for the allocation of gas from the KG-D6 reserves.

The first priority was given to the existing plants in each of the priority sectors to ensure utilisation of capacities already created and to obtain faster monetisation of natural gas. The next priority was given for the replacement of liquid fuels in energy-intensive industries for both environmental and economic reasons.

Next, existing plants in each of the priority sectors were given priority to meet their requirement of de-bottlenecking and expansions at the existing locations.

Based on the above factors, the following order of allocation was decided:

i. Fertiliser plants
ii. LPG and petrochemicals plants
iii. Power plants
iv. City gas distribution
v. Refineries

3.1.7 Natural Gas Pipeline Infrastructure

Globally, pipelines are the most preferred medium to transport petroleum products over long distances. However, for global

trading, gas is liquefied into LNG (because of its volume reduction) and transported by way of tankers.

Gas consumption levels are impacted by the level of pipeline infrastructure in the region. Absence of adequate infrastructure can prevent the development of regional markets. Hence, development of pipeline infrastructure is a prerequisite for growth in gas consumption levels.

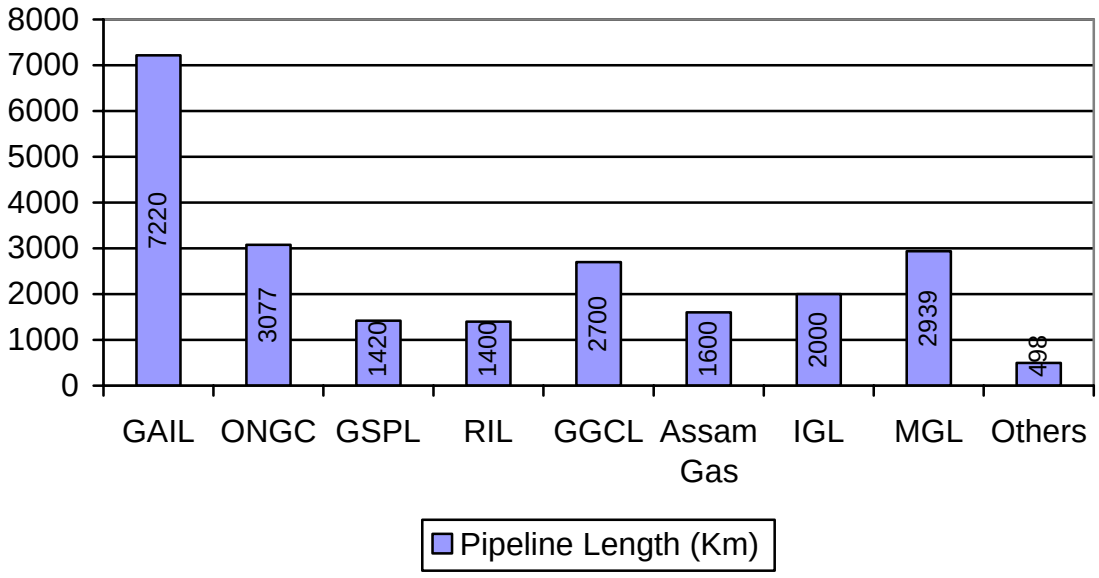
Pipeline infrastructure

India had a total natural gas pipeline infrastructure of around 22,854 km, supplying about 142 mmscmd of gas (excluding internal consumption). GAIL accounts for over 31.6 per cent of the total pipeline infrastructure in the country. ONGC (13.5 per cent), Mahanagar Gas Ltd (MGL, 12.9 per cent) and Gujarat Gas Company Ltd (GGCL, 11.8 per cent) are the other major players.

With a total pipeline length of 7,220 kms, GAIL is the leading pipeline infrastructure player in India. GAIL's pipelines are mostly based in the north-western region of India. The company's primary pipeline is the Hazira-Vijaipur-Jagdishpur pipeline which has a length of around 4,233kms. It has a supply capacity of 34 mmscmd. It is also the nations first cross-country pipeline.

Company wise pipeline length[24]

Figure 3.1-8 Company wise Natural Gas pipeline Length



3.1.8 LNG Infrastructure

Petronet LNG-Dahej

Promoters and equity structure

PLL is the first company to install an LNG receiving and regasification terminal in India. The company is promoted by GAIL, Bharat Petroleum Corporation Ltd (BPCL), IOC and ONGC with a stake of 12.5 per cent each. Other stakeholders include Gaz de France (GdF), Asian Development Bank (ADB) and public investors.

Capacity, SPA and prices

PLL set up the LNG regasification terminal at Dahej with a capacity of 5 million metric tonnes per annum (mmtpa) in 2004 and subsequently expanded it to 6.5 mmtpa in July 2008 through

[24] Source : MOPNG, Company Reports & Crisil Research

debottlenecking. In May 2009, PLL further expanded its capacity to 11.5 mmtpa at an investment of about Rs 15.6 billion.

PLL has a contract agreement of 25 years (ending 2028) with RasGas, Qatar, for the supply of 7.5 mmtpa LNG on FOB basis. The contract agreement specified a fixed price of $2.53 per mmbtu (FOB) until December 2008, after which, the price has been linked to the price of Japanese Crude Cocktail (JCC).

Shipping contract

PLL is responsible for transporting LNG from RasGas in Qatar to PLL's regasification terminal at Dahej. Accordingly, PLL has signed a time-charter agreement with a consortium consisting of M/s Mitsui OSK Lines Ltd (Japan), NYK Line & K Line (Japan), Shipping Corporation of India Ltd and Qatar Shipping Company. The agreement is for 2 LNG tankers of 138,000 scm capacity for a term ending April 2028. The company also possesses another tanker with a capacity of 155,000 scm.

Marketing plans, pipeline infrastructure and prospective buyers

In September 2003, PLL entered into three independent Gas Sale Purchase Agreements (GSPA) with GAIL, BPCL and IOC for 25 years in the ratio of 60:30:10 respectively. Sales commenced from April 2004. 'Take-or-Pay' and 'Supply-or-Pay' agreements have been signed with offtakers and end-consumers to lift 5 mmtpa. In June 2004, PLL agreed to grant marketing rights to ONGC for 0.625 mmtpa of LNG from its expansion project.

LNG is marketed through the HVJ pipeline in Gujarat, Madhya Pradesh, Rajasthan, UP, Haryana and Delhi. The entire R-LNG is transported from the terminal through the Dahej-Vijaipur pipeline which is part of the upgraded HVJ network of GAIL. All the three marketers of PLL's LNG have found buyers for their share of R-LNG.

Petronet LNG-Kochi

Capacity, SPA and prices

PLL is setting up a 2.5 mtpa LNG regasification terminal at Kochi, with a provision for further expansion of up to 5.0 mtpa. The terminal is expected to be commissioned in the first quarter of 2012. I has received requisite approvals from authorities such as the Cabinet Committee on Economic Affairs (CCEA), Department of Environment, Southern Naval Command and Department of Fisheries.

The agreement between PLL and RasGas, Qatar, involved supply of 5 mtpa to Dahej and 2.5 mtpa to Kochi. However, since commissioning of the Kochi terminal has lagged behind schedule, the whole 7.5 mtpa is being supplied to the Dahej terminal.

In May 2009, PLL was able to tie up 1.5 mtpa of LNG imports from Exxon Mobil's Gorgon project in Australia on a long-term basis. The supply will commence from 2014.

Shipping contract

PLL is expected to float an SPV to acquire equity in shipping vessels to carry LNG to the Kochi terminal. It proposes to hold a 49 per cent stake in this SPV. PLL has shortlisted several shipping firms for floating the SPV to acquire and operate two LNG carriers for its proposed terminal at Kochi. The shortlisted shipping firms include AP Moller, Exmar, Teekay, ETA Shipping, Pronav, Malaysian International Shipping Co, and the consortium of the Shipping Corporation of India and three Japanese firms, MOL, NYK Line and K Line.

Marketing plans, pipeline infrastructure and prospective buyers

The gas is likely to be marketed by IOC, GAIL and BPCL, and supplied in Kerala, Tamil Nadu and Karnataka through GAIL's proposed Kochi-Mangalore/Bengaluru pipeline.

Ratnagiri Gas & Power Project Ltd (RGPPL)

Promoters and equity structure

RGPPL has been incorporated by NTPC, MSEB, GAIL and a consortium of lenders which includes IDBI, ICICI Bank, State Bank of India (SBI), IFCI, Canara Bank, amongst others.

Capacity, SPA and price

The LNG terminal at Dabhol will have a capacity of 5 mtpa, which can be further expanded to 10 mtpa. The terminal complex will also include a power plant with a capacity of 1,844 MW. RGPPL is yet to complete dredging of the sea bed which is necessary for LNG tankers to berth at the facility. The company had contracted Gammon India Ltd for the same. However, dredging activity could not be taken up due to the lack of requisite clearances.

As the regasification terminal has been non-operational, RGPPL had been running its power plant using LNG supplied from PLL, Dahej (5.7 mmscmd upto September 2009). Currently, RGPPL receives gas from Reliance Industries' KG Basin reserves in order to operate its power plant. The government had mandated GAIL Ltd, which is one of the major stakeholders in the company to source LNG for the project. Accordingly, GAIL has signed a GSPA for LNG imports from Iran for 2.0 mmtpa.

GSPC, Mundra

GSPC is planning to set up a 7.5 mtpa LNG regasification terminal at Mundra at an estimated investment of Rs 35 billion. The company

holds a 50 per cent controlling stake, while the Adani Group holds 25 per cent participatory stake. IOC has expressed interest in picking up the residual 25 per cent stake in the terminal. GSPC has already awarded the FEED contract for the LNG terminal to Tractabel of Belgium. Post regasification, LNG will be transported using Gujarat State Petronet Ltd's (GSPL – a group company) pipeline network.

The terminal is expected to be commissioned by 2013-14.

Shell, Hazira

The LNG terminal at Hazira is promoted by Shell Gas B.V and Total Gaz Electricite Holdings (France). Shell holds 74 per cent of the equity while Total Gaz holds the remaining 26 per cent. The capital cost of the project was over Rs 30 billion.

Capacity, SPA and price

The Hazira LNG terminal has a capacity of 2.5 mtpa which can be ramped up to 5.0 mtpa and subsequently to 10 mtpa depending on market conditions. It is a merchant terminal and also provides customers with short-term contracts instead of fixed long-term contracts which run for over 20 years. Thus, the flexibility provided to clients helps it attract a number of customers.

However, a major drawback for Shell is that it does not have any long-term sourcing contracts. All its supplies are on spot basis. As a result, for a short period, its LNG may be priced higher than PLL's supplies. Shell sources its LNG supplies from its partner plants in Oman, Australia, Brunei and Malaysia. Supplies are also contributed by Total's LNG production in Indonesia, Qatar, Oman and Abu Dhabi.

Pipeline connectivity

The Hazira LNG terminal is connected with the GSPL gas grid network by way of a 17 km spur pipeline. It is also connected to GAIL's DVPL pipeline resulting in access to customers in Uttar Pradesh, Madhya Pradesh, Gujarat and other states. The terminal is also able to serve customers in Maharashtra via the Dahej-Uran pipeline.

3.1.9 Regulatory Framework

Brief overview of the policy trend

Previously, the government regulated the pricing and licensing of all petroleum products and returns on investments in the domestic petroleum sector through the administered pricing mechanism (APM). Besides, only public sector companies were allowed to operate in the sector. However, since 1991-92, the government has gradually been deregulating the sector.

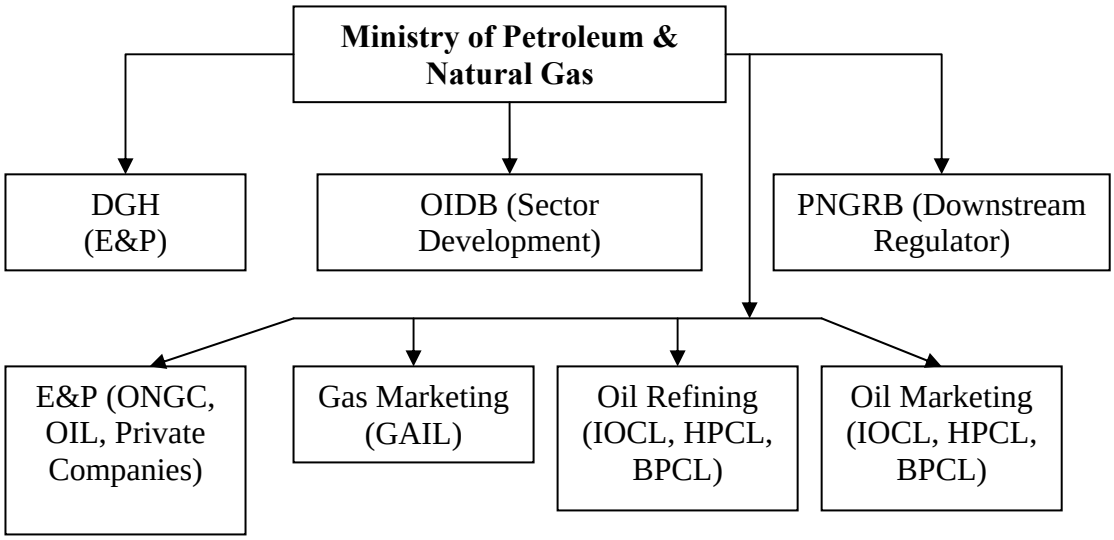
The government started the deregulation process by allowing private players to explore and develop oil and gas fields and set up refineries. Similarly, prices of natural gas which were previously fixed, are currently calculated on the basis of a formula approved by the EGOM. This formula takes fluctuations in the international crude oil prices into account. The government has also freed up investments in the refining sector.

Regulatory structure in India

While the government has deregulated the sector to a great extent, it still retains a measure of control through the nodal ministry (Ministry of Petroleum and Natural Gas) and various regulatory bodies such as PNGRB, OIDB, DGH and so on.

The below diagram shows the regulatory structure and functions of each entity in the structure:

Figure 3.1-9 Oil & Gas Industry Regulatory Structure in India



Evolution of Regulator

For the first two decades (since mid-1980s) of gas market development in India, most gas producers (ONGC, OIL), transmitters (GAIL) and even consumers were largely government-owned entities and little need was felt to have a proper regulatory framework. As the number of participants started to increase post NELP rounds, an increasing need was felt to put in place a regulatory framework.

Over the past few years, the key regulator and most of the key regulations have been put into place. However, giving sufficient powers to the regulator and the ability of the regulator to put regulations into practice have emerged as key concerns. Controversies/ confusion have generally erupted on most issues, and many parties have resorted to litigation. Researcher believes the current problems are teething problems in the evolution of regulations, and with time and experience, things will fall into place.

The first key step in the regulatory process was the enactment of the Petroleum & Natural Gas Regulatory Board in March 2006 by Parliament. However, the formal establishment of the PNGRB was significantly delayed to 1 October, 2007. In between the two events, in December 2006, the government of India notified a Policy for Development of Natural Gas Pipelines and City or Local Natural Gas Distribution Networks. Post this policy, and before the formal appointment of the PNGRB, Government authorized nine new long distance gas pipelines covering nearly 8,500km.

Table 3.1.9-1 Evolution of Regulatory framework

Date	Events
31-Mar-06	PNGRB constituted, PNGRB Act 2006 notified.
20-Dec-06	Policy for development of Natural Gas Pipelines and CGD networks notified
01-Oct-07	PNGRB Act came into force; Formal appointment of PNGRB
19-Mar-08	Regulations for CGD authorisation and tariff determination
06-May-08	Regulations for authorizing entities for natural gas pipelines
17-Jul-08	Regulations for access code for natural gas pipelines
20-Nov-08	Regulations for determination of natural gas pipeline tariffs
06-Jul-09	Draft regulation on determination of petroleum/ products pipeline tariff
11-Mar-10	Draft regulations on determination of petroleum/ products pipeline tariffs

3.2 Distribution of CNG

3.2.1 Compressed Natural Gas

Compressed Natural Gas (CNG) is a clean and safe fuel that can be used as a substitute for petroleum fuels like petrol, diesel and kerosene. It is so called because natural gas is compressed to a pressure of 200 -250 Kg/cm^2 to enhance the storage capacity of the cylinders that was then be mounted on vehicles. CNG is lighter than air and disperses faster in to the atmosphere thus minimizing the risk of fire or explosion. The level of polluting emissions and carbon residue from CNG is minimal thus reducing the maintenance cost of the engine and enhancing the active life of the vehicle. Exhaust emissions from NGVs are much lower than those from gasoline-powered vehicles. For instance, NGV emissions of carbon monoxide are approximately 70 percent lower, non-methane organic gas emissions are 89 percent lower, and oxides of nitrogen emissions are 87 percent lower. In addition to these reductions in pollutants, NGVs also emit significantly lower amounts of greenhouse gases and toxins than do gasoline vehicles. It avoids cases of fuel adulterations thus making available clean fuel. This has a very positive effect on the health and environment.

Dedicated NGVs produce little or no evaporative emissions during fueling and use. For gasoline vehicles, evaporative and fueling emissions account for at least 50 percent of a vehicle's total hydrocarbon emissions. Dedicated NGVs also can reduce carbon dioxide exhaust emissions by almost 20 percent.

Fuel Characteristics[25]

Table 3.2.1-1 Fuel Characteristics

	CNG	Petrol	Diesel
Toxic to skin	No	Moderate	Moderate
Toxic to lungs	No	Moderate	Moderate
Specific Gravity lighter or heavier than air (air = 1.00)	0.55 (lighter)	3.4	4.0
Source/feedstock	Natural Gas	Petroleum	Petroleum

Fuel Vs Emissions (gm/100 km)

Table 3.2.1-2 Fuel Vs Emissions

Fuel	Co2	UHC	Co	NOx	Sox	PM
Petrol	22,000	85	634	78	8.3	1.1
Diesel	21,000	21	106	108	21	12.5
LPG	18,200	18	168	37	.38	.29
CNG	16,275	5.6	22.2	25.87	.15	.29

Economies of CNG

The energy content per kilogram (Kg) of CNG is very similar to that of petroleum based fuels, but it has lower energy content per unit of volume. The excellent knock resisting property of CNG allows for use of a higher compression ratio resulting in an increased power output and greater fuel economy when compared to petrol. CNG can be used in engines with a compression ratio as high as 12:1 compared to normal gasoline (7.5:1 to 10:1). At this high compression ratio, natural gas-fuelled engines have higher thermal efficiencies than those fuelled by gasoline. The fuel efficiency of CNG driven engines is about 10-20% better than diesel engines.

[25] Source: US Energy Department

Use of CNG in vehicles results in higher mileage per unit due to its superior characteristics. The cost of CNG is also very competitive to that of petrol and diesel.

Types of CNG Stations

CNG stations can be broadly categorized in to the following categories:

Mother Stations: These types of stations typically have a high compression capacity and can be used to refill vehicles as well as to supply CNG to smaller daughter stations. Normally a mother station is connected to the natural gas supply pipeline and is equipped with a compressor which compresses low pressure natural gas to the required pressure of 250 bar for dispensing CNG to the vehicle cylinders. Alternately, a Mother station can also have CNG cascades for stocking and dispensing CNG. The cost of setting up Mother Station varies between Rs. 3 to Rs. 5 crores depending on the facilities available.

Daughter Stations: These are small CNG stations that cater to the CNG demands in areas where the gas pipeline are not present. CNG is dispensed at these stations using vehicle mounted cascades that are replaced and refilled at a Mother station as and when the pressure falls. The investment required for the setting up of a Daughter station varies between Rs 1.0 crore to Rs. 1.2 crores.

CNG Conversion Kits

Unlike gasoline and other petroleum fuels conventionally used in vehicles, which must be vaporized before ignition, CNG is already in gaseous form when it enters the combustion chamber of the vehicle. When the intake valve opens, the gas enters the combustion chamber where it is ignited to power the vehicle. Vehicles running on gasoline need to be fitted with a CNG conversion kit to make it

operate on CNG. Major parts of a CNG conversion kit are illustrated below:

1. Pressure Regulator
2. Petrol Solenoid Valve -Stops petrol flow when operating on CNG
3. On-Off valve and refueling connector - Opens or stops gas flow to the regulator and includes a refueling device
4. Control Module/Change-over Switch Electronic control component with fuel selection switch
5. CNG level indicator Shows CNG quantity on vehicle dashboard.
6. Gas-Air Mixer
7. CNG Cylinder with valve, vapor bags & bracket
8. Petrol hose
9. Low pressure gas hose
10. Ignition advance processor
11. High pressure gas tube
12. Wire harness
13. NRV in petrol return line
14. Pressure gauge

Conversion to CNG for different vehicle segments

Existing petrol vehicles can use CNG by installing a bi-fuel conversion kit and the converted vehicle will have the flexibility of operating either on CNG or petrol. CNG is lead and sulphur free and its use substantially reduces harmful engine emissions and helps keep the environment clean. Besides. operational cost of vehicles running on CNG is approximately one third that of petrol. Due to its relative advantages and superiority over conventional fuels, CNG is the most promising alternative fuel for city transport.

3.2.2 Conversion Cost[26] for Different Types of Vehicles

Table 3.2.2-1 Conversion Cost for different types of vehicles

Types of Vehicle	Cost of Conversion
Autos/Three Wheelers	Rs. 17,000
Cars/Taxis	Rs. 35,000
Bus/Trucks	Rs. 5,00,000

3.2.3 Cities Covered Under CNG Infrastructure[27]

There are 76 cities in India with PNG / CNG infrastructure. The states covered under are Andhra Pradesh, Assam, Delhi, Gujrat, Haryana Madhya Pradesh, Maharashtra, Rajasthan, Tripura, Uttar Pradesh, West Bengal, Daman & Diu etc. The detailed list of cities covered under CNG Infrastructure in India is placed at **Annexure– I.**

3.2.4 Entities[28] Engaged in CGD Business in India

There are 22 entities engaged in City Gas Distribution Business in India, the details are given below:

1. Gujarat Gas - Surat, Bharuch & Ankleshwar
2. GSPC - Rajkot & many other districts
3. Adani Energy - Ahmedabad, Faridabad
4. Sabarmati Gas - Gandhinagar, Mehsana, Sabarkantha
5. Vadodara Mahanagar Seva - Vadodara
6. Assam Gas Company Limited - Duliajan & nearby areas
7. Great Eastern Energy Corp. Ltd. - Asansol & Durgapur
8. Siti Energy - Moradabad

[26] Source : Personal Interview with the CNG Kit fitment agencies
[27] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010
[28] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

9. Indraprastha Gas Ltd. - Delhi, NOIDA, Greater NO1DA & Ghaziabad
10. Mahanagar Gas Ltd. - Mumbai, Thane, Mira Bhayandar & Navi Mumbai
11. Maharashtra Natural Gas Ltd. - Pune
12. Central U.P. Gas Ltd. - Kanpur, Bareiliy
13. Green Gas Ltd. - Agra, Lucknow
14. GAIL - Vadodara
15. HPCL - Ahmedabad
16. Bhagyanagar Gas Ltd. - Hyderabad, Vijaywada, Rajahmundry & Kakinada
17. Tripura Natural Gas Ltd. - Agartala
18. Avantika Gas Ltd. - Indore, Ujjain & Gwalior
19. Haryana City Gas - Gurgaon
20. GAIL Gas Ltd. - Dewas, Kota, Sonepat & Meerut
21. JV of DSM lnfra Tech. & M/s Saumya Mining Pvt. Ltd. - Mathura
22. Charotar Gas - Anand/ Kheda

3.2.5 CNG Activities in India

Sales

The State wise sales[29] in (000MT) for FY 2007-08 & FY 2008-09 are as follows:

[29] Source : IndianPetro.com

Table 3.2.5-1 State wise CNG sales

State	2007-08	2008-09	Avg. per day	% Growth
Gujarat	109.6	165.0	0.45	50.6
Delhi	386.2	459.5	1.26	19.0
Maharashtra	269.5	281.8	0.77	4.6
Andhra Pradesh	3.6	6.7	0.02	84.0
U.P.	28.4	36.7	0.10	29.3
Tripura	0.28	0.81	0.002	193.1
M.P.	-	0.29	0.001	-
Total	**797.6**	**950.8**	**2.61**	**19.2**

Vehicles on CNG

Number of Vehicles[30] as on 1st April 2009 is as follows:

Table 3.2.5-2 Number of Vehicles on CNG

State	Cars/Taxies	Autos	Buses	Others	Total
Gujarat	47137	84506	1919	2156	135718
Delhi	131852	91673	12831	6137	242493
Maharashtra	56107	130928	163	2871	191538
Andhra Pradesh	720	3997	119	27	4863
U.P.	846	16110	1135	4927	23018
Tripura	65	788	0	0	853
M.P.	215	175	0	0	390
Total	**236942**	**328177**	**17636**	**16118**	**598873**

CNG Stations

Number of CNG Stations[31] as on 1st April 2009 is as follows:

[30] Source : IndianPetro web site
[31] Source : IndianPetro web site

Table 3.2.5-3 Number of CNG Stations

State	Mother	Online	Daughter Booster	Daughter	Total
Gujarat	41	41	14	11	107
Delhi	77	52	48	4	181
Maharashtra	10	113	20	0	143
Andhra Pradesh	1	0	9	0	10
U.P.	4	6	5	0	15
Tripura	0	1	0	0	1
M.P.	1	0	0	4	5
All India	**134**	**213**	**96**	**19**	**462**

3.2.6 Pollution Reduction in CNG Fuelled Vehicles

As per the Emission test conducted by GAIL (India) Limited the pollution reduction (gram/km) in CNG fuelled vehicle is as follows:

Passenger Car (Petrol)

Table 3.2.6-1 Pollution Reduction in Car

Vehicle	Pollutant	Petrol	CNG	% Reduction
Maruti Omni	CO	19.79	0.55	97
	HC	1.14	1.02	11
Maruti Gypsy	CO	4.94	0.59	88
	HC	1.86	1.42	24
Premier Padmini	CO	18.38	0.94	95
	HC	2.83	2.03	28
Premier 118 NE	CO	15.6	2.04	87
	HC	2.57	1.92	25
Ambassador	CO	52.16	0.78	98
	HC	6.37	4.33	32

Auto Rickshaws (Petrol)

Table 3.2.6-2 Pollution Reduction in Three Wheeler

	Pollutant	Petrol	CNG	% Reduction
Bajaj Three Wheeler	CO	3.26	1.26	63.19
	HC	5.48	1.57	71.35
	CO_2	47.44	27.6	41.82
	NO_x	0.25	0.2	20.00

Diesel Buses

Table 3.2.6-3 Pollution Reduction in Three Wheeler

	Pollutant	Diesel	CNG	% Reduction
Ashok Leyland	CO	1.68	1.4	16.67
	HC	4.5	3.77	19.37
	NOx	13.73	8.0	41.77

3.2.7 Vision of Ministry of Petroleum & Natural Gas

Ministry of Petroleum & Natural Gas wishes to encourage supply of CNG for transport sector and Piped Natural Gas for household sector. It has finalized 'Vision-2015' of the oil sector for Consumer Satisfaction and Beyond', wherein 201 cities are to be provided CNG by the year 2015. List of 201[32] cities is placed at **Annexure II.**

Development of City Gas Distribution (CGD) project in any area depends upon pipeline connectivity, availability of gas and commercial viability of the project.

To further boost pipeline infrastructure & CGD projects, MoPNG has authorized nine new pipelines with a length of around 6335 km, which will connect more States with gas sources. In addition to this,

[32] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

In order to promote investment from public as well as private sector for laying trunk natural gas pipelines and city/local natural gas distribution networks throughout the country, the Government of India has enacted 'The Petroleum and Natural Gas Regulatory Board Act, 2006', wherein PNGRB would undertake authorization of city gas distribution networks and trunk pipeline networks.

3.2.8 Plan of PNGRB for development of CGD

Ministry of Petroleum & Natural Gas intends to encourage supply of CNG for transport sector and Piped Natural Gas for household sector. PNGRB has envisaged a rollout plan of CGD Network Development in more than 300 cities. On an average, six to seven cities would be taken up by PNGRB every month on the basis of Expressions of Interest (EOI) submitted to it by CGD entities as also on suo moto basis.

3.2.9 Cities Awarded by PNGRB

The bidding process which commenced in end-2008, has remained controversial. In the first round, of the six cities, GAIL’s 100% subsidiary won four cities on the basis of very low tariff bidding. The second round, which commenced in February 2009, was sent into disarray as some bidders bid “zero” as the network tariff, one of key bidding criteria. Over one year has elapsed, and the winners of second round have not been finalised yet. Now, with the power of the regulator to issue licences itself being questioned, the licensing process of further cities is further pushed back.

Cities awarded[33] under Round I & II

Table 3.2.9-1 Cities awarded by PNGRB

Round I		Round II	
Cities	**Winners**	**Cities**	**Winners**
Kakinada	Bhagyanagar Gas	Allahabad	IOC & Adani JV
Dewas	GAIL Gas	Chandigarh	IOC & Adani JV
Kota	GAIL Gas	Ghaziabad	IOC & Adani JV
Sonipat	GAIL Gas	Jhansi	GAIL Gas
Meerut	GAIL Gas	Rajahmundry	IOC & Adani JV
Mathura	DSM Infratech	Shahdol	Reliance Gas

3.2.10 Status of CNG Price

CNG prices[34] in various cities are as below:

SI No.	Name of the City	CNG price in Rs./ Kg.
1	Delhi	27.5
2	Noida	30.6
3	Greater Noida	30.6
4	Ghaziabad	30.6
5	Mumbai	31.47
6	Thane	32.41
7	Mira Bhayandar	31.7
8	Navi Mumbai	31.78
9	Pune*	35.4 & 35
10	Kanpur	35
11	Bariely	35
12	Vijayawada	30
13	Rajahmundery	35
14	Agartala	25
15	Indore	36
16	Ujjain	37
17	Vadodara	32.05

Table 3.2.10-1 Status of CNG Prices in India

[33] Source : Nomura Research Report on 'Gas in India' Published in 11th May 2010
[34] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

* The price difference in Pune is due to applicability of Octroi in Pune Muncipal Corporation area & non applicability of Octroi in Pimpri & Chinchwad Municipal areas.

3.2.11 Breakup of Running Cost

Running cost[35] (Rs./KM)of vehicles by using CNG, Petrol and Diesel on current prices are as follows:

	Delhi	Mumbai
Car/Taxi		
Petrol	3.43	3.73
CNG	**1.31**	**1.50**
Auto		
Petrol	2.05	2.23
CNG	**0.79**	**0.90**
Bus		
Diesel	10.74	11.98
CNG	**7.85**	**8.98**

Table 3.2.11-1 Breakup of Running Cost of Vehicles

[35] Source: MOPNG reply to Parliament of Rajya Sabha Question no. 321 answered on 17th August 2010

3.2.12 Equity Structures of CNG Companies

Table 3.2.12-1 Equity Structures of CNG Companies

Sr. No	Name of JV Company	JV Partners	Equity Stake (As per JV Agreement)
1	Indraprastha Gas Ltd.	GAIL (India) Limited & BPCL	GAIL: 22.5%, BPCL: 22.5%, Delhi Govt: 5%, Flls/Fls/ Public and others: 50%
2	Mahanagar Gas Ltd.	GAIL (India) Limited & British Gas	GAIL: 35% (Current 49.75%), British Gas: 35% (Current 49.75%), Maharashtra Govt: 10% (Current 0.5%), Public: 20% (Current - Nil)
3	Bhagya Nagar Gas Ltd:	GAIL (India) Limited & HPCL	GAIL: 22.5%, HPCL: 22.5%, State Govt: 5%, FlIs/Fls/ Public and others: 50%
4	Tripura Natural Gas Ltd.	GAIL (lndia) Limited, AGCL & TIDC	GAIL: 29%, TIDC: 10%, AGCL: 10%. Public and others: 51%
5	Central U.P. Gas Ltd.	GAIL (India) Limited & BPCL	GAIL: 22.5%,BPCL: 22.5%, State Govt: 5%, Fllst/Fls/First public and others: 50%
6	Green Gas Ltd.	GAIL (India) Limited & IOCL	GAIL:22.5%. IOCL: 22.5%, State Govt5%, Flls/Fls/ Public and others: 50%
7	Maharashtra Natural Gas Ltd .	GAIL (lndia) Limited & BPCL	GAIL: 22.5%. BPCL: 22.5%, State Govt 5%, FlIs/Fls/ Public and others: 50%
8	Avantika Gas Ltd	GAIL (India) Limited &HPCL	GAIL: 22.5%,HPCL: 22.5%. State Govt: 5%, Flls/Fls/ Public and others: 50%
9	GAIL Gas Limited :	A 100% subsidiary of GAIL (India) Limited	GAIL: 100%

3.3 Public Private Partnership

Researcher has reviewed published material and works on the Public Private Partnership containing quantitative data/information which was necessary as these analyses provide helpful insight and the emerging trends in PPP.

Lessons from Global Experience:

The global experience and lessons for India were for Implementation of PPP model presented by the ADB in its presentation made to Ministry of Finance. Though PPP is a relatively new approach to procurement, lessons may be drawn from the experiences of developed and developing countries on the conditions for success of PPP. The examples and lesson's highlighted are presented below:

Case Studies

Mexico: The Government of Mexico announced a major highway development program in 1989. To secure private sector participation, it adopted rather unusual selection criterion of shortest concession period. This resulted in very short concession periods of 8–15 years, and unaffordable high level of tolls (immediately after service commencement). This led to the newly built roads being mostly empty while non toll roads remained congested. Later on, enormous cost overruns were claimed by the BOT contractors, and concessions had to be renegotiated and extended to thirty years. Toll had to be lowered due to public outcry. The government had to bail out contractors and financiers. Political pressures resulted in overly concessional contracts to the private sector.

Chile: In the early 1990s, the Government of Chile decided to develop 2000 km of intercity expressway networks in BOT mode at an estimated cost of $3.3 billion. Most of the project companies experienced difficulties in securing longterm loans. The government

responded quickly by introducing a number of credit enhancement measures, including: (i) minimum revenue guarantee; (ii) least present value of revenue scheme; and (iii) foreign exchange risk guarantee. All contracts were awarded in the mid-1990s and construction was completed during 1998–2002. The average elapsed time between tender and commencement of operation was 4.5 years. Exceeding expectations, many foreign contractors participated.

United States: In Virginia, the government's private sector participation policy led to a proposal of developing a 22 km toll road that connects Dulles International Airport to Loudon County. Project cost was $350 million, of which $332 million was mobilized through the issue of bonds to institutional investors. When the operations started in the mid-1990s, the project company experienced lower than expected traffic level. While the original estimate of average traffic was 35,000 vehicles per day, the traffic level realized was only 8500 vehicles with an average toll of $1.77. The project company then reduced the toll to $1.00, which led to an immediate jump in traffic to 23,000 vehicles. However, since this was still lower than original projections, the project started to default and the terms of the bonds had to be renegotiated. One reason for this problem was underestimation of the adverse impact of the alternative Route 7, which runs parallel to the project road. However, business prospects improved for the toll route in the late 1990s, as Route 7 got congested and traffic reached the originally anticipated level.

United States:, In the early 1990s, cash-strapped Orange County in California decided to develop 16 km express lanes between two carriageways of Riverside Freeways, from Anaheim to Riverside. Toll for use of the express lanes for a round trip was $8. Service started in the mid-1990s. The express lanes soon reached close to their capacity, but users of the existing freeway continued to

experience enormous congestion. The project was financially successful but a failure in resolving congestion problems.

Lessons Learnt

Clarifying the objectives: Governments needs to be abundantly clear and determined about the basic motivation and objectives for opting for PPPs. While resource constraints and maximizing government revenue are legitimate motivators, they should be driven more by the core drivers of effective gains (improved service standards and customer satisfaction) and efficiency gains (value for money, improved service at optimal costs).

Detailed policy for implementing PPP projects is required. A detailed policy is needed to bolster the confidence and attract the participation of private investors and commercial lenders. This includes defining the sectors open to PPPs and the preferred scheme for each sector, and the government agency responsible for PPP implementation. Preferably, a single, centralized unit servicing as a 'one-stop' shop for investors and a nodal point for facilitating cooperation among different ministries and tiers of government. The policy must also clarify the types of support available from government (e.g. Provision of land for project site or right of way, fiscal incentives, performance guarantees, etc.).

Strategic planning and management by government is essential. PPPs can succeed only if they are structured and planned in detail and are managed by expert teams. Flexibility for necessary improvisation based on the emerging experiences and lessons learned is also important. Detailed planning is also needed to anticipate future needs and prioritize projects, as also to provide for investments in infrastructure facilities. Longer-range planning is needed for soliciting private sector participation on a competitive and sustainable basis and dealing with unsolicited offers. Capacity must be built in government at the central and, more particularly,

state levels. Governments also need to use technical and financial advisors, where needed, to match the advantages of the private sector, particularly in large-scale programs.

Develop a policy on unsolicited proposals from the private sector. PPP initiatives often come from private developers, particularly in countries where public institutions have technical limitations and/or are short of funds. Broadly, there are two ways to handle unsolicited offers. The government could negotiate the concession directly with the private developer or organize an international tender. If the developer wins, it could be compensated by having its preparation cost included in its financial proposal. If not, the tender documents can specify that the winner would reimburse it a lump sum. Unsolicited proposals for exclusive contracts may also be prohibited totally.

Project development by governments. Project development needs to be done by government, for which it needs to create dedicated funds. These funds would help create a pipeline of bankable projects which, as discussed earlier, are often in short supply. Well-prepared projects also reduce the cost of bids and attract more bidders in a public tender.

Proper allocation of risks. Effective PPP models involve sensible division of roles and fair sharing of responsibilities, costs, and risks between the public and private sectors. Risk is assigned to the partner best able to manage it. Commercial risk is better borne by the private sector partner, while regulatory risk is better borne by government agencies. Optimal, not maximum, assignment of risk is the principle to be adopted.

Provide adequate protection for lenders. PPP projects often raise debt funding on the basis of a limited-recourse project finance. This means that the lenders rely merely on project assets and cash flows and do not have recourse to the project sponsors. Debt finance

usually represents 60–80% of the financing structure. Therefore, PPP design and documentation should provide adequate protection to debt service against noncommercial risks related to force majeure, regulatory changes, contract termination, etc.

Mitigation of Risk in contractor-driven nature of BOT. Offering excessively concessional terms to the project company needs to be avoided. A BOT scheme may not be a perfect solution, since it tends to be contractor oriented. A BOT contract covers both construction and operation stages but project companies often try to recover all the costs during the construction period. Thereafter, their incentive to ensure that the special purpose companies succeed declines. This results in creating infrastructure without the services being available to the public. A challenge for India is development of O&M capacity and local industry for O&M. Strong O&M local industry would be required for BOT schemes to work well.

Rigorously analyze the traffic projections. Traffic projection should be done more systematically by specialized transport experts with adequate experience. Experience in road projects has indicated a tendency of overstating anticipated traffic. For instance, the Guangzhou–Shengzhen Superhighway Project projected traffic is twice higher than actually realized. The Dulles Greenway project realized only a quarter of the estimated traffic in the first few months of operation. This is often due to underestimation of the potential negative impact of competing roads and failure to estimate the impact of toll on traffic levels.

Avoid renegotiation and midway changes. Governments need to pay more attention to potential renegotiation later. In Latin America, over 60% of 1000 concession contracts awarded in the 1990s were renegotiated within three years. Bidders often offer below-cost prices to win the contract in anticipation of later renegotiation. A concession agreement should cover all possible causes of later

adjustments, leaving minimum room for renegotiation. In the Worli Sealink project in Mumbai, midway through the construction phase the project consultants were replaced. The new consultants suggested a change in project design that resulted in escalating the project cost by Rs 450 crore and further delays.

Need to consider foreign systems as an alternative. The potential of using foreign contractors could be considered for larger projects. Current BOT projects in India are small. In the highway sector, they range between $50 million and $150 million, whereas the usual size of overseas BOT projects ranges between $200 million and $500 million or even exceeds $2 billion (Malaysia's North–South Corridor BOT project worth $3.2 billion and China's Guangzhou/ShenzhenSuperhighway worth $1.6 billion).

Full and clear support by government is critical. Support for the PPP program and for specific PPP projects has to come from the highest political level of government. A strong political will is essential in overcoming resistance, and needs to be seen as a clear signal of the government's intention to meet its contractual commitments.

Implementation schedules need to be realistic. The implementation schedule should not be overly optimistic. This means managing the pressures and expectations of elected bodies, the media, and other stakeholders, which often exert pressure on implementing agencies for faster delivery. While political commitment is welcome and necessary, pressures for overly optimistic timelines need to be dealt with appropriately.

Proactive public communication and stakeholder management. Many PPPs have failed owing to strong opposition from civil society, local media, and other stakeholders. Public opposition has led to many cancellations, both before and after the concession award. **PPPs have also been confused with privatization.**

Alienation of actual users of the asset and lack of public support have increased project costs, delayed project completion, and ultimately jeopardized the sustainability of public services. Lack of communication and poor stakeholder management could become deal-breakers.

A predominant reason for this is lack of effective communication with the principal stakeholders of the project. It is important for the project sponsors to disseminate information among the various stakeholder groups about the virtues of partnership options and convince them about the benefits that would accrue to them, especially the poor. Stakeholder communication is required to prepare stakeholders for the institutional relationships between the public sector sponsors, the private consortium, and the consumers and citizens. They are required to influence stakeholders perception and behavior and build support for reforms and new ways of working. Feedback and consultations with tariff-paying citizens, labor unions, relevant government agencies, private investors, civil society organizations, and media will ensure support, client focus, and improved overall coordination of the project.

In a book on **'Public–Private Partnerships Principles of Policy and Finance' of E. R. Yescombe[36] (2007)** brought out the fact that over the last decade or so, private-sector financing through public–private partnerships (PPPs) has become increasingly popular as a way of procuring and maintaining public-sector infrastructure, in sectors such as transportation (roads, bridges, tunnels, railways, ports, airports), social infrastructure (hospitals, schools, prisons, social housing), public utilities (water supply, waste water treatment, waste disposal), government offices and other accommodation, and other specialised services (such as communications networks or defence equipment). This book reviews

[36] Promoter of Yescombe Consulting Ltd London, UK, www.yescombe.com

the general policy issues which arise for the public sector in considering whether to adopt the PPP procurement route, and the specific application of this policy approach in PPP contracts. The book also offers a systematic and integrated approach to financing PPPs within this public-policy framework. Policy and finance are inextricably entangled in PPPs, so the public sector must develop PPP policies taking account of financing constraints, and be careful to avoid entering into PPP arrangements whose financial implications are misunderstood, or not understood at all, thus undermining the benefit of the PPP. Similarly, the policy background and drivers for public-sector decisions are also often quite unclear to private-sector investors and lenders. Structuring PPPs is complex because of the need to reconcile the aims of the large number of parties involved on the private-sector side there are investors, lenders, and companies providing construction and operational services; on the public-sector side there are public authorities creating and implementing PPP policies as well as those actually procuring the PPP, not forgetting the general public who use the facilities that a PPP provides. Most of these parties need to have a basic understanding of policy and finance issues, and how their part of the project is linked to and affected by them.

In their book **'Public Private Partnerships - The Worldwide Revolution in Infrastructure Provision and Project Finance' by Darrin Grimsey[37] and Mervyn K. Lewis[38],** has examined the role of public private partnerships for infrastructure. Perhaps the most distinctive feature of the partnership mode is its flexibility, and this characteristic can be illustrated in a number of ways. First, the arrangement encompasses a variety of public sector–private sector

[37] Partner, PricewaterhouseCoopers, Melbourne and Fellow of the Australian Centre for Public Infrastructure at Melbourne University Private, Australia
[38] Professor of Banking and Finance, University of South Australia, Australia and Fellow of the Academy of Social Sciences in Australia

interactions, such as leasing, franchises, concessions, BOT, BOOT, DBFO, DCMF, and joint ventures. Second, PPPs have been applied to a range of infrastructure categories: 'hard economic' (roads, bridges, railways, telecommunications, etc.); 'hard social' (hospitals, schools, water supply, sewerage, prisons, etc.); 'soft economic' (R & D facilitation, technology transfer); and 'soft social' (community services). Third, partnership-type arrangements operate in countries as diverse as Australia, Bulgaria, Chile, France, Malaysia, the Netherlands, the Philippines, Poland, Portugal, South Africa, the United Kingdom and the United States, to name some examples. PPPs allow for situations where revenues come from tolls and charges on the general public, to ones where the public sector is the customer and procures and pays for the services. The payment schedules build in many service quality and performance incentives. Fifth, if properly structured, a PPP contract is able to take account of new service demands and future monitoring and reporting requirements that may develop over the lifetime of a project.

The 'International Conference on Meeting India's Infrastructure Needs with Public Private Partnerships The International Experience and Perspective' was held on February 5-6, 2007 at Shangri-La Hotel, New Delhi jointly organized by the Department of Economic Affairs (DEA), Ministry of Finance, Government of India, the World Bank, International Finance Corporation, Public-Private Infrastructure Advisory Facility and Infrastructure Development Finance Company Limited. It brought together investors, operators and the government, so that India could learn more about how other countries have successfully harnessed Public Private Partnership (PPP) approaches, and also showcase opportunities on offer for the private sector. The conference was attended by five Cabinet Ministers from the Government of India and senior officials from central and state governments, and from line agencies. The private sector showed very keen interest in the

conference; thirty international and twenty five domestic investors and developers/operators sent their representatives. This was complemented by the participation of policy-makers from countries such as the UK, Korea, Malaysia, Chile, Colombia and Brazil, who provided their perspective on the development of PPP programs and the lessons learnt. The main conclusions drawn by the researcher from the conference were: India's recent progress in developing PPPs has been very impressive and has generated a lot of private sector interest; Sustaining and accelerating the present progress will need strengthening of policy and regulatory frameworks and substantial improvement in government capacities for managing and overseeing PPPs when they are in operation; At present the principal challenge is to develop a shelf of bankable projects; and Finance is perhaps not the binding constraint right now, but could increasingly become an issue as the program is scaled up.

At the request of Department of Economic Affairs, Ministry of Finance of Government of India, **a study titled as 'India – Building Capacities for Public Private Partnership' was carried out by World Bank's Energy & Infrastructure unit & Finance and Private Sector Development unit of South Asia Region in June 2006.** This report has been prepared by Mark Dutz, Clive Harris, Inderbir Singh Dhingra (World Bank) and Chris Shugart (Consultant). This report mainly covers three points viz. 1) Approaches elsewhere to developing capacities for PPPs, 2) PPPs in India & 3) Developing and strengthening capacities for PPPs in India.

The Department of Economic Affairs, Ministry of Finance, Government of India, and the Asian Development Bank (ADB) organized four Regional **Workshops of Chief Secretaries on Public–Private Partnership (PPP) for Accelerated Infrastructure Development in India.** The workshop was held in Delhi on 26th July 2006. The report summaries the following important parameters of

PPP like Overview of Infrastructure Development in India and Importance of PPP, An International Perspective of Risks in PPP Financing and What Do Foreign Investors Look for in PPP Projects, Facilitating PPPs in India: Private Sector Perspective, What Should Not Be Done in PPPs, Financing PPPs: Lenders' Perspective, What Do Foreign Investors Look for in PPP Projects?, Facilitating PPPs in India: Private Sector Perspective etc.

3.4 Project Finance & Risk Management

In their book of 'Financing Large Projects' by M. Fouzul Kabir Khan[39] & Robert J. Parra[40] . The book follows the development cycle of a "typical" infrastructure project in its presentation of materials. It describes project origination and early development activities, negotiations with ceding authority and others of project agreements, sources of international finance and credit enhancements, and the sponsor's support required for classic and non-classic deals. The book also discusses the architecture of the typical financial model, due diligence and appraisal process conducted by lenders, scope and content of negotiations related to each of several finance documents, role of derivatives and hedges, and typical issues encountered in structuring a security package. It is particularly thorough in its coverage of emerging market issues. At the same time, it also discusses the evolving nature of Project Finance in the industrialized world. This book explain with the examples from various types of infrastructure projects to illustrate their points, including bulk water system, power generation, container port, toll road and telecommunications facility. They also discuss other types of Project Finance, including those related to oil

[39] Executive Director and Chief Executive Officer of Infrastructure Development Company (IDCOL) in Bangladesh, a company jointly created by the World Bank and the Government of Bangladesh.
[40] Director at PricewaterhouseCoopers Securities LLC, U.S.

and gas, mining, leveraged tax leasing, industrial revenue bonds, ship and aircraft, horticulture etc. Further, it Simplifies concepts related to risk sharing, particularly in infrastructure Project Finance. Several areas are identified and examined the risk-sharing provisions of typical project agreements, including those related to power purchase and sale, engineering, procurement and construction, fuel supply and transport as well as operations and maintenance agreements.

In an Academician book of 'Principle of Project & Infrastructure Finance' by Willie Tan[41], gave insight from Project Manager perspective. This book has provided a guide on the principles of project and infrastructure finance to students and practitioners. By "principles," researcher, mean a set of rules or claims about the nature of something. Principles tend to be general or universal, and go beyond specific ways of financing individual projects. They are developed by abstracting from "reality" (or "facts") to isolate only the essential elements for analysis. The non-essential elements are ignored. For any set of essential elements, further approximations (such as absence of friction in physics or a featureless plain in models of city form) are then made to develop general models that can subsequently be applied to specific cases. Sometimes, the model assumptions are not approximations of reality but are quite unreal. Simple examples include the assumption of a closed economy in Keynesian economics and the assumption in neoclassical growth theory that an economy produces only one homogeneous good. In a globalized world, the assumption of a closed capitalist economy is clearly unrealistic. As for growth theory, even Robinson Crusoe produces more than one good. However, the intent is not so much to reflect or construct "reality"

[41] Willie Tan is Program Director of the M.Sc. (Project Management) program, and Co-Director of the Center of Project Management and Construction Law at the School of Design and Environment, National University of Singapore.

but to invoke obviously unreal assumptions as a pedagogic device to start with a simple model and progressively make it more and more realistic (or “concrete”) by relaxing these assumptions. Once we understand how a closed economy operates, the next step is to consider what happens in a more complicated open economy with external trade and investment.

A Lessons of Experience on Project Finance in Developing Countries is published by World Bank & International Finance Corporation (IFC) Washington, D.C. This volume describes IFC's Greenfield project finance activities over the past decade, initially against the background of rapid growth in capital flows and project finance activities in developing markets and then in light of their subsequent recent slowdown. It describes the essentials and some of the complexities of project structuring, for the benefit of a wider audience, to help explain the importance of "getting it right." Although it is still too early to tell the final outcome for most projects affected by the crisis, this analysis highlights those features of structuring which in IFC's experience contribute to more durable projects over the long term. A primary message is the importance of clearly identifying and addressing project risks up-front and the potential costs of complacency in dealing with critical issues such as foreign exchange or market demand risks. In addition to strong fundamentals, projects that are conservatively structured in financial terms and that carry strong sponsor support in terms of technical and management strength and financial commitment are those projects most likely to be successful. Although the report focuses on transactions, underlying the discussion is the importance of good policies. Particularly important is the need for governments to provide a supportive legal and regulatory framework. Project finance, which is essentially contract based financing, can be successful in the long term only against a background of solid rules, regulations, and policies. If, for example, judicial processes are not

seen as fair or transparent, sponsors and investors will be wary of investing even under the most carefully crafted contractual structure. In a supportive environment, however, project finance structuring can offer a relatively transparent and efficient means for countries seeking to increase the level of private participation in economic activity and investment. Another important policy message running through this discussion, and reinforced by the lessons of the financial crisis that began in 1997 in developing countries, is the priority governments need to give to strengthening local financial markets. Many of the project difficulties suffered in the wake of the financial crisis would perhaps have been more manageable if a greater share of project financing had been sourced locally. Local markets need to be able to provide long-term debt and equity financing on a reasonably competitive basis, so that projects without a natural foreign exchange risk hedge do not need to resort heavily to foreign currency financing and can therefore reduce potentially significant foreign exchange risk.

Designing, Structuring & Financing Private & Public projects has been covered in the book titled as 'Project Finance in theory & Practice' by Stefano Gatti[42](2007). The book detailed the market at an international level; Trends clearly demonstrate that project finance loans are a rapidly growing segment of the syndicated loan market and that the destination of funds is quickly changing. In particular, the largest portion of loans is beginning to flow into PPPs (public private partnerships) and into projects where public administrative bodies play the role of concession awarder to private sponsors. In Europe, PPP projects account for more than 36% of total project finance loans; in Asia this percentage stands at a remarkable 25%. Further it focuses on risk analysis and risk management and specifies that project contracts as risk management

[42] Stefano Gatti is Professor of Banking and Finance at Bocconi University in Milan,

tools. Together with insurance policies, in fact, they are the most powerful instruments of this kind for reducing a deal's cash flow volatility, to the benefit of both lenders and sponsors. Here author also describe what legal advisors, independent technical advisors, and insurers are required to do in the overall process of deal design, implementation and funding. Book also presents an overview of financing options. & address the role played by multilateral and bilateral institutions in developing countries. Syndicated loans, equity and mezzanine/subordinated loans, and leasing and project bonds are all included and analyzed from the economic and financial points of view. Further, explores some recent developments in the literature on project finance, brought about by the forthcoming adoption of the new Basel II rules. The chapter looks at Basel II requirements for lenders in terms of credit risk analysis of specialized lending deals (which encompasses project finance) and discusses the asset-unresolved issue of how to measure the value at risk of a project finance transaction. And also includes three case studies on Project Finance.

In a book of Christopher L. Culp on 'The Risk Management Process - Business Strategy and Tactics' in the Wiley Finance series contains insights specifically for finance and investment professionals as well as sophisticated individual investors and their financial advisors. This book is a split into three parts. Part one begins with a discussion of risk management and corporate finance. Beginning a book on the business strategy and tactics or risk management with a discussion of basic principles of corporate finance may seem strange. But in fact, risk management and corporate finance are inextricably related, with corporate finance being the backbone of the strategy of risk management. In many ways, risk management itself is a substitute for equity capital. Companies that have enough equity, after all, may well prefer to take an occasional loss rather than to spend considerable sums of

money managing their risks. Indeed, the first principles of the theory of corporate finance the Modigliani-Miller capital structure irrelevance propositions tell us that value-maximizing firms should not spend money to manage their risks at least not under certain assumptions. For many years, the reasons why firms should not manage risk were swept to the side by assumptions that firms behave just like risk-averse Limitations of the Study individuals. As the modern theory of corporate finance has evolved, however, theories that explain why corporations can sometimes increase their value by pursuing formal risk management initiatives started to appear with increasing frequency. Today, the list of reasons for a corporation to pay serious attention to risk management is impressive. Nevertheless, without a solid understanding of why risk management makes sense, the design of a risk management strategy and the implementation of that strategy can easily fall flat. At best, a failure to connect explanations for why managing risk can add shareholder value with the design of a risk management program will leave some unexploited efficiency gains and opportunities on the table. But at worst, the disconnect between corporate finance and risk management can lead a firm to implement the wrong risk management program altogether, sometimes leaving it exposed to even greater risks than if it had done nothing. Part Two of the book builds on the principles outlined in Part One for how firms can create value by adopting risk management programs and processes and explores how a value-enhancing risk management process can be implemented by a firm. Part Two thus explores the business of risk management, and, in turn, the impact of risk management on business strategy more broadly. Part Three of the book discuss how a company can try to ensure that the gaps between the risk tolerances commensurate with its business strategy.

4. NATURAL GAS HIGHWAY AND ITS IMPLEMENTATION

The first research objective of the study ‘to determine the Current Status of CNG Distribution systems in India’; was met in chapter no.1 i.e. Introduction to CNG business. Immense Literature Review i.e. chapter no. 3 has fulfilled the second objective of the study i.e. ‘to determine the factors affecting CNG distribution business in India’. Further, Primary and Secondary data would analyse to fulfil the objective number 3. Before getting into working out the Primary and Secondary data analysis, a need is felt to by the researcher to know the National Highway wide CNG distribution Project from Management and Operations point of view. Accordingly, this chapter has been prepared.

This chapter deals with an important part of the Management of CNG project. The Operation and Management systems require for distribution of CNG systems is discussed in-depth in this chapter. It explains the need of Natural Gas Highway by mentioning the amount of Vehicular Pollution and availability of alternate fuels. Rational for Delhi Mumbai Natural Gas Highway for instant research has been deliberated here in light of abundant Natural Gas availability and Gas transmission infrastructure of GAIL and GSPC in Gujrat.

Specifically, CNG distribution is Retail sales business of Natural Gas, therefore it become important to deliberate the CNG Station Location & its Spread, Ownership of retail outlets, Design and layout CNG Station, CNG station operations, CNG Equipment Supply & Station Maintenance, Financing of CNG Vehicle and easy CNG Conversion, Suppliers of CNG Kits, Installation and monitoring of CNG Kits, and the overall the CNG station management system is dicussed in this chapter.

4.1 Need of Natural Gas Highway

Researcher, before getting into the details of Management and Operation of CNG distribution along National Highway, reiterated the rationale for providing the CNG on National Highway.

Global warming and increasing ambient air pollution is a major cause of concern for all and calls for immediate actions to control any further damage to the environment. Various studies conducted worldwide shows that the major contributor to this increasing ambient air pollution is vehicular emissions. As per a study conducted by the Central Pollution Control Board vehicular emissions contribute to as high as 72% of the ambient air pollution in major cities.

4.1.1 Vehicular Pollution

Internal combustion engines need a mixture of air and fuel to burn and produce energy to move the vehicle. It is these burnt gases which come out of the exhaust that have the potential to cause pollution. In Petrol engines, the gases comprise of a mixture of un-burnt hydrocarbons (HC), Carbon Monoxide (CO) and Oxides of Nitrogen (NOx).

It is a combination of these gases that results in automobile pollution when they are in excess quantity. Within a certain range they are acceptable but when the engine is not tuned properly or a vehicle uses obsolete technology or the quality of fuel is not good then all these result in a higher level of emission of all the gases.

If the air fuel mixture ratio is not correct then, it increases the chances of pollution as it leads to inefficient fuel combustion. Also it leads to reduced power and fuel wastage, which in turn means less efficient performance of the engine along with lower fuel economy.

Contributors to Vehicular Pollution

- Increasing population in the urban areas
- High vehicle density
- Predominance of older and outdated vehicles plying on the roads
- Large number of in-efficient two stroke vehicles
- Adulteration of fuels
- Poor road conditions
- Inadequate traffic management system

There is a predominance of private vehicles like two wheelers and cars over public transport vehicles (buses). According to TERI, replacement of a single bus by an equivalent number of two wheelers will add to the air pollution by 27% and cars would cause 17% more pollution. Regardless of whether a bus is new or old, it offers large benefits in fuel savings, emissions and safety.

The Vehicle population in India is predominantly based on petroleum fuels like Diesel and Petrol. These fuels are not fully combustible and results in higher polluting emissions and greater wear and tear of the engine. The Central Pollution Control Board (CPCB) has, in a study, identified 24 cities in India that have extremely high level of pollution. This is not only having an adverse effect on the environment but also on the health of its citizens. According to the World Bank study, the annual health cost to India was up to 1.15 Billion USD due to ambient air pollution.

4.1.2 Alternate Fuel

The quest for finding an alternate to the existing conventional vehicular fuels like Petrol and Diesel was initiated around 1930. Besides there is a growing concern that the world may soon run out of petroleum based fuel resources. All these make it imperative that the search for alternative fuels is taken in right earnest. Various alternate fuels like Propane, LPG, Ethanol, Methanol, Electricity

and Natural Gas are being considered for replacement of the existing conventional polluting auto fuels like Petrol, Diesel and Kerosene. Amongst these, Natural Gas is emerging as the most promising alternate auto fuel not only for its commercial viability but also due to its environmental friendliness. As discussed in the first chapter of thesis, today natural gas is being used as vehicle fuel in many countries including Argentina, Egypt, New Zealand, Australia, Pakistan, Thailand and India. There are over 5000 CNG refueling stations globally catering to approximately 2 million vehicles[43].

Almost, the entire surface transport of India is based on petroleum fuel, but it's availability is of growing concern. The production or domestic crude has been declining and the transport system has been increasingly dependent on imported crude oil to meet its needs. This is severely affecting the economic condition of India. **These factors, coupled with the increasing concern for a cleaner environment, have resulted in greater emphasis on use of a clean fuel like Natural Gas in the automotive sector.**

4.2 Rational for Delhi Mumbai Natural Gas Highway

The proposed analysis is Distribution of Compressed Natural Gas (CNG) along the Delhi-Mumbai National Highway (NH8). Delhi & Mumbai are the biggest metro cities in India. This national highway is one of link of Golden Quadrilateral Highway identified by National Highway Authority. Also, NH8 is the densest tariff as far as vehicular movement is considered. Further, Delhi & Mumbai both the cities have independent companies operating CNG network. These are Indraprastha Gas Ltd & Mahanagar Gas Ltd for Delhi & Mumbai city respectively. Further NH8 is passing through state of Gujrat and it is understood earlier that from the city of Gandhinagaer to city of Valsad, CNG is now available. Currently,

[43] Source: International Association of NGVs

there is no CNG corridor present except above mentioned to cities. Therefore, it become appropriate to provide the CNG along NH8, and such project here termed as Natural Gas Highway. Map of NH8[44] is given below:

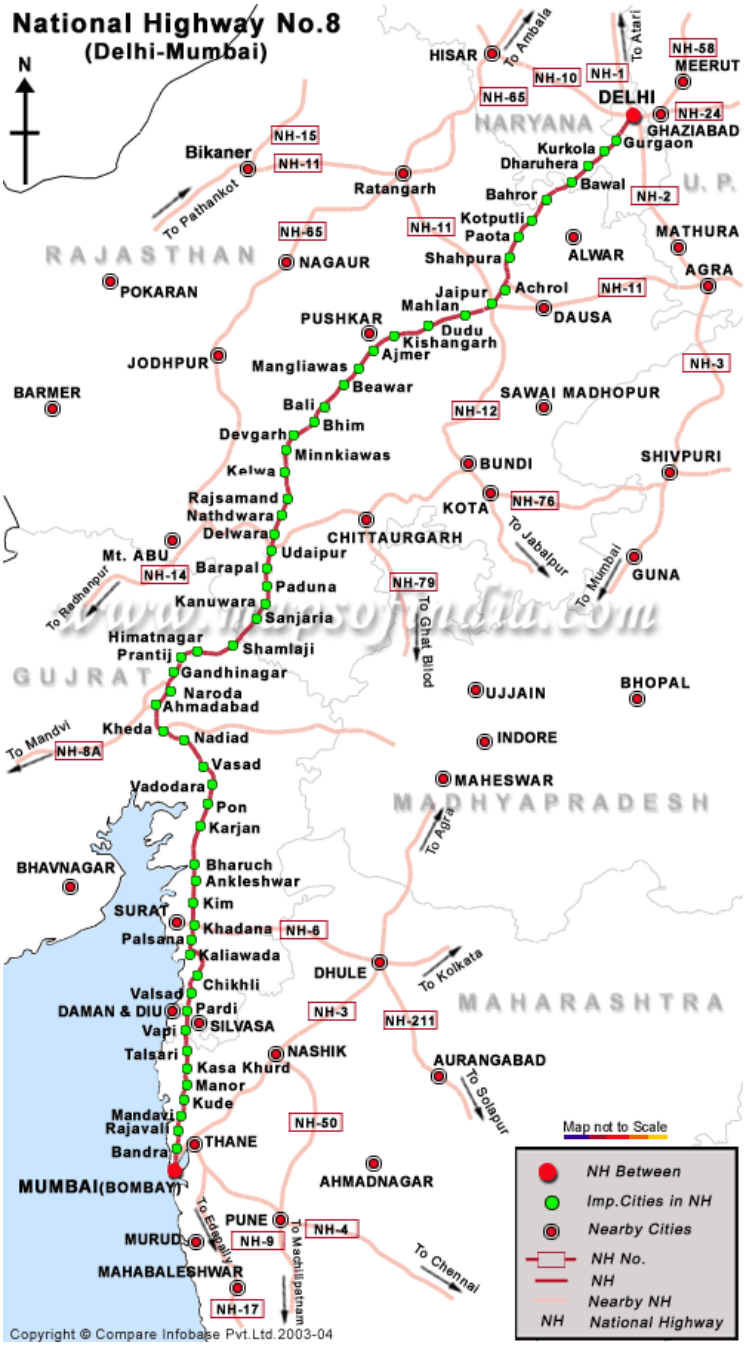


Figure 4.2-1 Map of Delhi Mumbai National Highway

[44] Source: http://www.mapsofindia.com/driving-directions-maps/nh8-driving-directions-map.html

4.3 Abundant Natural Gas Availability

The success or failure of implementation of the CNG project depends on adequate availability of Natural Gas. The Mashlekar Committee report on Auto Fuel Policy has observed that the feasibility of using CNG as an alternative auto fuel would depend on the overall natural gas availability as well as availability of a strong natural gas transmission infrastructure connecting various regions. **NH8 not only has connectivity to huge reserves of indigenous natural gas but also has connectivity to imported LNG.** NH8 can be supplied by three LNG regasification terminals. The same has been explained in detail in the subsequent part of this chapter. Two LNG terminals are present in Gujrat and one in Mahasratra and further, one more is being set up on the coasts of the Mundra.

4.4 Gas Transmission Infrastructure

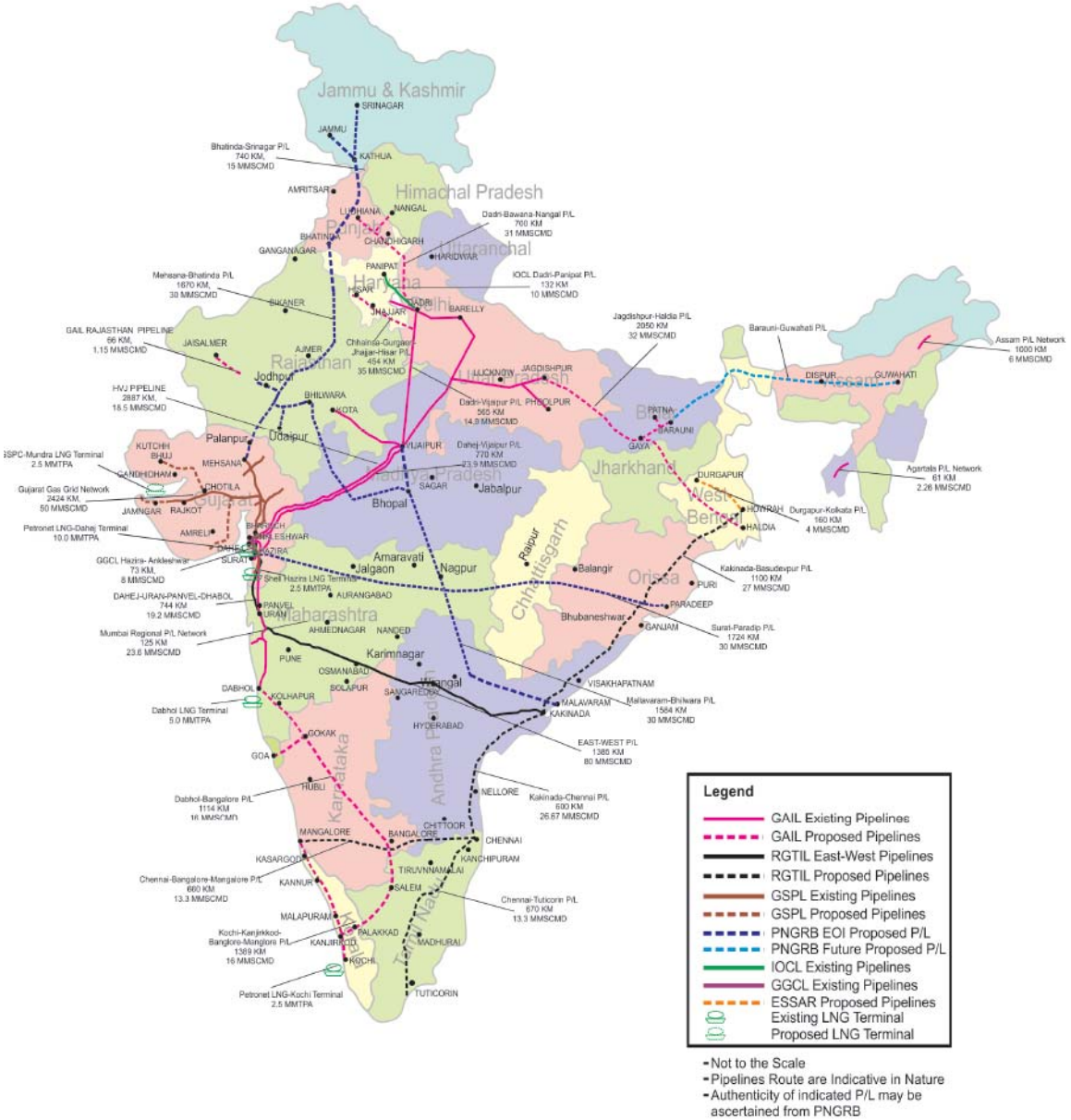
A country wide Gas Transmission pipeline network including the pipeline which are under implementation is as given below (Map[45] is attached)

Figure 4.4-1 Map of Indian Gas Transmission Pipeline Network

[45] Source : PNGRB Website

PETROLEUM AND NATURAL GAS REGULATORY BOARD
1st FLOOR, WORLD TRADE CENTRE, BABAR ROAD, NEW DELHI-110001 FAX No: 23709151
Ph. No: 011-23457700, 011-23457744, 011-23457751
www.pngrb.gov.in

GAS PIPELINES IN INDIA



4.4.1 Pipeline Network for CNG Distribution along NH8

Researcher explained earlier that, NH8 CNG is already available in the city of Delhi, Mumbai and few cities present on NH8 of the Gujrat state. (The detailed list of cities of Gujrat present along NH8 and having CNG distribution facility is discussed separately in the later part of this chapter). Therefore, to make the CNG available on the remaining part of NH8, connectivity has to provide from the existing Natural Gas pipeline of infrastructure.

In view of this, Researcher made an attempt to connect the NH8 with the existing Natural Gas pipeline infrastructure. Therefore, Researcher plots the National Highway no. 8 from the GPRS based facility available in Internet. The detailed route survey of the same is placed at **Annexure III**.

GAIL has the Natural Gas pipeline infrastructure upto Kota in the state of Rajasthan. Kota is being served by two major pipeline of GAIL, which are Dahej – Vijaipur – Kota and Hazira - Vijaipur – Kota pipeline. The details of existing pipelines[46] connecting to NH8 is as follows:

Table 4.4.1-1 GAIL Pipeline System for Gas Supply to NH8

Network	Length (Km)	Capacity (MMSCM)	Date of Commissioning	Route
HVJ/DVPL/ GREP	4233	57	March 87 & March 04	Gujrat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Delhi, Haryana
Vijaipur Kota	463	8	March 07	Madhya Pradesh

[46] Company Reports

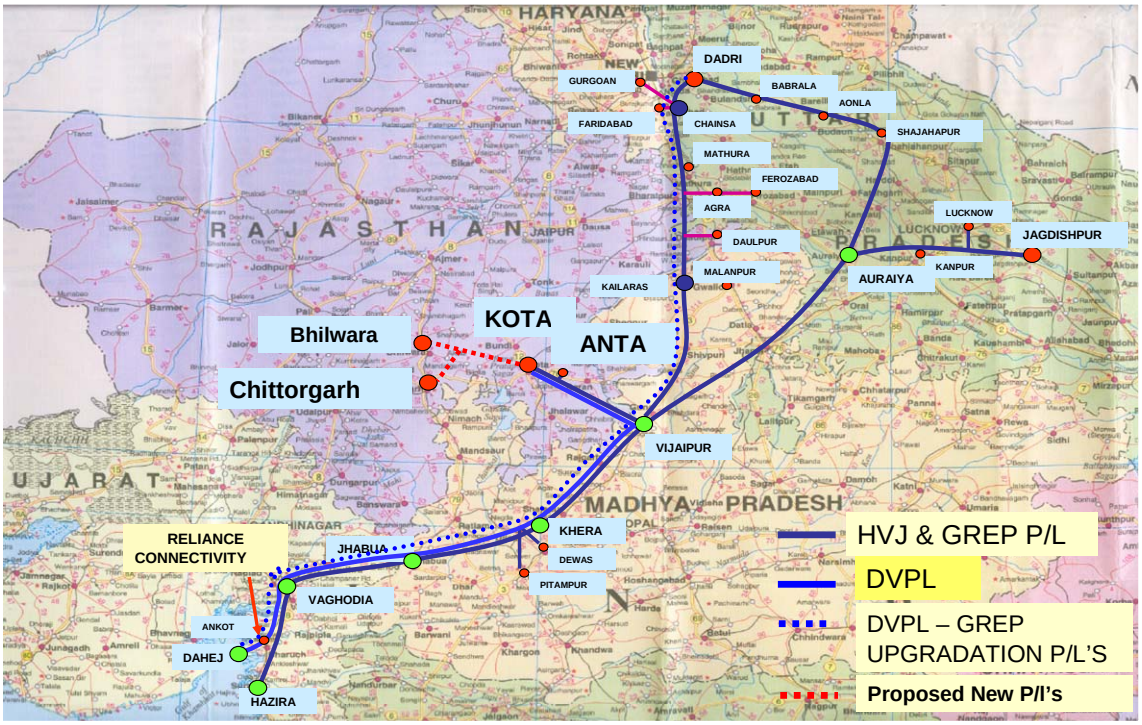


Figure 4.4-2 GAIL Pipeline System for Gas Supply to NH8

In order to supply the Natural Gas from Kota to NH8, connectivity has to be established. Researcher has identified Ajmer as the nearest location along NH8 where the connectivity of Natural Gas may be made based on General packet radio service (GPRS) view of map. The distance between Kota and Ajmer is 202 Km. the pictorial view of the same is produced from GPRS is as given below:

Figure 4.4-3 Map of Kota – Ajmer Pipeline

The gas will supplied to NH8 through this pipeline. The project will have to incur the capital cost for this purpose. While estimating the Financial Feasibility of the project, Researcher has considered the same. The pipeline specification considered by researcher is 20 inch diameter, 202 Km steel Natural Gas pipeline. The pipeline diameter is estimated based on Panhandle Equation as prescribed by the regulator i.e. PNGRB.

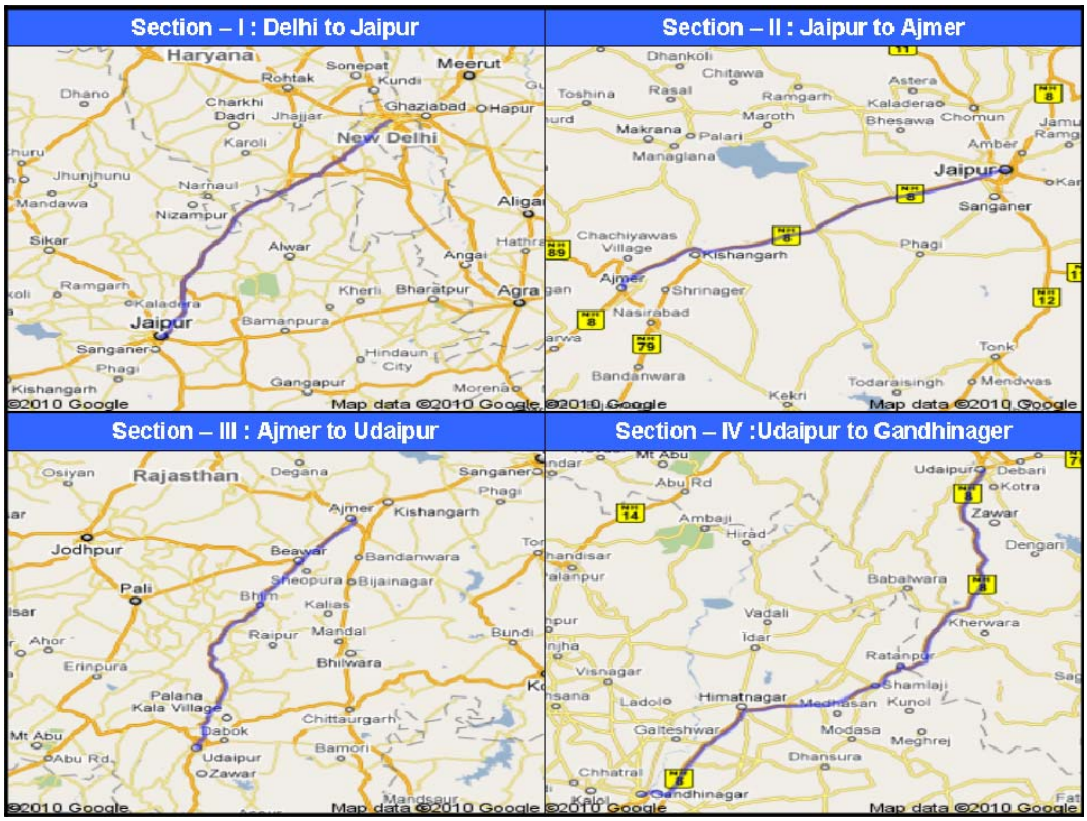
Researcher carried out the GPRS based route survey on NH8 for identifying the length of Natural Gas pipeline required to distribute the CNG and number CNG stations required to install across NH8. Researcher studied the route survey by dividing the NH8 into 6 different sections, based on distance and availability of CNG. The section wise details of route survey are as given under:

Table 4.4.1-2 Route survey of NH8

Section No	Route Description	Length of the Section (Km)	Natural Gas pipeline length required along the section (Km)	CNG station required across the section (Nos)
I	Delhi to Jaipur	261	150	4
II	Jaipur to Ajmer	135	135	4
III	Ajmer to Udaipur	271	271	6
IV	Udaipur to Gandhinager	233	133	2
V	Gandhinager to Vapi	386	-	-
VI	Vapi to Mumbai	171	49	2
Total	**Delhi to Mumbai**	**1457**	**738**	**18**

The section wise pictorial view based on GPRS survey is given below:

Figure 4.4-4 Route Survey of NH8



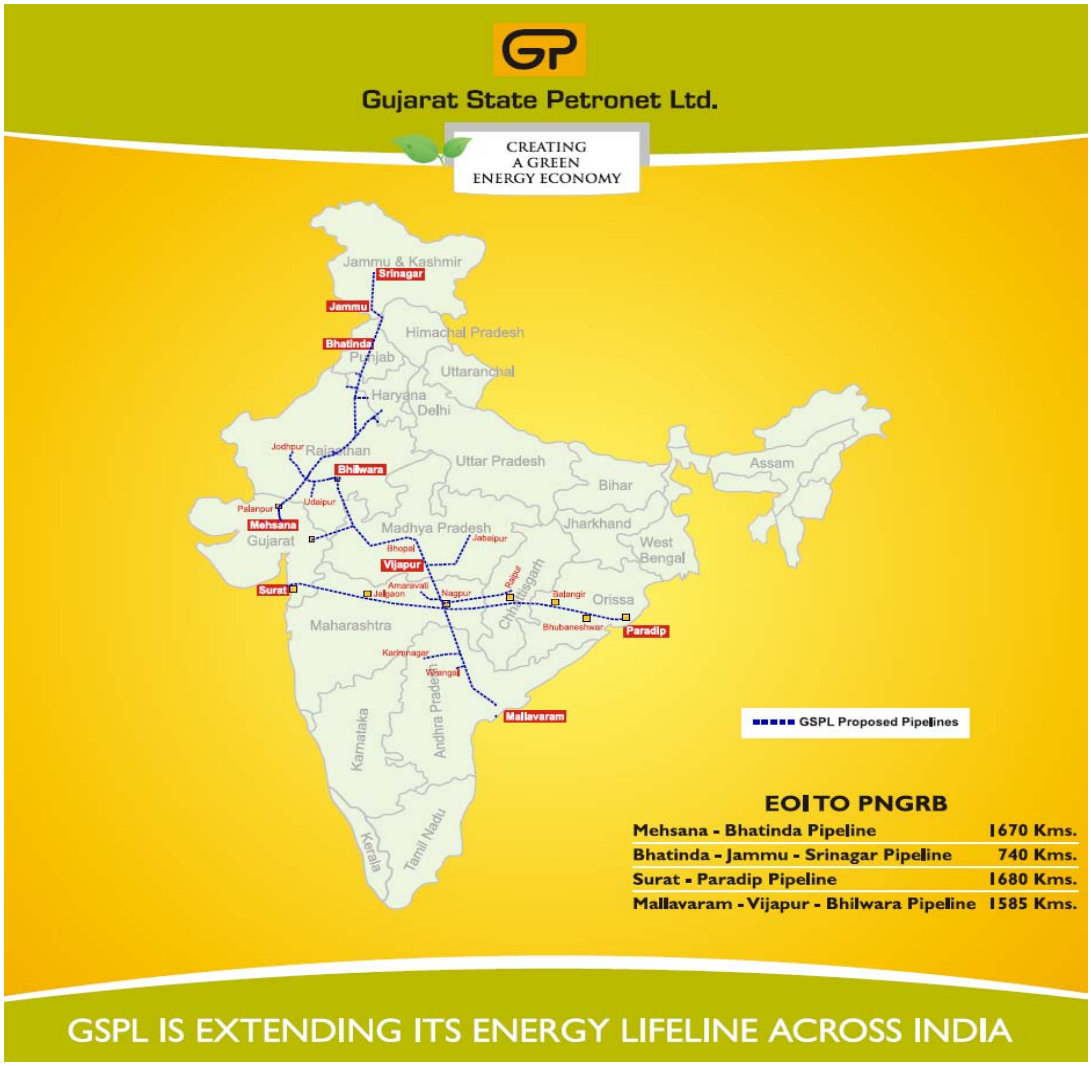
4.4.2 Gujrat Natural Gas Grid

GSPL, which is a subsidiary of GSPC, was incorporated to construct and manage a state-wide gas transmission network in Gujarat, connecting production centres and LNG terminals with major demand centres across the state. Its existing gas transmission network comprises 1,635 km of medium-to-high pressure pipelines connecting natural gas supplies from Hazira and Dahej to the districts of Ahmedabad, Anand, Baroda, Bharuch, Gandhinagar and Surat.

The majority of GSPL's customers include power, fertiliser, chemical and steel plants that purchase natural gas directly from suppliers. Its customers also include several local gas distribution companies that supply natural gas to retail consumers. The company plans to set up a gas transmission and distribution network outside the state as well. Map[47] for the same is given below:

[47] Source : GSPC Web site

Figure 4.4-5 Map of GSPL Network



4.5 CNG Station Location & Spread

As discussed earlier, by the researcher, the CNG is currently available at Delhi, Mumbai and few cities of the Gujrat state. Researcher has made an attempt to identify, currently existing Infrastructure which distributes the CNG along NH8. Accordingly following are the list of cities compiled as state wise, city wise and agency wise supplying the CNG along NH8:

Table 4.4.2-1 Existing CNG Station Location & Spread on NH8

Sr. No	Location	State	Agency
1	Delhi	Delhi	Indraprastha Gas Limited
2	Gandhinagaer	Gujrat	Sabarmati Gas
3	Ahemdabad	Gujrat	Adani Gas & HPCL
4	Kheda	Gujrat	Chartor Gas
5	Baroda	Gujrat	GAIL & Vadodhara Mahanager Gas
6	Bharuch	Gujrat	Gujrat Gas
7	Ankleshwar	Gujrat	Gujrat Gas
8	Kim	Gujrat	Gujrat Gas
9	Khadana	Gujrat	Gujrat Gas
10	Valasas	Gujrat	Gujrat Gas
11	Vapi	Gujrat	Gujrat Gas
12	Mumbai	Maharashtra	Mahanager Gas

Thus, there is no need to put CNG or pipeline infrastructure on the above locations of NH8. As explained earlier, in order to identify the locations along the highway where CNG stations can be located, a internet based survey was conducted along NH 8.

4.6 Sourcing of Gas

The important parameter, for successful CNG distribution project came out of Literature Review is sourcing or supply of Gas. Gas sourced for the instant Project is from GAIL's Kota terminal of Vijaipur Kota Pipeline. Kota is placed 202 Km from Ajmer. As explained earlier, a pipeline has to be laid from Kota to Ajmer to supply the Gas on NH8.

Vijaipur Kota line is connected to main cross country pipelines like Dahej to Vijaipur & Hazira to Vijaipur Natural Gas pipeline of GAIL. Gas can be sourced from both domestic as well as imported

LNG. Domestic gas source connected with this system is ONGC's Mumbai High, RIL-BG's Panna, Mkuta & Tapti field and RIL KG basin gas. Further two LNG terminals are connected with this systems viz. Petronet at Dahej & Shell at Hazira. Therefore, **Gas can be made very easily available on NH8.**

4.7 CNG Project: Operation and Management

Researcher made an attempt to review the aspects of CNG distribution project from Operation and Management point of view, which is one of the major aspects for any project. Accordingly, an Interview was done with top executives of CNG Distribution Company in Delhi. Following are the important aspects deliberated during the interview and same are placed below:

4.7.1 CNG Station Ownership

While setting up the CNG stations, there are two options available: Out right purchase of land and setting up of its own CNG stations by the Project Company or tie up with oil companies like HPCL, BPCL etc. for setting up the CNG stations in the existing Petrol/Diesel outlets. In the second option, Project Company will assist the oil companies in setting up the CNG station by assisting in the procurement of the necessary equipments and other facilities. A revenue sharing agreement will be worked out mutually.

4.7.2 Standardization of Station Layout and Design

In order to create a strong brand visibility, it is necessary that all the CNG stations should follow a standardized design and layout scheme. The National Institute of Design may be appointed for standardization of size and design of all the CNG station and it will be adopted at all the CNG stations. The number of CNG dispensers at each station would depend upon the size of the station.

4.7.3 CNG Station Operations

In case of Project Company owned CNG stations, the daily operation of the station will be handled by itself. In case of CNG stations set up at existing retail outlets or oil companies the day to day operations of the CNG stations would be outsourced to the dealer operating the petrol pump by entering in to a long term Operation Agreement with them. The selected Operator of the CNG stations would be responsible for the CNG filling, stock keeping, customer handling, billing and cash management activities and maintaining the safety and environment of the stations. The remuneration paid to the Operator would be linked to the sales volume at the respective stations.

4.7.4 CNG Equipment Supply & Station Maintenance

For the smooth and efficient operation of the CNG station, it is necessary to use the equipments of the highest quality. Discussions have to make with various reputed CNG equipment suppliers for supply of major equipments like compressors, dispensers, cascades etc.

The suppliers of CNG equipments would also be responsible for the maintenance of the CNG equipments. A long term Maintenance Contract will have to be finalized with the selected suppliers.

4.7.5 CNG Vehicle Financing

Project Company may plans to initially finance few CNG Vehicles which will be operated by State Government Road Transport Corporation on the NH8 route. This will create awareness about the benefits of CNG apart from creating an anchor demand and also induce the private bus operators to consider CNG as an alternate fuel. Subsequently, State Government Road Transport Corporation can initiate a phased role out plan to replace its entire diesel bus fleet with CNG buses. It can be further assumed that sum of (Rs.

25000) will be recovered every month from each vehicle thus financed till the cost of conversion is recovered.

4.7.6 CNG Conversion

One of the most crucial aspects affecting the viability of the project is the conversion of existing petrol and diesel vehicles to CNG. The existing petrol vehicles can be converted to dual fuel engines (CNG and Petrol). Diesel vehicles can not be converted to dual fuel engines due to technology limitations as well as commercial viability. Various awareness programmes will be initiated to educate the vehicle users about the benefits of CNG and to induce them to convert their vehicles to CNG. Aggressive marketing and conversion drive is the key to the success of the project.

4.7.7 Conversion Kit Suppliers

It is very necessary that non-CNG vehicles be fitted with authorized CNG conversion kits of reputed manufacturers. Use of spurious and duplicate conversion kits will result in higher occasions of accidents. Project Company will have to identify and empanel reputed conversion kit manufacturers for supplying conversion kits. Only vehicles fitted by authorized conversion kits will be allowed to refuel at the CNG stations.

The conversion kit supplier will also be responsible for the maintenance of the kit in different locations. A team of technical experts from the supplier’s side will remain present at the various locations to handle any emergency.

4.7.8 Kit Installation and Monitoring

While implementing the project, it is very necessary that only authorized conversion kits are used in vehicles. Steps will be taken to ensure that spurious and duplicate conversion kits are not used in vehicles as this could pose serious safety risks to the vehicle owners and operators. Vehicle owners can get CNG conversion kits fitted in

their vehicles only at authorized garages and work shops. Upon installation, a magnetic swipe card will be issued to the vehicle owner. When ever the vehicle owner gets his vehicle refilled at a CNG station, the swipe card can be used to ascertain that the vehicle has been fitted with an authorized CNG conversion kit. In case the vehicle owner does not have the swipe card he can be denied access to the filling station thus preventing spurious kits to be used. The swipe card can store useful information which can be used for the purpose of monitoring and analyzing data as well as for payments.

4.7.9 CNG Conversion Centers

In order to ensure smooth conversion of all targeted vehicles to CNG, a series of conversion garages will set up in different locations. For this existing large auto garages will be targeted and necessary training will be given to them in CNG conversion by the conversion kit supplier. This would not only reduce the cost of setting up new garages but will also enable making use of the skills of the existing auto mechanics thus providing better services to the vehicle owners. Assistance will be sought from the ITIs (Industrial Training Institutes) in different locations to offer courses in CNG conversion technology to create a pool of skilled manpower capable of handling the auto conversion activities.

4.7.10 Original Equipment Manufacturers

The target vehicle segments for conversion are cars, jeeps, tempos, trucks, buses and other LCVs. As Project Company plans to set up its CNG station network along the national highway, the initial focus will be on buses as they constitute a major chunk of the highway vehicular traffic. The major manufactures of buses are Telco and Ashok Leyland. Meetings have to be held with these manufacturers to discuss various issues related to conversion and supply of new CNG vehicles in Delhi, Harayna, Rajasthan, and Gujarat & Mahasrashtra.

4.7.11 CNG Stations Management System

All CNG Stations should be a state of art technology employing the latest in fool proof connectivity and management solutions which will include smart cards, centralized monitoring of gas sales and monitoring system. This will not only assure operational efficiency but pilferage or false billing can also be taken care of thus providing incentive to private operators and State Transport Corporation for CNG buses.

5. SURVEY ANALYSIS OF RESEARCH PROBLEM

Researcher, in the previous chapters has given the backdrop of Study along with objectives to be studied and the Research Methodology to be used for solving the solving the research problem. Further researcher has also gone through immense Literature Review for achieving the Research objective and also to prepare the Questionnaire for Primary data collection.

In view of this, the researcher has made an attempt to achieve the objectives no. 2 & 3 stated in the chapter of Research Methodology by capturing the Opinion of Experts from the Oil & Gas Industry regarding the three major aspects of the research. These are as follows:

1. The current CNG status in the Country
2. Feasibility of Distribution of CNG along NH8
3. Identification of most appropriate project execution model for Distribution of CNG among the Private, Government and Public Private Partnership.

Therefore, to capture the above mentioned aspects of the research, a Questionnaire has been designed. The questionnaire for this purpose contains 73 questions and it is designed in such a manner that a respondent is required to simply put a tick (✓) mark or rank from 1 to 3 as a part of response (and nothing elaborate/easy type to be written). The copy of this Questionnaire is placed at **Annexure IV.**

It was an endeavor of Researcher, that, questions do not seek any specific details about their function, however, at the same time due care has been taken by researcher for collecting the relevant data, in order to meet the research objective. Researcher has made the use of technology for getting the responses to this Questionnaire. The

Questionnaire was made online and data requires submission through Internet. However, the facility of manual filling of Questionnaire of course was there. Briefly following were the methods used while submitting the Questionnaire by the respondents:

Methods of submitting questionnaire

a) **Online:** The Questionnaire was made available online and No need to print and send. This online questionnaire was available on the following link:

http://questionpro.com/t/AES0PZH6vh

b) **Manual:**

i. One may download the soft copy of this questionnaire from http://www.scribd.com/doc/34828535/Final-Questionnnaire and e-mail the duly filled questionnaire to shivaraj@gail.co.in

ii. Alternatively manually filled questionnaire may be physically post to Researcher at: Shivaraj Bhor, EA-329, Maya Enclave, DDA Flats, New Delhi 110064

It may be noteworthy that, all the respondent filled the Questionnaire online and following befits are reaped from this initiatives:

1. Paperless
2. Advanced question types
3. Real-time feedback from respondents
4. Very fast response collection
5. Handy for Respondents
6. No need to enter the data

5.1 Profile of Respondent

Instant research study is to analyze the Project Execution model for distribution of CNG along National Highways. It may be noted that CNG business is niche business and very limited people i.e. who are currently working with such industry is only exposed to in and out of the CNG industry. Further, only relevant employees ie. Top to Middle level managerial executives are considered in the sample size. Thus, the instant research is based on Non-Probabilistic, Judgmental Sampling and accordingly 67 respondents have filled the Questionnaire.

Sector wise Profile:

As discussed above, being the niche area of research of CNG business, the Sample has to be from Oil & Gas sector companies, therefore, an attempt was made by the researcher to collect the data from Oil & Gas Sector, Oil and Gas Industry Analysts and Oil and Gas Consultants. Further few PPP companies in Oil & Gas sectors are also participated in the Survey. The sector wise profile for the same is given below:

Table 4.7.11-1 Sector wise Profile for Survey Respondent

Sector	No of Respondents
Oil & Gas Companies	38
Oil & Gas Industry Analyst	20
Oil & Gas Consultant	5
PPP Companies in Oil & Gas	4
Total	**67**

The list of companies, who are participated in the survey, is placed at **Annexure V.**

Experience wise Profile:

Researcher have compiled the following table reflecting the details of respondent's experience in number of years,

Table 4.7.11-2 Experience Profile of Survey Respondent

Experience in Years	No of Respondents
Above 20	15
Between 15 to 19	11
Between 10 to 14	11
Between 5 to 9	16
Below 4	14
Total	**67**

5.2 Analysis of Questionnaire

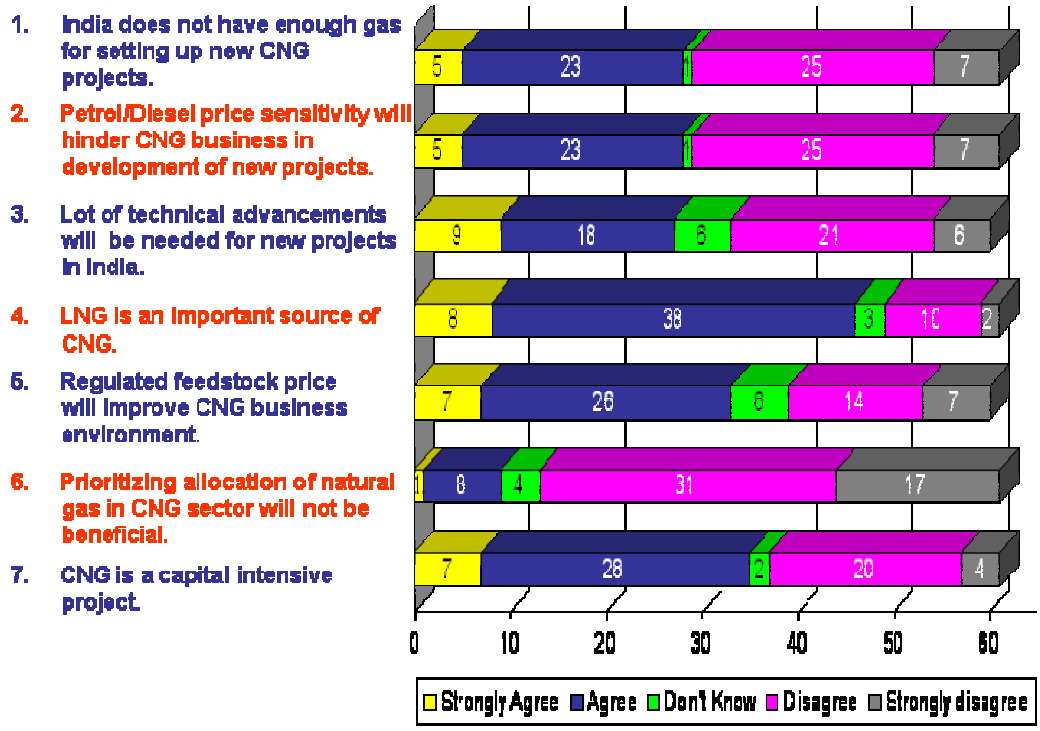
5.2.1 Section – A: Attributes of CNG Distribution

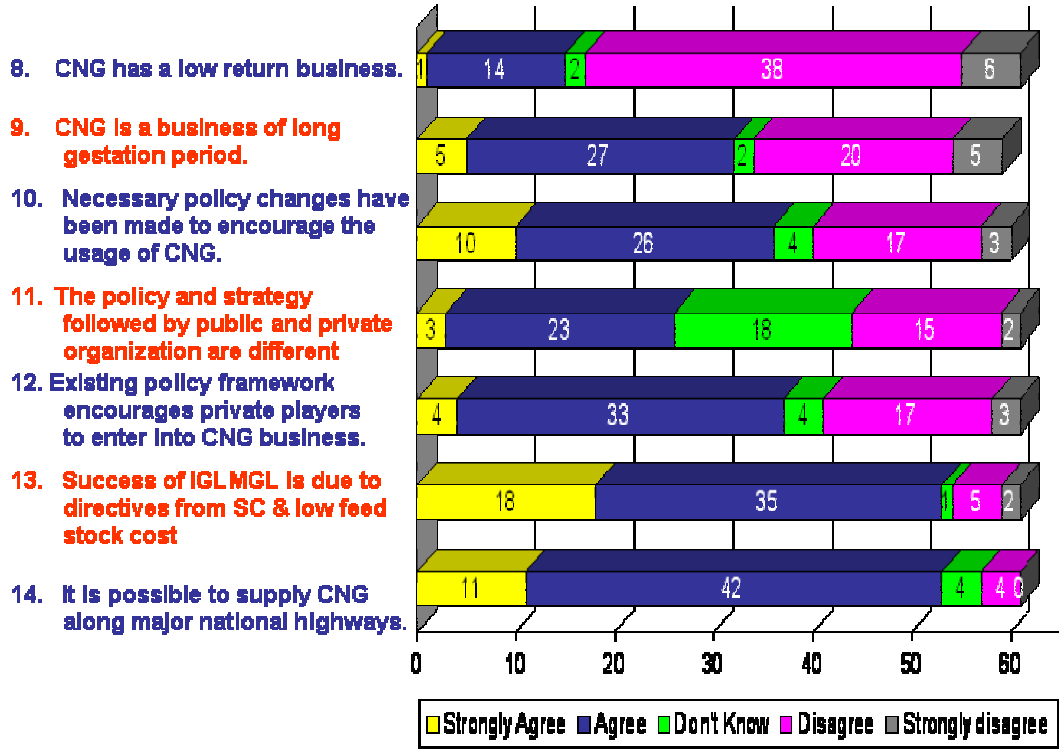
Researcher in this section made an attempt to capture the expert opinion regarding attributes of CNG distribution. These questions are derivation of the in-depth Literature Review. The questions are designed to fulfill the objectives mentioned in the chapter of Research Methodology. Accordingly researcher has prepared the questions in this section and these are primarily focusing on to capture the primary data pertaining to CNG activities in India.

Table 5.2.1-1 Summary Respondent to CNG Distribution

Questions	Respondents	Mean (out of 5)
1. India does not have enough gas for setting up new CNG projects.	61	3.10
2. Petrol/Diesel price sensitivity will hinder CNG business in development of new projects.	61	3.10
3. Lot of technical advancements will be needed for new projects in India.	60	2.95
4. LNG is an important source of CNG.	61	2.34
5. Regulated feedstock price will improve CNG business environment.	60	2.80
6. Prioritizing allocation of natural gas in CNG sector will not be beneficial.	61	3.90
7. CNG is a capital intensive project.	61	2.77
8. CNG has a low return business.	61	3.56
9. CNG is a business of long gestation period.	59	2.88
10. Necessary policy changes have been made to encourage the usage of CNG.	60	2.62
11. The policy and strategy followed by public and private organization are different in context to CNG business.	61	2.84
12. Existing policy framework encourages private players to enter into CNG business.	61	2.70
13. Success of Indraprastha Gas limited (IGL) & Mahanagar Gas limited (MGL) is due to directives from Supreme Court & low feed stock price of Natural Gas.	61	1.98
14. It is possible to supply CNG along major national highways.	61	2.02

Figure 5.2-1 Respondent to CNG Distribution





1. India does not have enough gas for setting up new CNG projects.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	5	8
Agree	23	38
Don't Know	1	2
Disagree	**25**	**41**
Strongly Disagree	7	11

Table 5.2.1-2 India does not have gas for CNG projects

On asking about the adequacy of Gas for distribution of CNG projects, majority of the respondents (32 out ot 61) i.e. 52% have shown their dis-agreement to non-availability of Gas, which shows that *India has sufficient Gas for taking up CNG distribution projects*

2. Petrol/Diesel price sensitivity will hinder CNG business in development of new projects.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	5	8
Agree	23	38
Don't Know	1	2
Disagree	**25**	**41**
Strongly Disagree	7	11

Table 5.2.1-3 Petrol/Diesel price sensitivity

Researcher tried to find out the obstacle arises due to price of Petrol and Diesel on CNG distribution by asking 'whether Petrol/Diesel price sensitivity will hinder CNG business in development of new projects'. The majority of expert i.e. 32 out of 61 (52%) is of the opinion that Prices of Petroleum fuel like Petrol and Diesel will not make any obstacle for CNG business.

3. Lot of technical advancements will be needed for new projects in India.

Particulars	Value	Percentage
No of Respondents	60	
Strongly Agree	9	15
Agree	18	30
Don't Know	6	10
Disagree	**21**	**35**
Strongly Disagree	6	10

Table 5.2.1-4 Lot of technical advancements needed in India

It becomes pertinent to know by the researcher about the Technical Capability for doing the business of CNG distribution. Researcher rightly pointed the same question to experts of Oil & Gas Industry. The majority of the expert i.e 27 out of 60 (i.e. 45% with mean of 2.95) is of the opinion that no technical hurdle is currently exist for executing CNG project along National Highways.

4. LNG is an important source of CNG.

For successful execution and implementation of any Project, it is necessary to have the tie up of Raw Material used in the system. The success of project of CNG distribution is to secure upstream tie up i.e. Security of Supply of Natural Gas. Since the Domestic and Imported Gas are the two major sources of Gas supply. Therefore, researcher tried to seek the expert opinion regarding 'Whether LNG is an Important Source of CNG'. It is observed majority of expert's opinion 46 out of 61 i.e. 75% favor the statement. In view of this strong opinion from the expert, researcher draws the conclusion that 'LNG is an Important Source for CNG distribution project'.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	8	13
Agree	**38**	**62**
Don't Know	3	5
Disagree	10	16
Strongly Disagree	2	3

Table 5.2.1-5 Analysis of LNG is an important source of CNG

5. Regulated feedstock price will improve CNG business environment.

Particulars	Value	Percentage
No of Respondents	60	
Strongly Agree	7	12
Agree	**26**	**43**
Don't Know	6	10
Disagree	14	23
Strongly Disagree	7	12

Table 5.2.1-6 Regulated feedstock price

Researcher, while explaining the upstream security of Feed stock, mentioned about the importance of LNG supply. Similarly, cost of the Gas supply has to be looked into. Researcher, therefore, put the query regarding 'Whether Regulated Feed stock price will improve the CNG business environment' to the specialist of Oil and Gas Sector. Majority of the Specialist i.e. 33 out of 60 (55%) forms the opinion that Regulated price of Gas will favor the CNG distribution project. It is to be noted that, LNG is an important source for distribution of Natural Gas has been observed by the researcher. *However, the price of LNG is market driven, therefore conclusion from these two aspects together can be framed as CNG project requires LNG but at certain level of regulated price like Domestic Gas price. Thus CNG is project is first viable on Domestic Gas*

allocation due to its low regulated price as compared to costly imported LNG.

6. Prioritizing allocation of natural gas in CNG sector will not be beneficial.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	1	2
Agree	8	13
Don't Know	4	7
Disagree	**31**	**51**
Strongly Disagree	17	28

Table 5.2.1-7 Prioritizing allocation of natural gas in CNG

Interestingly, Researcher has poised the questions in a manner where first LNG concluded as Important Source of Gas for CNG distribution project. Then Regulatory Price issue was discussed in-depth, the result of the same was in favor of domestic Gas since it falls under regulatory Pricing Mechanism. At this juncture, Researcher sought the judgment whether 'Prioritizing allocation of natural gas in CNG sector will not be beneficial'. It makes very significant contribution to study, as 79% of the population of experts is of the judgment that Priority allocation of Natural Gas is beneficial for the development of this Business. *Thus, allocation of Gas from Government is very much required for successful implementation of CNG distribution project along National Highway.*

7. CNG is a capital intensive project

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	7	11
Agree	**28**	**46**
Don't Know	2	3
Disagree	20	33
Strongly Disagree	4	7

Table 5.2.1-8 Analysis of CNG is a capital intensive project

Distribution of Gas through trunk pipeline is very capital intensive project. However, it is relevant to know by the researcher, whether 'CNG is a capital intensive project, as amount of volume handled by CNG distribution entities is very small as compared to other Natural Gas consuming industry. The majority, i.e. 35 out of 61 (57%) of Oil and Gas expert is of the belief that CNG is capital intensive project. *Thus, a conclusion may be drawn that Distribution of CNG requires the huge capital outlay. Government, itself being in Capital deficit position, may not able to support such huge capex.*

8. CNG has a low return business.

Researched up till now, tried to demystify the various CNG distribution related aspects like Domestic Supply of Gas and its availability, LNG availability, Regulatory Price of Gas and Priority allocation of Gas. Now the Researcher sought, the expert view on the financial feasibility of the project which may be judged from the return of the business of CNG distribution. Therefore, researcher quoted that 'whether CNG has a low return business'. The majority of expert i.e. 44 out of 61 is disagreed that statement. *Therefore, researcher forms the conclusion that Distribution of CNG is definitely a profitable proposition.*

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	1	2
Agree	14	23
Don't Know	2	3
Disagree	**38**	**62**
Strongly Disagree	6	10

Table 5.2.1-9 Analysis of CNG has a low return business

9. CNG is a business of long gestation period.

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	5	8
Agree	**27**	**46**
Don't Know	2	3
Disagree	20	34
Strongly Disagree	5	8

Table 5.2.1-10 CNG is a business of long gestation

Researcher, in the above question no. 7 concluded that CNG is capital intensive project. Generally, capital intensive project are having long gestation period. In view of this, researcher tested the statement 'whether CNG is a business of long gestation period' from the group of expert on Oil and Gas Sector. The majority of the expert 32 out of 59 is of the opinion that CNG is a long gestation period. The instant study is, **An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway.** Since, as concluded from the experts, that such projects are of long gestation in Nature. It becomes necessary to arrange the funds for the project with long moratorium period. Further, Cost of Funding is also been tested by the researcher in the subsequent part of the chapter.

10. Necessary policy changes have been made to encourage the usage of CNG.

Particulars	Value	Percentage
No of Respondents	60	
Strongly Agree	10	17
Agree	**26**	**43**
Don't Know	4	7
Disagree	17	28
Strongly Disagree	3	5

Table 5.2.1-11 Necessary policy changes have been made

Till now, in this chapter, researcher focused on the project feasibility aspect for distribution of CNG along National Highways. It is very necessary to evaluate the project from the angle of Regulatory and policy framework. With these surroundings, researcher framed the query 'whether necessary policy changes have been made to encourage the usage of CNG.' Mass of the expert i.e. 36 out of 60 (60%) is of the judgment that Government has made the required changes in their regulation or policy to encourage the usage of CNG. This is really a significant outcome for the researcher, as it depicts *Government's positive move towards, making CNG available as clean and green fuel in the country.*

11. The policy and strategy followed by public and private organization are different in context to CNG business.

The instant research is to evaluate the suitable project execution model for distribution of CNG along national highways among Private, Government and Public Private Partnership. Therefore, it force researcher, to know 'whether the policy and strategy followed by public and private organization are different in context to CNG businesses. As most of the Oil & Gas companies are Public Sector Undertakings (PSUs), therefore a 30% expert says they are not in a position to justice the query. However, 43% i.e. 26 out of 61 of

expert agrees that the policy and strategy followed by public and private organization are different in context to CNG business. *This outcome from experts suggests that there is significant difference exist in the project execution model of Private and Government.*

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	3	5
Agree	**23**	**38**
Don't Know	18	30
Disagree	15	25
Strongly Disagree	2	3

Table 5.2.1-12 The policy and strategy for CNG business

12. Existing policy framework encourages private players to enter into CNG business.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	4	7
Agree	**33**	**54**
Don't Know	4	7
Disagree	17	28
Strongly Disagree	3	5

Table 5.2.1-13 Existing policy framework

It is observed while discussing the question no. 10, that Necessary policy changes have been made to encourage the usage of CNG. The Researcher here sought the opinion from specialist of Oil & Gas on 'whether existing policy framework encourages private players to enter into CNG business.' Majority of the specialist, i.e. 37 out of 61 (61%) is agreed to this statement. Existing policy framework, induces the competition in the business of CNG distribution. That is the reason; customer will be most benefited from competition along with the achievement of social objective to move the country on

clean and green fuel. *Therefore, inference can be made from the Question no 10 and 12 that Government wants to promote the CNG distribution and accordingly they made the policy changes, further these changes are in favor of inducing competition in the process of CNG evolution.*

13. Success of Indraprastha Gas limited (IGL) & Mahanagar Gas limited (MGL) is due to directives from Supreme Court & low feed stock price of Natural Gas.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	18	30
Agree	**35**	**57**
Don't Know	1	2
Disagree	5	8
Strongly Disagree	2	3

Table 5.2.1-14 Analysis of Success of IGL & MGL

Any project would be successful, if and only if the product or services rendered through that project have been demanded by customer. The Indraparastha Gas Limited and Mahanager Gas Limited are the two big success stories for CNG distribution in the country. Demand served by these two companies may be due to directives of Apex Court. Researcher sought the clarification on the same be asking 'whether Success of Indraprastha Gas limited (IGL) & Mahanagar Gas limited (MGL) is due to directives from Supreme Court & low feed stock price of Natural Gas'. Expert in masses (i.e. 87%) strongly agreed for the acceptance of this statement. Thus, this is a significant outcome from the study that for Success of CNG distribution, demand needs to be created by giving directives from Government side. *Therefore, it can be concluded that, PPP or Government model is best suited for such project of CNG distribution.*

14. It is possible to supply CNG along major national highways.

Particulars	Value	Percentage
No of Respondents	61	
Strongly Agree	11	18
Agree	**42**	**69**
Don't Know	4	7
Disagree	4	7
Strongly Disagree	-	-

Table 5.2.1-15 It is possible to supply CNG on highways

In the previous question, Researcher sought the information for CNG Distribution Company in the city of Delhi and Mumbai. Now Researcher like to take the view regarding CNG distribution along National Highways, therefore Researcher posed the same question to the Oil and Gas professionals, The mass of expert 53 out of 61 i.e. 87% agrees to the statement. **In view of this strong opinion, Researcher draws the conclusion that CNG can made available along National Highways.**

Second part of Section A, is to be rank the following aspects of CNG in order of suitability on the present scenario. Here Rank 5 is the extremely important aspect.

Question	Count	Mean
1. Eco- friendly.	60	4.183
2. Safer fuel.	60	3.650
3. Abundant and readily available.	59	3.000
4. Cheaper fuel.	60	3.500
5. Reduction in load carrying capacity of Goods carrier.	56	3.089
6. Reduction in maintenance cost.	58	3.052
7. Cargo space is reduced due to CNG cylinder in Vehicles.	58	3.466

Table 5.2.1-16 Summary of Ranks of CNG attributes

Ranks of CNG attributes

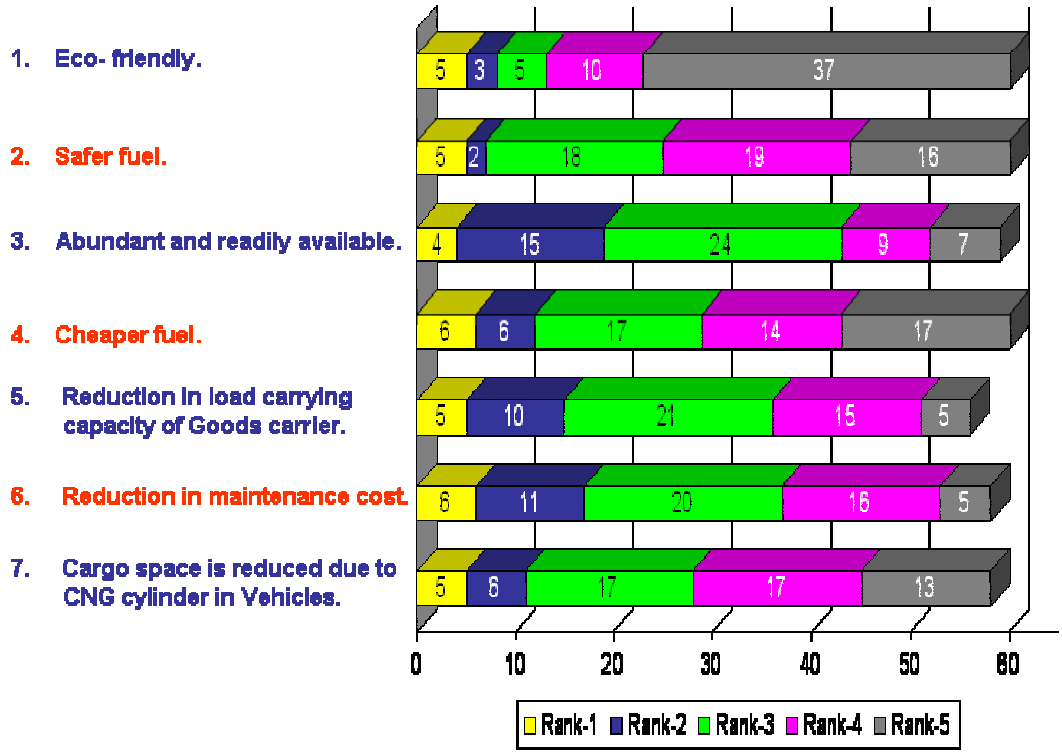


Figure 5.2-2 Ranks of CNG attributes

CNG is considered as the Safe, Eco-friendly and the Cheaper fuel. Researcher, in the above section made an attempt to verify such CNG related attributes from the expert. Therefore, as given in the table and chart above, based on the expert opinion, researcher draws the following conclusion:

- Expert (47 out of 60 i.e. 79%) is of very strong opinion **that CNG is Eco-Friendly.**
- Expert (35 out of 60 i.e. 59%) is of opinion that **CNG is Safe Fuel.**
- It is a mix reaction from group of expert, that CNG is abundantly and readily available. Perhaps this is because the Gas allocation to CNG business is currently very limited. And also concluded from the question no. 6 of part A above that, **Priority allocation needs to be given to this Sector.**

- Majority of Expert (31 out of 60 i.e. 51%) is of opinion that **CNG is Cheap fuel.**

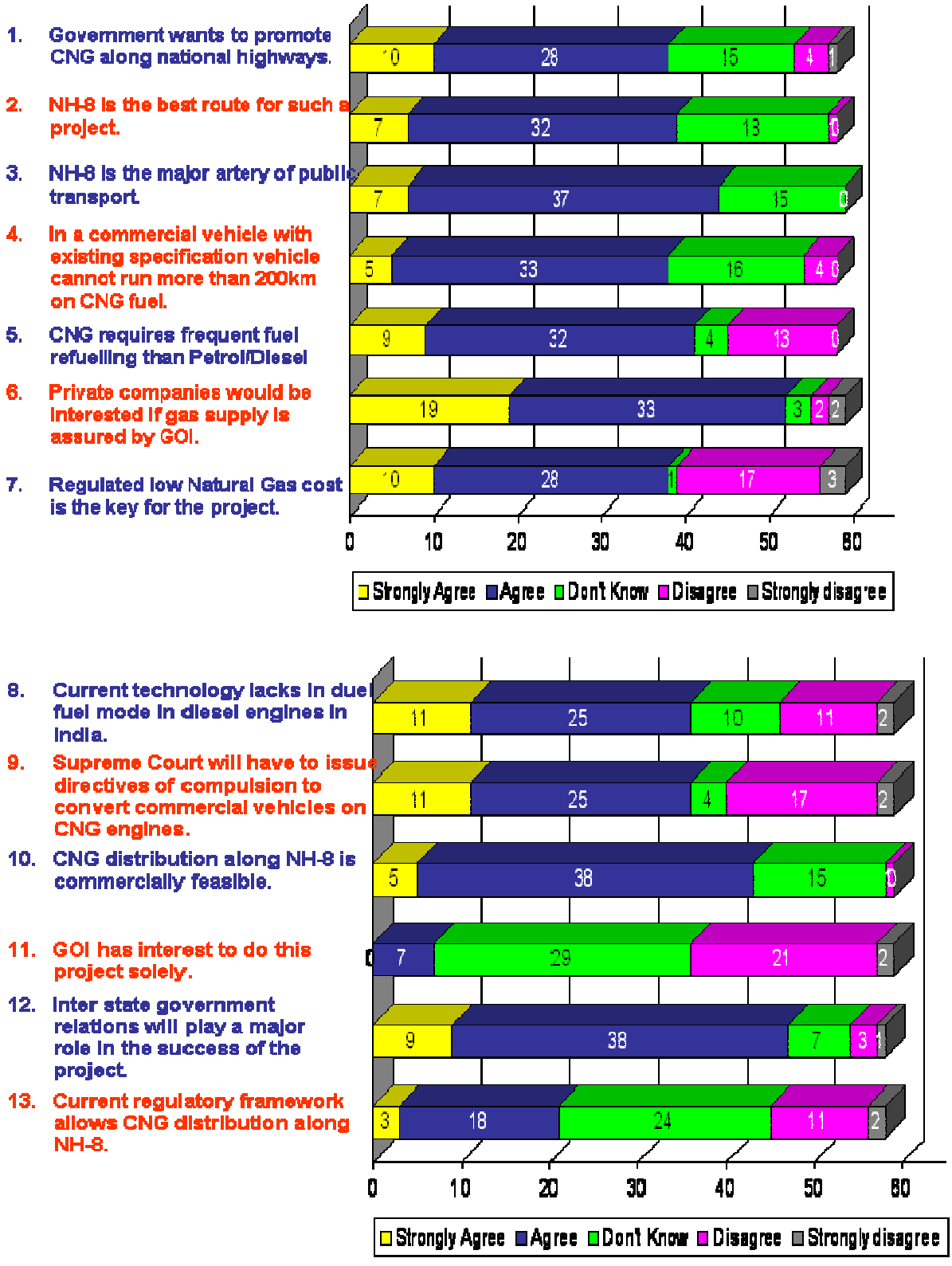
- This study is related to Distribution of CNG along National Highways. CNG in this situation mainly used by commercial vehicles like trucks, Buses, Cars etc. From, the customer point of view, researcher sought the views from the specialist regarding reduction in load carrying capacity after installation of CNG kit into Petrol and Diesel engine. It is important to know that majority of the specialist 41 out of 56 i.e. 70% is of the opinion that, there is reduction in load carrying capacity of the vehicle. In the further research one may look into the quantitative details and its impact on the customer.

5.2.2 Section B – CNG Distribution along NH8

Table 5.2.2-1 Feasibility of CNG distribution

Question	Count	Score
1. Government wants to promote CNG along national highways.	58	2.276
2. NH-8 is the best route for such a project.	58	2.224
3. NH-8 is the major artery of public transport.	59	2.136
4. In a commercial vehicle with existing specification, vehicle cannot run more than 200km on CNG fuel.	58	2.328
5. CNG requires frequent fuel refuelling than Gasoline/Diesel.	58	2.362
6. Private companies would be interested if gas supply is assured by GOI.	59	1.898
7. Regulated low Natural Gas cost is the key for the project.	59	2.576
8. Current technology lacks in duel fuel mode in diesel engines in India.	59	2.458
9. Supreme Court will have to issue directives of compulsion to convert commercial vehicles on CNG engines.	59	2.559
10. CNG distribution along NH-8 is commercially feasible.	59	2.203
11. GOI has interest to do this project solely.	59	3.305
12. Inter state government relations will play a major role in the success of the project.	58	2.121
13. Current regulatory framework allows CNG distribution along NH-8.	58	2.845

Figure 5.2-3 Expert opinion on Project Execution Model



1. Government wants to promote CNG along national highways

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	10	17
Agree	**28**	**48**
Don't Know	15	26
Disagree	4	7
Strongly Disagree	1	2

Table 5.2.2-2 Government to promote CNG

The research intent is to evaluate the feasibility of CNG distribution along National Highways. An attempt has been made by the researcher to know 'whether really Government wants to promote the CNG along National Highways'. The majority of expert i.e. 38 out of 58 (55%) has agreed for the statement. *Thus, Researcher, herewith conclude that Government would sooner or later will think of creating National Highway wise CNG distribution network so that vehicle can run along the National Highway on eco-friendly fuel.*

2. NH-8 is the best route for such a project.

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	7	12
Agree	**32**	**55**
Don't Know	18	31
Disagree	1	2
Strongly Disagree	-	-

Table 5.2.2-3 NH-8 is the best route for such a project.

Given the above backdrop, that Government wants to distribute the CNG along National Highways, Researcher wants to evaluate 'whether NH8 is the best route for such project' it is noteworthy to mention that mass of the specialist i.e 39 out of 58 (which is 67%) is

agreed to the statement. Thus, researcher, by choosing the NH8 for evaluation of CNG distribution has taken right step for research.

Researcher has indentified the important research objective in the chapter of Research Methodology which is '*To evaluate the project ownership and execution model Feasibility for CNG Distribution along NH8 among Private, Government, and Public Private Partnership model'*. In view of conclusion drawn by the researcher from Question no.1 & 2 above, it can be said that objective partially fulfilled as expert of Oil and Gas sector is of the opinion that *Government want to promote the CNG along National Highways and NH8 is the best route for such projects.*

3. NH-8 is the major artery of public transport.

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	7	12
Agree	**37**	**63**
Don't Know	15	25
Disagree	-	-
Strongly Disagree	-	-

Table 5.2.2-4 NH-8 is the major artery of public transport.

NH8 is emerged as the important arm of National Highway in the country, from the explanations given in the chapter of Research Methodology and Literature Review. The same has been tested by the Researcher from analysis of Primary data and conclusion drawn from the expert opinion (44 out of 59) above that, NH8 is the major artery of Public Transport.

4. In a commercial vehicle with existing specification vehicle cannot run more than 200km on CNG fuel

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	5	9
Agree	**33**	**57**
Don't Know	16	28
Disagree	4	7
Strongly Disagree	-	-

Table 5.2.2-5 Milegae on CNG vehicle

The current study is to determine the feasibility of CNG distribution along NH8. for creation of effective network of CNG distribution, the location has to be identified along NH8, in such a way that vehicle can comfortably run along Highway, with lower stoppage for fuel refueling. Therefore, it become important for researcher to determine, the distance travelled generally by the vehicle on CNG as a fuel. Accordingly, Researcher framed the query and it has been observed that 38 out of 58 experts, is of the opinion that CNG vehicle can not run more than 200 Km at a single stretch. Researcher used same mileage, while working out the number of CNG station on NH8. *Thus, Researcher has established the link between Primary Data obtained from Survey Questionnaire and the same is used in Financial Model i.e. Secondary Data prepared for evaluation of Financial feasibility.*

5. CNG requires frequent fuel refueling than Gasoline/Diesel.

It is observed above from the previous question number 4, that CNG vehicle can not run more than 200 Km, therefore CNG requires frequent refueling of Gas, the same has also been concluded from the analysis of statement mentioned here. Here also, majority of expert is of the opinion that CNG requires frequent refilling. The

same input has been considered while working out the Financial Feasibility of CNG distribution Project along NH8.

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	9	16
Agree	**32**	**55**
Don't Know	4	7
Disagree	13	22
Strongly Disagree	-	-

Table 5.2.2-6 CNG requires frequent fuel refuelling

6. Private companies would be interested if gas supply is assured by GOI.

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	19	32
Agree	**33**	**56**
Don't Know	3	5
Disagree	2	3
Strongly Disagree	2	3

Table 5.2.2-7 Interest of Private companies

Referring to the research objective no. 3, mentioned in the Research Methodology chapter, study of Private Company's participation is an important objective of the instant research. In view of this, Researcher coined the statement 'whether Private companies would be interested if gas supply is assured by GOI.' From the very strong opinion of the expert (52 out of 59), a conclusion may be drawn that Private party would be interested to do this project if gas supply is assured by Government. Therefore, combination of Private parties along with *Government can be win-win situation for such project. In view of this Public Private Partnerships would be an ideal way to do this project.*

7. Regulated low Natural Gas cost is the key for the project.

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	10	17
Agree	**28**	**47**
Don't Know	1	2
Disagree	17	29
Strongly Disagree	3	5

Table 5.2.2-8 Regulated Natural Gas cost

As explained by the researcher, in the previous question where the supply was secured by Government to Private entity. Now researcher sought the opinion about the impact of regulated feed stock price on CNG distribution project along National Highways. It is very strong opinion from the expert i.e. 38 out of 59 (64%), that Regulated low feed stock price is the key for the project. In view of conclusion drawn from Question no. 6 & 7 of this section, *Government is playing key role in CNG distribution project. Therefore, Public Private Partnership is the best suited model for such projects.*

8. Current technology lacks in duel fuel mode in diesel engines in India

It is understood by the researcher that unlike Petrol engine, Diesel engine converted into CNG engine do not have the facility to switch over to Diesel model in case of CNG tank is empty. The same has also been verified and concluded by the researcher from the expert that, Current technology lacks in duel fuel mode in Diesel engines in India

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	11	19
Agree	**25**	**42**
Don't Know	10	17
Disagree	11	19
Strongly Disagree	2	3

Table 5.2.2-9 Current technology lacks in duel fuel

9. Supreme Court will have to issue directives of compulsion to convert commercial vehicles on CNG engines

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	11	19
Agree	**25**	**42**
Don't Know	4	7
Disagree	17	29
Strongly Disagree	2	3

Table 5.2.2-10 Supreme Court will have to issue directives

With a backdrop of conclusion from Question no 6 & 7 of this section (B) and Question no. 9 of the previous section (A), it is again concluded by majority of experts i.e 36 out to 59 (61%) that *Government has to play important role for implementation of CNG along National highways.*

10. CNG distribution along NH-8 is commercially feasible

The most important part of the secondary data analysis is to work out the financial feasibility of CNG distribution along NH8. The same query was framed to the experts and the mass majority i.e. 43 out of 59 (72%) was of the opinion that CNG distribution along NH8 is commercially feasible. *This support the secondary analysis made by researcher, that CNG distribution along NH8 is feasible. In view*

of above the 3rd Research objective mentioned in chapter no. 2 is partially achieved.

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	5	8
Agree	**38**	**64**
Don't Know	15	25
Disagree	1	2
Strongly Disagree	-	-

Table 5.2.2-11 CNG along NH-8 is commercially feasible.

11. GOI has interest to do this project solely

Particulars	Value	Percentage
No of Respondents	59	
Strongly Agree	-	-
Agree	7	12
Don't Know	29	49
Disagree	21	36
Strongly Disagree	2	3

Table 5.2.2-12 GOI has interest to do this project solely.

Researcher made an attempt to know 'whether GOI has interest to do this project solely. The majority i.e. 23 out of 30 were disagreed the statement (excluding who don't know the answer. *Thus, it made very clear by the group of experts that Government do not want to execute the project of CNG distribution on its own.* Therefore, with the backdrop of this project discussed earlier in depth an inference can be made that Government solely do not want to execute the project, Government want to go hand in hand with Private entity. *Therefore, PPP would be an ideal model for Distribution of CNG.* The same result is also required to be tested with secondary data analysis i.e. from Financial Model.

12. Inter state government relations will play a major role in the success of the project.

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	9	16
Agree	**38**	**66**
Don't Know	7	12
Disagree	3	5
Strongly Disagree	1	2

Table 5.2.2-13 Inter state relations will play a major role

The instant research for CNG distribution along National Highways requires the involvement of various State Governments. For example, CNG distribution along NH8, requires the co-ordination with various State Government like Delhi, Haryana, Rajasthan, Gujrat and Maharashtra. In view of this, researcher posed the Question 'whether Inter state relations will play a major role for success of project'. Majority of the respondents i.e. 47 out of 58 i.e. 72%, agreed for the statement. The inference from the above may be taken that again, **Government has to play vital role in coordinating with the various state Government agency involved in the CNG distribution project. Therefore, again it is proved that, PPP model would be most suitable for the project.**

13. Current regulatory framework allows CNG distribution along NH-8.

Particulars	Value	Percentage
No of Respondents	58	
Strongly Agree	3	5
Agree	18	31
Don't Know	**24**	**41**
Disagree	11	19
Strongly Disagree	2	3

Table 5.2.2-14 Current regulatory framework allows CNG

Majority of the respondents i.e. 21 out of 34 (excluding Don't know cases) are of the opinion that Current regulatory framework allows CNG distribution along NH-8.

Second Part of the Section B is to Rank of the following aspects of distribution of CNG along NH-8 in order of suitability on the present scenario. Respondent have asked to ranked these on 3 point scale in order of importance (1 being the best option followed by 2 and 3)

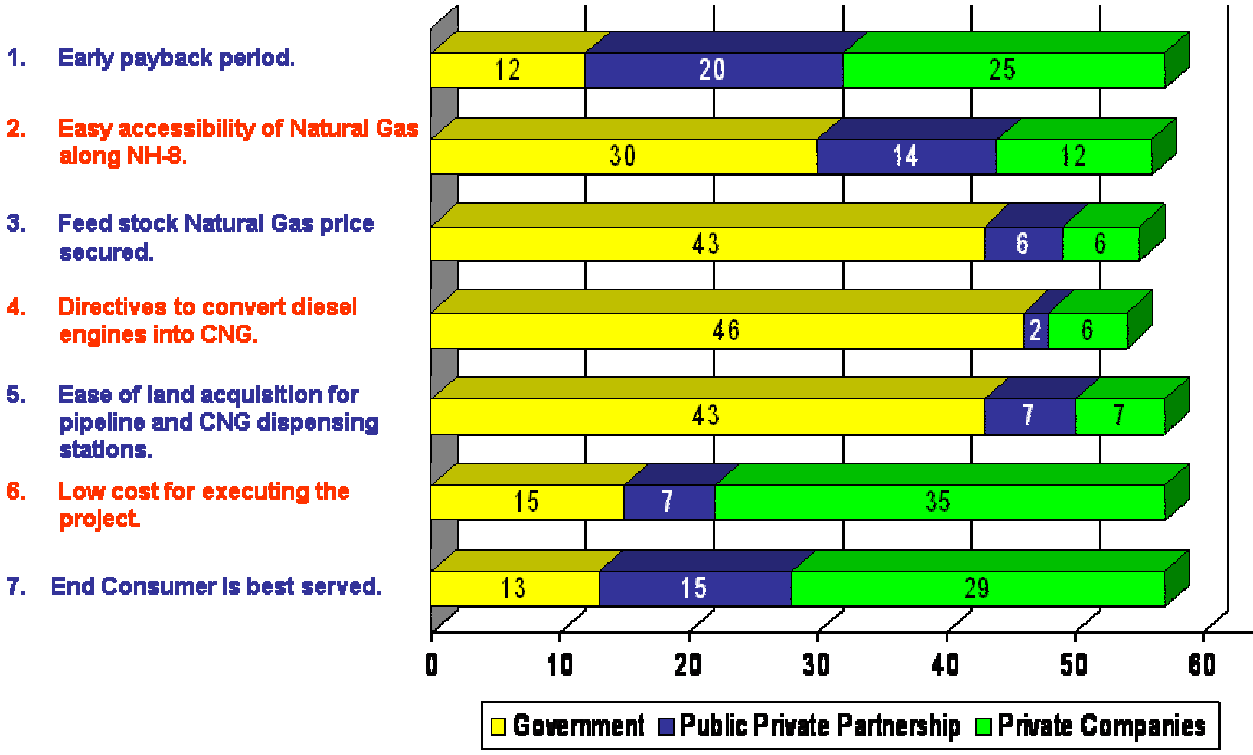
Researcher has made an attempt to analyze the significant difference between the project execution and ownership model among the Private, Government and Public Private Partnership. The parameters used for working out the significant differences are as follows:

- Early Payback period
- Easy accessibility of Natural Gas along NH-8
- Feed stock Natural Gas price secured
- Directives to convert diesel engines into CNG
- Ease of land acquisition for pipeline and CNG dispensing stations
- Low cost for executing the project

- End Consumer is best served

The data collected from the expert in respect of above parameters to analyze the significant difference between the project execution model among the Private, Government and Public Private Partnership is as given under:

Figure 5.2-4 Comparison of Project Execution Model



1. Early payback period

Average Rank	
Government	2.40
Public Private Partnership (PPP)	**1.68**
Private Companies	1.91

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	12	21.05%	10	17.54%	**35**	**61.40%**
PPP	20	35.09%	**35**	**61.40%**	2	3.51%
Private	25	43.86%	12	21.05%	20	35.09%

Table 5.2.2-15 Early Payback period.

Researcher draws the conclusion from the opinion of expert that PPP is the best execution model compared to Government & Private with the average score 1.68.

2. Easy accessibility of gas along NH-8.

Average Rank	
Government	**1.77**
Public Private Partnership (PPP)	**1.84**
Private Companies	2.39

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	30	53.57%	9	16.07%	17	30.36%
PPP	14	25.00%	**37**	**66.07%**	5	8.93%
Private	12	21.43%	10	17.86%	34	60.71%

Table 5.2.2-16 Easy accessibility of gas along NH-8.

Researcher here draws the conclusion from the opinion of expert that PPP and Government model is the best model for CNG project execution along NH8.

3. Feed stock Gas price secured.

Average Rank	
Government	**1.38**
Public Private Partnership (PPP)	**1.89**
Private Companies	2.73

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	**43**	**78.18%**	3	5.45%	9	16.36%
PPP	6	10.91%	**49**	**89.09%**	0	0.00%
Private	6	10.91%	3	5.45%	46	83.64%

Table 5.2.2-17 Feed stock Gas price secured

It is very clear from the above opinion of the oil and gas specialists that, Government and PPP are the two suitable models over the Private model.

4. Directives to convert diesel engines into CNG.

Researcher from the opinion mentioned below, draws the conclusion that Government & PPP is the best model for CNG distribution project along National Highways. This is because; Government is in best position to issue such directives like already given for Delhi and Mumbai city.

Average Rank	
Government	**1.24**
Public Private Partnership (PPP)	2.00
Private Companies	2.76

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	**46**	**85.19%**	3	5.56%	5	9.26%
PPP	2	3.70%	**50**	**92.59%**	2	3.70%
Private	6	11.11%	1	1.85%	47	87.04%

Table 5.2.2-18 Directives to convert diesel engines into CNG

5. Ease of land acquisition for pipeline and CNG dispensing stations.

Average Rank	
Government	**1.38**
Public Private Partnership (PPP)	**1.91**
Private Companies	2.70

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	**43**	**75.44%**	5	8.93%	8	14.29%
PPP	7	12.28%	**48**	**85.71%**	2	3.57%
Private	7	12.28%	3	5.36%	46	82.14%

Table 5.2.2-19 Ease of land acquisition

As acquiring of land is important activity, to execute the project and Government due to its power has been ranked 1 among the other project execution model

6. Low cost for executing the project.

Average Rank	
Government	2.34
Public Private Partnership (PPP)	**1.91**
Private Companies	1.73

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	15	26.32%	7	12.50%	34	60.71%
PPP	7	12.28%	**48**	**85.71%**	2	3.57%
Private	35	61.40%	1	1.79%	20	35.71%

Table 5.2.2-20 Low cost for executing the project.

As discussed in depth in the previous section by the researcher, CNG distribution along National Highways is Capital intensive project. Therefore, executing the project at lower cost would lead to successful implementation with higher rate of return. Researcher with this backdrop, and opinion received in the instant question, draws the conclusion that, private entities are best to execute the project at lower cost due to their expertise. **Therefore, this expertise of private parties along with Government strength would lead to Successful Public Private Partnership. Thus PP is most suited model for CNG distribution along NH8.**

7. End Consumer is best served.

At the interpretation of question no.6 above, PPP comes out as an best model, further this conclusion is strengthen by the expert saying 'PPP model serves the end consumer is best served'

Average Rank	
Government	2.36
Public Private Partnership (PPP)	**1.79**
Private Companies	1.84

Data Table						
	1		2		3	
Model	Count	Percentage	Count	Percentage	Count	Percentage
Government	13	22.81%	10	17.86%	33	58.93%
PPP	15	26.32%	**39**	**69.64%**	3	5.36%
Private	29	50.88%	7	12.50%	20	35.71%

Table 5.2.2-21 Consumer is best served.

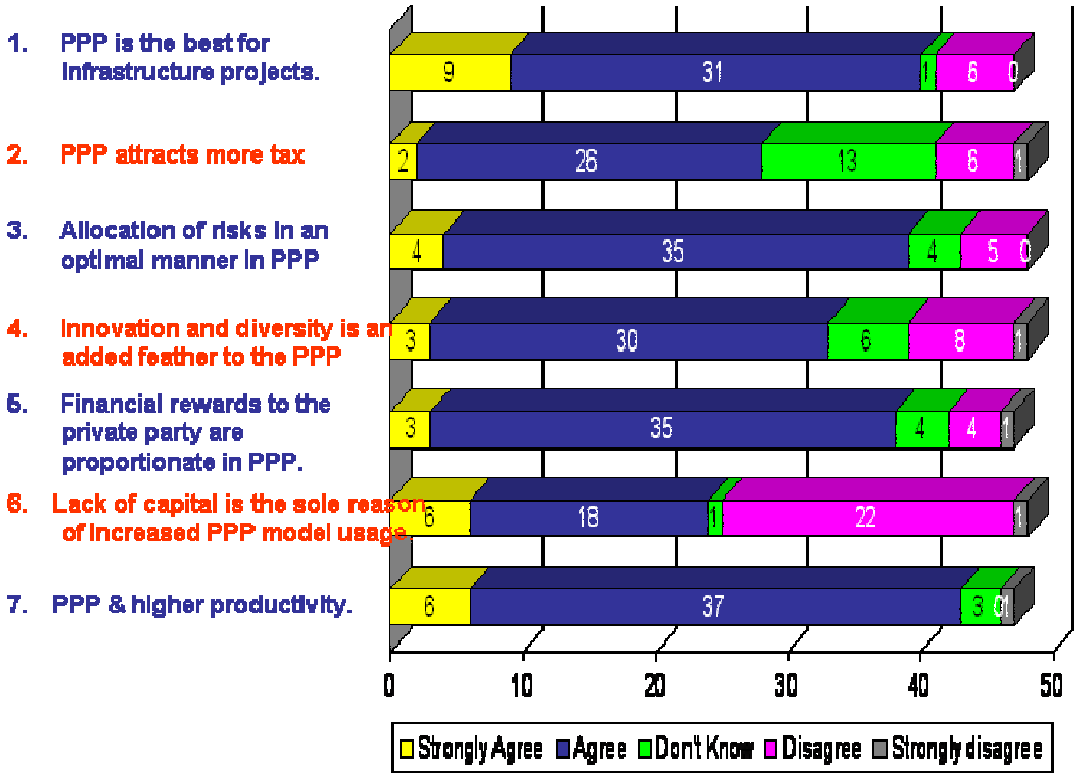
With the backdrop of explanations given while analyzing the Questionnaire and careful interpretation of above table and chart, it can be concluded that PPP is best model to execute CNG distribution project along National Highways.

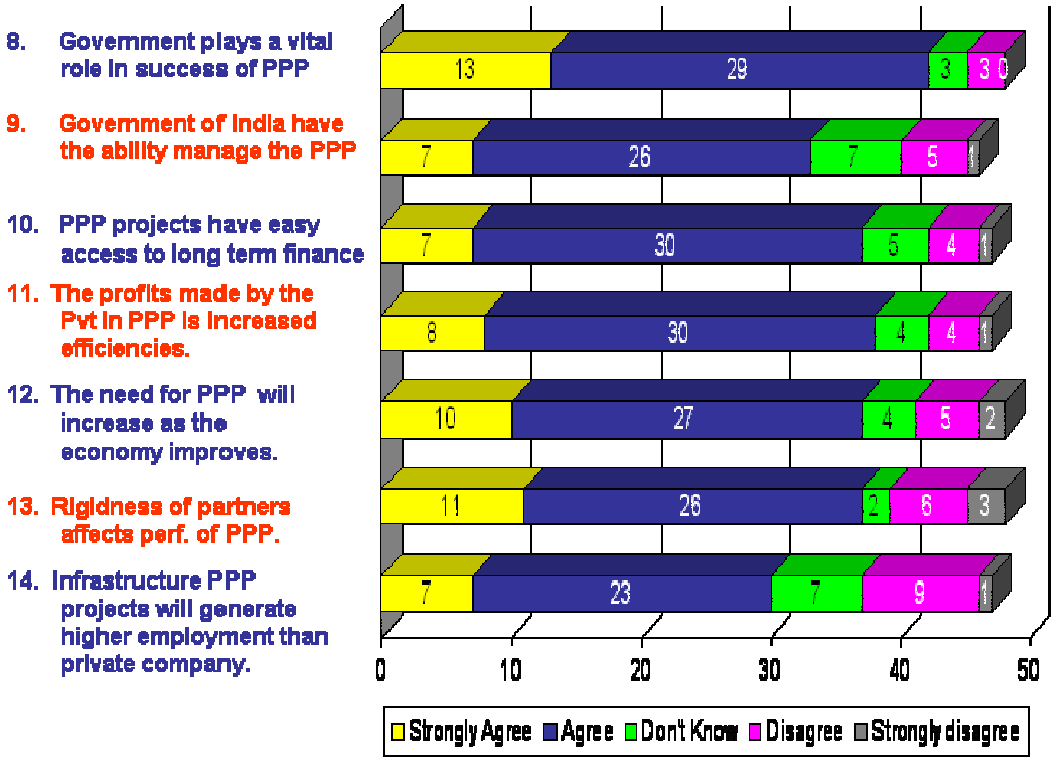
5.2.3 Section C - Project Execution Model

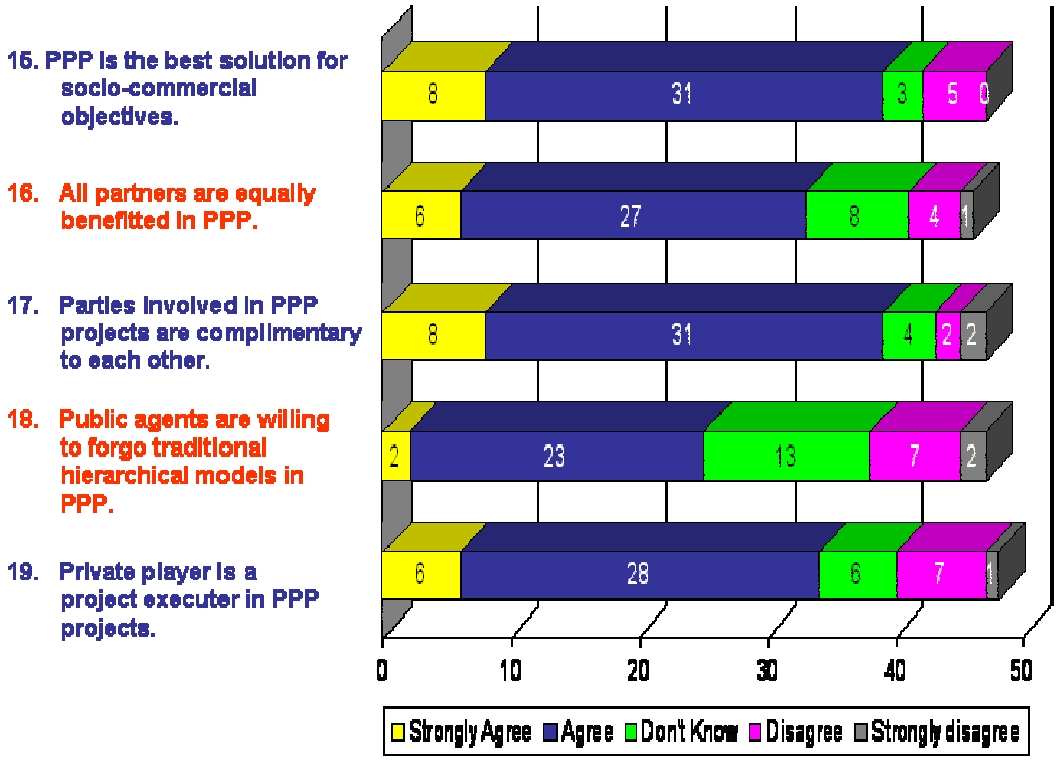
Table 5.2.3-1 Summary of Responses to Project Execution Model

Questions	Count	Mean
1. PPP is the best option as compared to JV or any other Partnership model for infrastructure projects.	47	2.085
2. PPP attracts more tax exemptions/benefits, compared to private companies.	48	2.542
3. Allocation of risks in an optimal manner between the parties of PPP is the best way to manage risks.	48	2.208
4. Innovation and diversity is an added feather to the PPP project.	48	2.458
5. Financial rewards to the private party are proportionate with the achievement of pre-specified outputs in PPP.	47	2.255
6. Lack of capital is the sole reason of increased PPP model usage.	48	2.875
7. PPP alleviates/Improves the capacity constraints and bottleneck in the economy through higher productivity.	47	2.000
8. Government plays a vital role in success of PPP projects.	48	1.917
9. Government of India have the ability manage the PPP	46	2.283
10. PPP projects have easy access to long term finance at lower rates.	47	2.191
11. The profits made by the private-sector in PPP model come from increased efficiencies.	47	2.149
12. The need for public-private partnerships will increase as the economy improves.	48	2.208
13. Rigidness of partners affects the performance of PPP.	48	2.250
14. Infrastructure PPP projects will generate higher employment than private company.	47	2.447
15. PPP is the best solution for socio-commercial objectives.	47	2.106
16. All partners are equally benefitted in PPP.	46	2.283
17. Parties involved in PPP projects are complimentary to each other.	47	2.128
18. Public agents are willing to forgo traditional hierarchical models in PPP.	47	2.660
19. Private player is a project executer in PPP projects.	48	2.354

Figure 5.2-5 Responses to Project Execution Model







1. PPP is the best option as compared to JV or any other Partnership model for infrastructure projects.

Giving the backdrop and analysis made in section A & Section B of the primary data analysis, It is derived that, PPP is best suited model for distribution of CNG along NH8. However, researcher made an attempt to find out 'whether PPP is the best option as compared to Government or Private model for infrastructure projects'. Majority of the respondents, 40 out of 47 (i.e. 85%) have shown their agreement. *In view of this, foundation for deciding the PPP model as a best model to implement the CNG has became further stronger.*

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	9	19
Agree	**31**	**66**
Don't Know	1	2
Disagree	6	13
Strongly Disagree	-	-

Table 5.2.3-2 PPP is the best option

2. PPP attracts more tax exemptions/benefits, compared to private companies.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	2	4
Agree	**26**	**54**
Don't Know	13	27
Disagree	6	13
Strongly Disagree	1	2

Table 5.2.3-3 PPP attracts more tax benefits

Refer to the majority of expert feedback placed in above table i.e 28 out of 48 (58%), regarding PPP model is benefiting from the tax point of view. *In view of this, PPP model is becoming the rightly suggested model for CNG distribution.*

3. Allocation of risks in an optimal manner between the parties of PPP is the best way to manage risks.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	4	8
Agree	**35**	**73**
Don't Know	4	8
Disagree	5	10
Strongly Disagree	-	-

Table 5.2.3-4 PPP is the best way to manage risks.

CNG is a Infrastructure project and several risks are associated with such kind of projects. Therefore, researcher made an attempt to vouch 'whether PPP is the best way to manage risks'. Majority of respondents i.e. 39 out of 48 (i.e. 81%) were in agreement of the statement. *Therefore, here again researcher able put one more feather in the cap of PPP project execution model for CNG distribution.*

4. Innovation and diversity is an added feather to the PPP project.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	3	6
Agree	**30**	**63**
Don't Know	6	13
Disagree	8	17
Strongly Disagree	1	2

Table 5.2.3-5 Innovation and diversity in PPP project.

Similar to analysis of previous question no 3, here once again PPP project has few more characteristics like Innovation and Diversit

5. Financial rewards to the private party are proportionate with the achievement of pre-specified outputs in PPP.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	3	6
Agree	**35**	**74**
Don't Know	4	9
Disagree	4	9
Strongly Disagree	1	2

Table 5.2.3-6 Financial rewards in PPP

PPP model is very transparent in Nature and same is being reflected in the researcher's question 'whether Financial rewards to the private party are proportionate with the achievement of pre-specified outputs in PPP'. Most of the expert is in agreement with the statement. *Thus, PPP again may be concluded as best suitable model for CNG distribution.*

6. Lack of capital is the sole reason of increased PPP model usage.

CNG distribution as explained earlier also, is a High Capital Intensive Infrastructure project. Funding of the same would be a challenge. Therefore, researcher tried to make out 'whether Lack of capital is the sole reason of increased PPP model usage'. Interestingly, mass of the expert has shown dis-agreement with the statement. Inference here can be made that *PPP is not only formed due to lack of capital but due to win –win situation by way of expertise among the partners.*

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	6	13
Agree	18	38
Don't Know	1	2
Disagree	**22**	**46**
Strongly Disagree	1	2

Table 5.2.3-7 Lack of capital is the sole reason PPP

7. PPP alleviates/Improves the capacity constraints and bottleneck in the economy through higher productivity.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	6	13
Agree	**37**	**79**
Don't Know	3	6
Disagree	-	-
Strongly Disagree	1	2

Table 5.2.3-8 PPP Improves productivity

Similar to previous discussion regarding advantage of PPP, one more advantage has been concluded in favor of PPP model is that PPP alleviates/Improves the capacity constraints and bottleneck in the economy through higher productivity.

8. Government plays a vital role in success of PPP projects.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	13	27
Agree	**29**	**60**
Don't Know	3	6
Disagree	3	6
Strongly Disagree	-	-

Table 5.2.3-9 Government plays a vital role

One of the strong pillars in PPP is government and researcher made an attempt to seek 'whether Government plays a vital role in success of PPP projects'. *Majority of the specialist is of the opinion that Government has a key role to play in PPP.*

In India, CNG sector is regulated. Therefore, by making partnership with Private Party, Government can manage the CNG distribution project in feasible and implementable manner.

9. Government of India have the ability manage the PPP process.

Particulars	Value	Percentage
No of Respondents	46	
Strongly Agree	7	15
Agree	**26**	**57**
Don't Know	7	15
Disagree	5	11
Strongly Disagree	1	2

Table 5.2.3-10 Government have the ability manage the PPP

Researcher here tried to obtain the expert opinion regarding, Government's success in PPP by asking 'Government of India have the ability manage the PPP process.' Majority i.e. 33 out of 46 (72%) have shown their agreement. *Therefore, it is concluded that CNG distribution along NH8 by PPP model may be successful.*

10. PPP projects have easy access to long term finance at lower rates.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	7	15
Agree	**30**	**64**
Don't Know	5	11
Disagree	4	9
Strongly Disagree	1	2

Table 5.2.3-11 PPP projects have access to finance

As explained earlier in this section, PPP is most suitable for CNG distribution project. As these projects are long gestation and capital intensive (discussed previously), Long term funding for the project at lower rate is needed. Here Researcher sought the opinion regarding 'whether PPP model has an easy access to long term funding at lower rates'. Majority of the expert i.e. 37 out of 47 (79%) has shown the agreement. *Therefore, PPP would be again found suitable for CNG distribution project due to involvement of Government.*

11. The profits made by the private-sector in PPP model come from increased efficiencies.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	8	17
Agree	**30**	**64**
Don't Know	4	9
Disagree	4	9
Strongly Disagree	1	2

Table 5.2.3-12 Profits of PPP

As discussed earlier in this section, transparency is the key in PPP model, same has once again reflected in the above opinion of expert

regarding, the profits made by the private-sector in PPP model come from increased efficiencies.

12. The need for public-private partnerships will increase as the economy improves.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	10	21
Agree	**27**	**56**
Don't Know	4	8
Disagree	5	10
Strongly Disagree	2	4

Table 5.2.3-13 PPPs and economy

As discussed above, efficiency is the key in PPP model, same has once again reflected in the above opinion of expert regarding; the need for public-private partnerships will increase as the economy improves.

13. Rigidness of partners affects the performance of PPP.

One of the important aspect for failure of PPP ownership model is rigidness of one of the partner; same has been agreed by the majority of respondent as shown below:

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	11	23
Agree	**26**	**54**
Don't Know	2	4
Disagree	6	13
Strongly Disagree	3	6

Table 5.2.3-14 Rigidness of partners affects PPP

14. Infrastructure PPP projects will generate higher employment than private company.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	7	15
Agree	**23**	**49**
Don't Know	7	15
Disagree	9	19
Strongly Disagree	1	2

Table 5.2.3-15 PPP Vs Private - Employment Avenue

15. PPP is the best solution for socio-commercial objectives.

Distribution of CNG, is a project of socio-commercial objective, Researcher, therefore made an attempt to seek the expert opinion on the same. Majority of the expert i.e. 39 out of 47 (83%) is in agreement with the statement. *Thus PPP is again proved to be a suitable model for CNG project execution.*

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	8	17
Agree	**31**	**66**
Don't Know	3	6
Disagree	5	11
Strongly Disagree	-	-

Table 5.2.3-16 PPP is the best solution

16. All partners are equally benefitted in PPP.

Particulars	Value	Percentage
No of Respondents	46	
Strongly Agree	6	13
Agree	**27**	**59**
Don't Know	8	17
Disagree	4	9
Strongly Disagree	1	2

Table 5.2.3-17 All partners are equally benefitted in PPP

17. Parties involved in PPP projects are complimentary to each other.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	8	17
Agree	**31**	**66**
Don't Know	4	9
Disagree	2	4
Strongly Disagree	2	4

Table 5.2.3-18 Parties involved in PPP are complimentary

18. Public agents are willing to forgo traditional hierarchical models in PPP.

Particulars	Value	Percentage
No of Respondents	47	
Strongly Agree	2	4
Agree	**23**	**49**
Don't Know	13	28
Disagree	7	15
Strongly Disagree	2	4

Table 5.2.3-19 Hierarchy in PPP

19. Private player is a project executer in PPP projects.

Particulars	Value	Percentage
No of Respondents	48	
Strongly Agree	6	13
Agree	**28**	**58**
Don't Know	6	13
Disagree	7	15
Strongly Disagree	1	2

Table 5.2.3-20 Private player in PPP projects

In the instant study, the Researcher is proposed to have PPP model with Private entity as a project executing partner. In view of this, researcher sought the opinion from Oil and Gas specialist 'whether Private Player is a project executer in PPP projects.' Majority of the specialist, 34 out of 48 i.e. 71% have shown the agreement to the statement. ***Therefore, from the discussion made by the researcher till now, a sound conclusion can be made that the 'PPP' is best suitable model for distribution of CNG along NH8.***

Second part of Section C is to Rank of the following aspects of distribution of CNG along NH-8 in order of suitability on the present scenario. Respondent were asked these to ranked them on 3 point scale in order of importance (1 being the best option followed by 2 and 3)

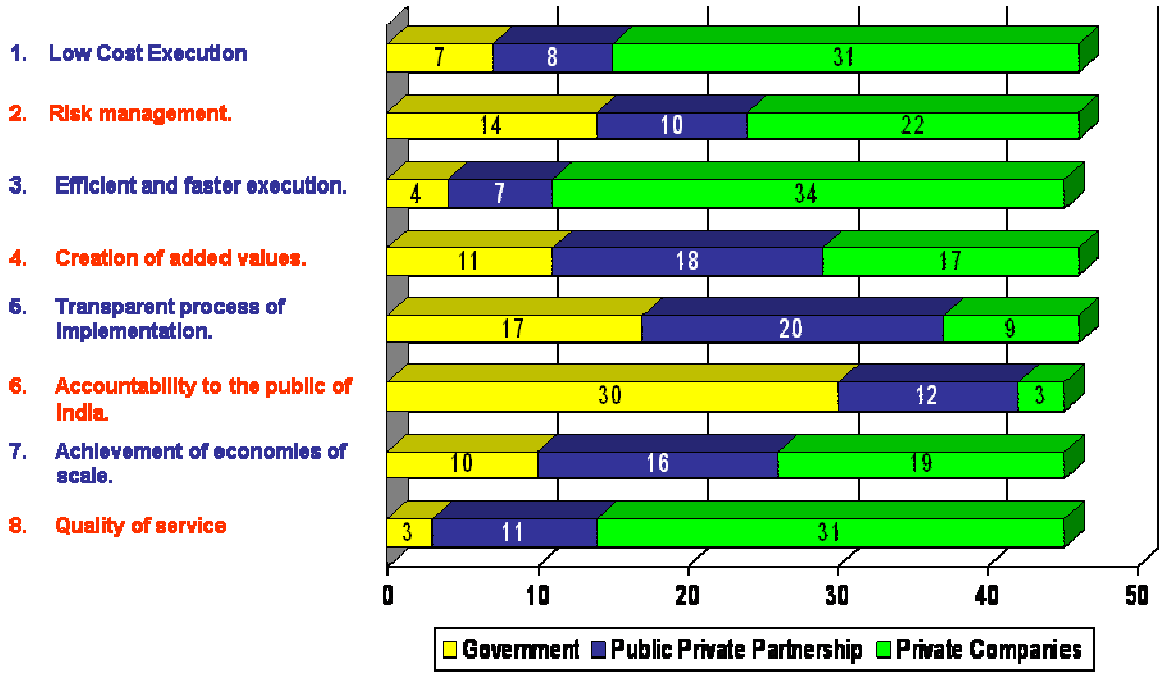
Researcher made an attempt to analyze the significant difference between the project execution model among the Private, Government and Public Private Partnership. The parameters used for working out the differences are as follows:

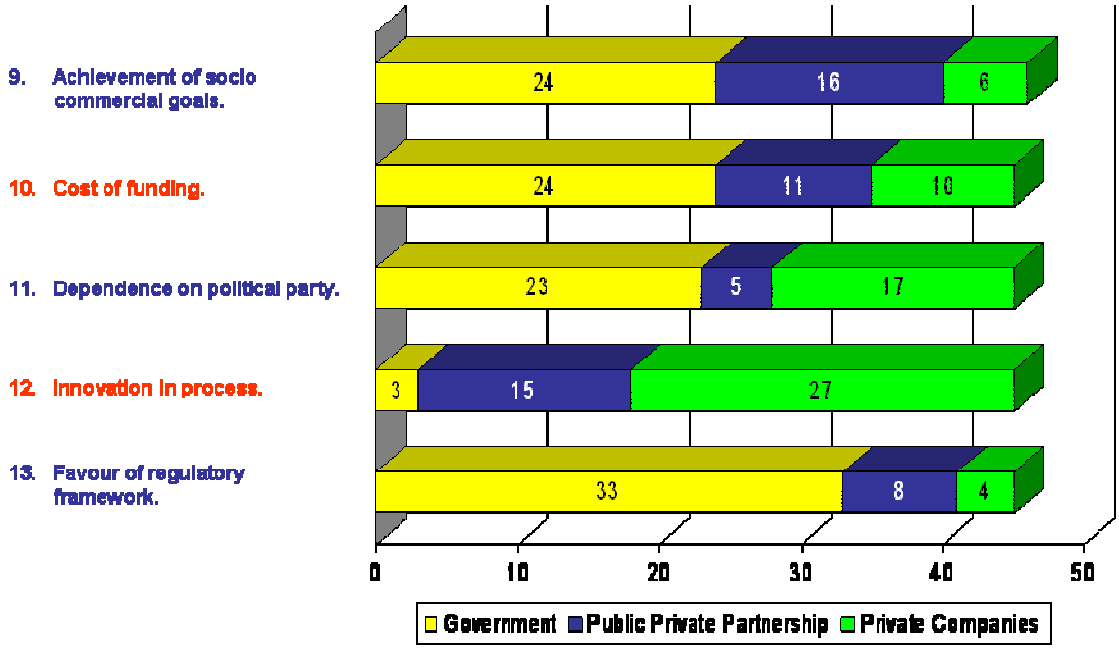
- Low Cost Execution
- Risk management.
- Efficient and faster execution.
- Creation of added values.

- Transparent process of implementation.
- Accountability to the public of India.
- Achievement of economies of scale.
- Quality of service
- Achievement of socio commercial goals.
- Cost of funding.
- Dependence on political party.
- Innovation in process.
- Favour of regulatory framework.

The data collected from the expert in respect of above parameters to analyze the significant difference between the project execution model among the Private, Government and Public Private Partnership is as given under:

Figure 5.2-6 Comparison among project execution Model





With the backdrop of explanations given while analyzing the Questionnaire and careful interpretation of above chart shows that, on the front of Cost, Risk Management, speed of execution & innovation, Private Parties are taking the lead over other execution entities. However, Accountability towards public of India, Cost of funding, achieving socio-commercial objective and Regulatory risk point of view Government model is taking edge over private parties.

Since after marriage of Public and Private Entity for living together would share the risk of each other and reward accordingly. Therefore, PPP would be the most suitable model for CNG distribution along National Highways.

6. FINANCIAL ANALYSIS FOR NATURAL GAS HIGHWAY

Researcher, in the previous chapter of Survey Analysis of Research Problem, has drawn the conclusion that PPP is the most suitable for distribution of CNG along National Highways. This conclusion partially fulfils the objective no. 3 of the study which is 'to evaluate the project ownership and execution Feasibility Model for CNG Distribution along NH8 among Private, Government, and Public'. Data analyzed in the Primary Section was of qualitative in nature. Now, the Researcher has made an attempt to validate the conclusion and suggestion drawn from Primary data in Quantitative terms.

As success of all the projects depend upon the financial viability, therefore, it becomes far more important for Researcher to evaluate the financial feasibility of the project. The project is evaluated based on secondary data available for the study. The secondary data is taken from Annual Reports of the CNG companies, Research Report, Consultant Report, Study Report by the regulator and Inferences and Conclusions drawn from the analysis of Primary Data etc. For working out the Financial Feasibility, the Excel based complex model is developed. The detailed working sheet of the model is discussed in the subsequent part of this chapter. However, the same are also made as a part of annexure to the thesis.

6.1 Project Cost Estimates

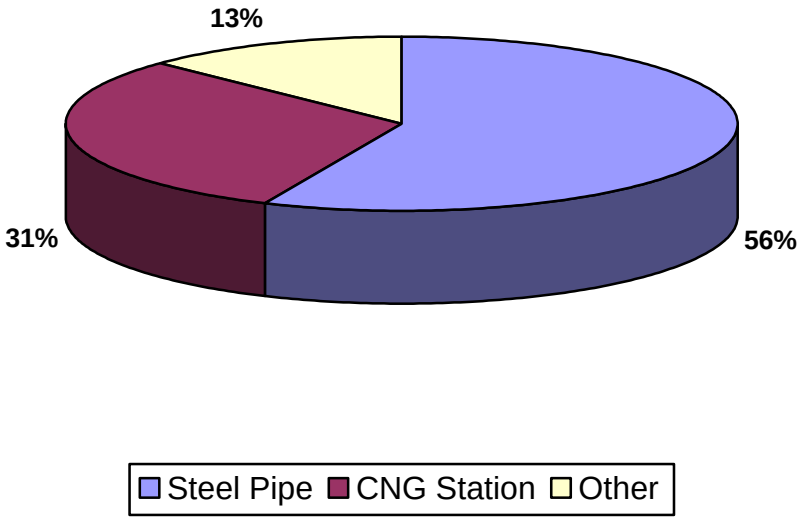
Researcher has drawn the conclusion while analyzing the Primary data that, CNG distribution along National Highway is Capital Intensive Project (Refer to interpretation for Question no. 7 of Section A of the Survey Questionnaire). Therefore, in order to carry out the Financial Feasibility, researcher has to prepare the estimates for Capital Expenditure (Capex) to distribute the CNG along NH8.

Accordingly, an assumption was made that a ‘Project Company’ has to establish. The project company may be owned by of Government or Private or PPP. Here the Researcher uses the word ‘’Project’ or Project Company interchangeable for setting up the Infrastructure of CNG distribution by Private, Government or PPP model.

Researcher has explained the Infrastructure required for sourcing the Natural Gas along NH8 in the previous chapter of ‘Natural Gas Highway and Its Implementation’. Accordingly, Project Company plans to set up a 20 inch, 202 KM steel pipeline from Kota to Ajmer to supply the Natural Gas to its CNG stations located at 18 sites with 6 dispensers at each station. The detailed calculation for estimation of amount of Capex is attached at **Annexure VI**. The CNG stations will be set up in a phased manner over the years. The total investment in the project is Rs.3242 Crores.

The majority of Capital expenditure is towards the steel pipe which is Rs.1838 Cr i.e. over 56% of total project cost. As discussed above, project requires the installation of CNG stations at 18 sites with 6 dispensers at each location, the cost of installation of these stations would be Rs. 993 Cr. i.e. over 31%. Thus over 87% of project cost is only CNG station and pipeline cost. Other capex includes the Engineering cost, Startup cost, Preliminary and Pre-operative expenditure and Contingencies and Escalation etc. The chart showing the distribution of Capex is placed below:

Figure 6.1-1 Capital Expenditure



6.1.1 Steel Pipe Cost Estimation

As discussed above, Capital expenditure the steel pipe cost forms over 56% of total capital expenditure. The cost of steel pipe is function of Diameter of the pipe and length of the pipe. Petroleum and Natural Gas Regulatory Board (PNGRB) in its regulation has given the guideline to determine the Diameter by Panhandle Equation. The 'Panhandle Equation' uses the following parameter to determine the Diameter.

- d : Section Internal Diameter
- L : Section Length
- E : Efficiency Factor
- P1 : Inlet Pressure
- P2 : Outlet Pressure
- Z : Compressibility Factor
- T1 : Fluid Temperature

- S : Fluid SG Gas

Online calculators are available for these complex calculations. The detailed specification of pipeline diameter is placed at **Annexure VII**. Therefore, Researcher estimated the Steel Pipe cost, Based on the diameter calculation as per 'Panhandle Equation', length as per route survey and steel cost based on Ernest & Young (E&Y) estimates.

6.1.2 CNG Station Assumptions

Researcher up till now, deliberated the important aspects of CNG distribution project like Price, Capex, Feed stock price, O&M Cost, Steel pipe cost, Demand etc.

In this section, following are the important assumption considered by the researcher, while preparing the model for Financial Feasibility of CNG distribution project:

Table 6.1.2-1 CNG Station Data

CNG Stations Data	Unit	Amount	Remark
CNG Stations	Nos	18	Route Map is annexed
No. of Dispensers	Nos	6	Assumption
Land per Dispenser per Station	M^2	150	Discussion with IGL
Rate of Land	Rs/Ft^2	200	Assumption
Buildings Cost	Rs/Ft^2	800	Assumption
Canope Cost	Rs/Ft^2	200	Discussion with IGL
Demand / CNG Stations	MMSCMD	0.31	Derived
Demand / CNG Stations	SCMD	305,556	Derived
Demand / CNG Stations	SCMH	12,731	Derived
Capacity of Booster Comp	SCMH	1200	Standard Configuration
No of Booster Comp	Nos	11	Derived
Booster Compressors/Stations	Nos	11	Derived
Cylinders in a Cascade	Nos	40	Discussion with IGL
Cascade per Station	Nos	2	Discussion with IGL
Backup Generator per Station	Nos	2	Discussion with IGL
CCTV (5 per 150 M^2)	Nos	3	Discussion with IGL
Steel Tubing Cost/Dispenser	Rs	672,354	As per Purchase order issued to Rhino Services
Composite Work/Dispenser	Rs	2,000,000	Discussion with GAIL Gas
PMC/Stations	Rs	4,000,000	Discussion with GAIL Gas
Engineering Cost	%	5	As per Indore City
Start-up and commissioning expenses	%	2	As per Indore City
Contingencies and escalation	%	5	As per Indore City
Preliminary and pre-operative expenses	%	1	As per Indore City
Unaccounted Gas Loss	% of Vol.	0.30%	Discussion with IGL
Conversion Loss	% of Vol.	0.70%	Discussion with IGL

6.2 Cost of Feed Stock

Researcher has deliberated the various sources of Gas for CNG distribution along NH8 in the chapter no.4 of 'Natural Gas Highway and its implementation' at para no.4.6. Thus, there are 2 main source of gas supply to the CNG stations – indigenous gas and LNG from the Shell, Hazira or Petronet LNG terminals at Dahej. The indigenous gas would be available from the gas fields of ONGC/GSPC/RIL/PMT.

The models considered for evaluation are PPP, Government and Private. The feed stock Gas price is dependant on Source of Gas and use of transmission network.

The major elements of Gas Price (i.e. feed stock cost) are as follows:

- Commodity Price (i.e. Basic Gas Price paid to Seller of Gas)
- Transportation charges (paid to transporter i.e. either GAIL in case of Private and Government Model or RIL in case of PPP model)
- Another major element of Gas cost is Marketing Margin (discussed in detailed in the later part of this section. Marketing margin is paid to Gas Seller i.e. either GAIL in case of Private and Government Model or RIL in case of PPP model)
- Taxes and Levies as per applicable rates

From the immense Literature Review, Researcher understood that, In India, Domestic Gas price is determined by the Government; therefore, if the project is being owned and operated by Government agency, a cheap gas would be made available to them. Thus Gas from National Oil Companies (i.e. from ONGC) would be allocated to Government model. Further, Researcher has drawn the conclusion, from the analysis of Primary data that, 'Gas sourcing is an important aspect for distribution of CNG along NH8.

If the project is owned and operated by Private Company, they have to operate the project on Imported Gas i.e. LNG. Currently, in India LNG is the costliest Gas.

If the project is owned and executed by PPP model, an advantage would be available for project to get the chap domestic Gas. The domestic gas may either be from National Oil Companies or Private companies like Reliance.

Since, Private and Government model under study, would use same GAIL's network for sourcing of Natural Gas, same transmission tariff will be applicable to these model.

Marketing Margin is a margin charged by Gas Seller to Gas Buyer as a trading margin. In the instant case of research, GAIL or RIL is a seller of Gas and Project Company operated by Government or PPP or Private model would be buyer and in turn they would sell this Gas as CNG to end consumers. Currently, in India, marketing margin is applicable all types of gas whether it is Domestic (both Gas produced by National Oil companies or Private Companies operating in India) or Imported Gas. However, rate for Marketing Margin of the Gas produced by National Oil Companies is Rs.200/MSCM where as in case of imported gas it is around Rs.350/MSCM. Further, in case of imported gas the marketing margin is escalated by 5%, each year in the month of January. Therefore, applicable Marketing Margin makes the RLNG costlier than the domestic gas.

Based on the Gas Source and the model of the project execution, the cost of feed stock would vary and the delivered feed stock gas price is as follows:

Table 6.1.2-1 Feed Stock Gas Price for the Project

Gas Price at CNG Station					
Sr. No.	Component	Unit	GCV Pvt - RLNG	NCV Gov- ONGC	NCV PPP- RIL
A	Basic Price	USD/MMBtu	5.37	4.20	4.20
B	Regasification	USD/MMBtu	0.67	0.00	0.00
C	Ex-Terminal (in USD)	USD/MMBtu	6.04	4.20	4.20
D	Exchange Rate	USD 1 = INR	45.00	45.00	45.00
E	Ex-Terminal (in INR)	INR/MMBtu	271.77	189.00	189.00
F	Gujarat Vat	INR/MMBtu	10.87	7.56	0.00
G	RIL Transmission Charges	INR/MMBtu	0.00	0.00	67.95
H	Inter connectivity	INR/MMBtu	0.00	0.00	0.30
I	GAIL Transmission Charges	INR/MMBtu	59.32	65.25	65.25
J	GAIL Transmission Charges	INR/MMBtu	0.00	0.00	0.00
K	GAIL Transmission Charges	INR/MMBtu	0.00	0.00	0.00
L	Service Tax - Trans Charges	INR/MMBtu	6.11	6.72	13.75
M	RIL Marketing Margin	INR/MMBtu	0.00	0.00	6.08
N	GAIL Marketing Margin	INR/MMBtu	8.40	5.04	0.00
O	Octroi Duty	INR/MMBTU	0.00	0.00	0.00
P	Sales Tax	INR/MMBtu	44.56	34.20	3.90
Q	**Final Price at CNG Station**	**INR/MMBtu**	**401.03**	**307.77**	**346.22**
R	**Final Price at CNG Station**	**INR/SCM**	**15.72**	**9.89**	**11.13**

6.3 Sale Price of CNG

Researcher, based on the understanding gained through Literature Review, attempted to work out the Sales price of CNG that will be distributed along NH8. Project Company would sale the CNG at unique sale price all along the NH8.

The Price of CNG would be based on the concept of replacement of fuel i.e. Diesel. However, to promote CNG, discount has to be given on the replacement fuel i.e. price over Diesel. Researcher, considered the 10% discount over the average price of Diesel in the

various state covered by NH8. Accordingly, the CNG price works out to be Rs.36.38/Kg. The detailed calculation is as given below:

Table 6.1.2-1 Sale price of CNG from Project

Data for Price of Diesel @ 8th September 2010			
Sr No	**State**	**Basis**	**Price (Rs/Liter)**
1	Delhi	PPAC Data	37.71
2	Mumbai	PPAC Data	42.06
3	Gujrat	PPAC Data	42.24
4	Rajasthan - Jaipur	IOC Web Site	39.69
	Average Price		**40.43**
	% Discount over Diesel	10%	4.04
	Competitive CNG Pricing		**36.38**

6.4 Operating Expenditures

As explained by the researcher in the previous chapter, the CNG distribution project is a Capital intensive project with High gestation period. In order to maintain and operate this infrastructure, a significant amount of Operation and Maintenance (O&M) cost has to be incurred. The majority of assumptions required for estimation of O&M cost were based on Annual Report of leading CNG Distribution Company (i.e. a Secondary data source). Researcher has made an attempt to further validate this assumption by visiting the top executives of leading CNG Distribution Company in the city of Delhi. Based on this meeting and secondary data available from Annual Report, researcher has framed the assumptions for O&M cost for CNG distribution along NH8.

Further, In order to maintain higher profitability and to make the investments a viable proposition, it is of utmost importance to maintain low levels of operating expenses. Thus optimum utilization of the resources is very important. The major components of operating expense are Power cost, Staff cost, Administrative and Marketing cost, Spares and Insurance and Maintenance. The Operation & Maintenance cost has been considered at 3.5% of the total investment while insurance has been considered at 0.5% of the

total investment. It has been assumed that there would be 365 operational days in a year.

6.4.1 Manpower Cost

The manpower required to operate the CNG station and the cost thereof is estimated by researcher, based on the visit to leading CNG Distribution Company in the city of Delhi. The cost shown below is the actual cost of manpower deployed at the CNG station.

Table 6.4.1-1 Manpower Requirement & their Costing

Sl No.	Item Description	Amount
I	Car - 4 Men Per Dispenser	Rs.1.5 Lakh Per Annum
II	Supervisor - 4 per Station	Rs.2 Lakh Per Annum
III	Technician - 4 per Station	Rs.2 Lakh Per Annum
IV	Security - 4 per Station	Rs.1.5 Lakh Per Annum
V	Company Staff - 50 Person	Rs.20 Lakh Per Annum

6.4.2 Power Cost

Power cost constitutes a major component of the total operating cost. It has been assumed that the approximately power requirement is 25 KW per hour for compressor of capacity of 1200 SCMH. The cost of power has been considered at Rs.6/KWH.

6.4.3 Depreciation and Amortization

The entire Capex will be depreciated over a period of life of asset. PNGRB in its regulation prescribes the life of Natural Gas pipeline as 25 years. Therefore, in the same line, Researcher considered the life of project as 25 years. Thus, the project Depreciation has been computed on the Straight Line Method over the period of project life of 25 years.

6.5 Project Financing

Project Financing is the most important part for any infrastructure setup. It has been assumed that the project will be financed by a mix of equity and debt in the ratio of 35%:65%. Since this is a long term capital intensive project which will have wide range of Socio-

Economic benefits, various National as well as International Financial Institutions can be approached to avail soft loan facilities at lower interest rates.

Accordingly, Researcher has developed the model for analyzing the best out of three entities viz. Private, Government and PPP for distribution of CNG along NH8. Flexibility has been made to analyze the impact of the debt leverage on the project viability. This impact has been deliberated the last section of this chapter i.e. in Sensitivity Analysis.

For the purpose of financial analysis, it has been assumed that the cost of debt would be 10% for a 10 year loan excluding period of moratorium.

6.6 Demand Estimation

The demand is always been the main driver for the success of any project. Revenue is derived from the demand of the services or product rendered by the project. Researcher has estimated the demand of CNG based on the personal interview with the top officials of NHAI. The demand for CNG is a function on number vehicles running on the National Highways and the rate of conversion of Diesel vehicle into CNG vehicles. Accordingly, researcher has estimated the demand of CNG along NH8. The detailed calculation for demand estimation is as given below:

Table 6.4.3-1 Demand Calculation

	Unit	Amount	Basis
Demand Estimations			
No of Truck/Km/Hr	Nos	3	Assumptions – NHAI meeting
No of Cars/Km/Hr	Nos	3	Assumptions – NHAI Meeting
Pipeline on NH8		737	Route Map is annexed
CV - Trucks/Buses	Nos	53064	Calculated
Cars	Nos	53064	Calculated
Average Distance Travelled			
CV - Trucks/Buses	Km/Day	480	60 Km for 8 Hr
Cars	Km/Day	300	60 Km for 5 Hr
Average Mileage on CNG			
CV - Trucks/Buses	Km/Kg	4	Discussion with Drivers
Cars	Km/Kg	12	Discussion with Drivers
Demand Calculations			
CV - Trucks/Buses	Kg/Day	6,367,680	Derived
Cars	Kg/Day	1,326,600	Derived
Total		**7,694,280**	
CV - Trucks/Buses	SCM/Day	4,548,343	Based on Methane Density
Cars	SCM/Day	947,571	Based on Methane Density
Total		**5,495,914**	
Total Demand	**MMSCMD**	**5.50**	

6.6.1 CNG Station Capacity Utilization

In view of lower vehicle conversion in first year, only 30% of vehicle population is assumed to converted to CNG and going to increase marginally by 5% each year and will achieve 100% CNG population in 10^{th} year of operation.

Since there will be large turnout of CNG vehicles once the project becomes operational, it is necessary that adequate CNG should be available at all the stations. Inadequate supply will result in higher waiting period at the CNG stations resulting in frustration and will hamper the success of the project.

The year wise demand built-up for first three year of operation is as given below:

Table 6.6.1-1 Demand built-up

Item Description	2014-15	2015-16	2016-17
Demand Buildup (%)	30%	35%	40%
Demand Buildup (MMSCM)	602	703	803

6.7 Financial Analysis

Financial Analysis has been made by Researcher, by preparing the various Financial Statements prepared for the project. The separate statement has been prepared for each model i.e. for Private, Government and PPP model. These statements include:

- Project Cash Flow & its IRR
- Equity Cash flow & its IRR
- Profit & Loss Statement
- Balance Sheet Statement
- Debt Service Statement

All the above statement for first five years are discussed here in the subsequent sections. However, as discussed earlier, the project has a life of 25 years. Therefore, detailed working for 25 years is placed in the annexure.

6.7.1 Private Model

An attempt has been made by the Researcher, to prepare the detailed statements of CNG distribution along NH8 for Private Model. The statement covers the Project Cash Flow &its IRR, Equity Cash flow & its IRR, Profit & Loss, Balance Sheet, Debt Service Calculations. As clarified above, the calculation for first five year is placed here in this section for deliberation and inference. However, the detailed calculation sheet over the entire life of the project is placed at **Annexure no VIII**.

Profitability Statement: Profitability statement is the most important Financial Statement reflecting the Revenue, Expenditure and Profit earned by the project. Since the first three years are the gestation period for the project, there would not be any revenue flowing to the projects. It is assumed that 1st April 2011 would be the zero date for the project. In view of this, a table is produced below showing the profitability statement started from the year 2014-15.

Table 6.7.1-1 Profit & Loss Statement – Private Model

(Amount in Rs. Cr)

	2014-15	2015-16	2016-17	2017-18	2018-19
Revenue	351	409	468	526	584
Opex	254	268	283	299	316
Un accounted Loss	9	11	13	14	16
PBDIT	**88**	**130**	**172**	**212**	**252**
Depreciation	141	141	141	141	141
Interest	221	206	190	175	160
PBT	**(274)**	**(216)**	**(159)**	**(104)**	**(48)**
Tax	-	-	-	-	-
PAT	**(274)**	**(216)**	**(159)**	**(104)**	**(48)**

Balance Sheet: Balance sheet is again one of the most important financial statements, prepared for knowing the Strength of the company. Researcher made an attempt to prepare the Balance sheet for Private model. As briefed by researcher, while preparing the profitability that, 1st April 2011 would be the zero date for the project. Therefore, the balance sheet is prepared from the Financial Year 11-12.

Table 6.7.1-2 Balance Sheet – Private Model

(Amount in Rs. Cr)

	2011-12	2012-13	2013-14	2014-15	2015-16
Liabilities					
Share Capital	351	843	1,231	1,231	1,231
Reserves	-	-	-	(178)	(319)
Loan	653	1,566	2,286	2,133	1,981
Total - Liabilities	**1,004**	**2,410**	**3,517**	**3,186**	**2,893**
Assets					
Gross Block	-	-	-	3,517	3,517
Less Depreciation	-	-	-	141	281
Net Block	**-**	**-**	**-**	**3,376**	**3,235**
CWIP	1,004	2,410	3,517	-	-
Current Asset	-	-	-	(190)	(342)
Total - Assets	**1,004**	**2,410**	**3,517**	**3,186**	**2,893**

Project Cash flow and Project IRR Statement for Private Model:

(Amount in Rs. Cr)

	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	1,004	1,406	1,107	-	-
Inflows	-	-	-	88	130
Net Project Cash flow	(1,004)	(1,406)	(1,107)	88	130
Project IRR	**6.60%**				

Table 6.7.1-3 Project Cash flow and Project IRR - Private Model

Researcher has presented the year wise Cash outflows and Inflows to the CNG distribution project in case of Private Model. Cash outflow is capital expenditure made and cash inflow is amount generated by the Project. Project IRR, is an amount of return made by the project when net present value of discounted cash inflows and cash outflows shall be equal. The instant study falls under the category of Infrastructure project. It is evident from above that project is very low project IRR i.e. only 6.6% which is very low by any Industry Standard e.g. PNGRB, itself specifies the 14%, return in their regulation of CNG distribution.

Equity Cash flow and Equity IRR for Private Model

(Amount in Rs. Cr)

	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	351	492	387	-	-
Inflows	-	-	-	(286)	(228)
Net Equity Cash flow	(351)	(492)	(387)	(286)	(228)
Project IRR	**5.81%**				

Table 6.7.1-4 Equity Cash flow and Equity IRR - Private Model

It is evident from above that; project has very low Equity IRR i.e. only 5.81% which is again very low by any Industry Standard. Researcher, draws the conclusion from above that Equity IRR is lower than Project IRR, this means Private Model is value eroding proposition for the shareholder. From the point of Financial Management, Equity IRR has to be more than Project IRR due to Financial Leverage taken by the project. ***In view of lower Equity IRR than Project IRR, in the instant case, Private model is not at all feasible for CNG distribution along NH8.***

6.7.2 Government Model

Similar statements as mentioned in the Private models, has been prepared for the Government Model. By comparing these statements, Researcher would able to draw the conclusion regarding the suitable model for CNG distribution. The detailed statements covering Project Cash Flow & its IRR, Equity Cash flow & its IRR, Profit & Loss Statement, Balance Sheet, Debt Service Calculations is placed at **Annexure no IX**. for the entire life of project. However, the calculation for the first five years is produced below.

Profitability Statement – Government Model

(Amount in Rs. Cr)

	2014-15	2015-16	2016-17	2017-18	2018-19
Revenue	683	797	910	1,024	1,138
Opex	254	268	283	299	316
Un accounted Loss	9	11	13	14	16
PBDIT	**420**	**518**	**615**	**711**	**806**
Depreciation	141	141	141	141	141
Interest	221	206	190	175	160
PBT	**58**	**171**	**283**	**395**	**505**
Tax	19	57	94	131	168
PAT	**39**	**114**	**189**	**264**	**337**

Table 6.7.2-1 Profitability Statement – Government Model

Researcher after assessment of the Profitability statement of Private and Government sector, draws the interpretation that, unlike Private model, Government model in the year of inception of operation i.e. in the year 2014-15, will be declaring the profit of Rs.39 Cr. Whereas, Private model will show loss of Rs.274 Cr. Attention may be given for expenditure which are same for both the model, however difference in profit on account of lower margin due to higher Gas Cost. **Therefore, Government is better model than Private Model.**

Balance Sheet – Government Model

(Amount in Rs. Cr)

Balance sheet has also been prepared for accessing out the strength of the project for Government Model.

	2011-12	2012-13	2013-14	2014-15	2015-16
Liabilities					
Share Capital	351	843	1,231	1,231	1,231
Reserves	-	-	-	25	100
Loan	653	1,566	2,286	2,133	1,981
Total – Liabilities	**1,004**	**2,410**	**3,517**	**3,390**	**3,312**
Assets					
Gross Block	-	-	-	3,517	3,517
Less Depreciation	-	-	-	141	281
Net Block	**-**	**-**	**-**	**3,376**	**3,235**
CWIP	1,004	2,410	3,517	-	-
Current Asset	-	-	-	14	76
Total - Assets	**1,004**	**2,410**	**3,517**	**3,390**	**3,312**

Table 6.7.2-2 Balance Sheet – Government Model

Researcher, from the above table concluded that, a very strong balance sheet of Government Model as compared to Private Model. Strong balance sheet is due to higher margin in Government model. In private model, negative reserves are depicted, where as positive reserves amount has been arrived in Government model. ***Thus, from profitability and Balance sheet point of view Government model is more suitable than Private mode for distribution of CNG along NH8l.***

Project Cash flow and Project IRR statement - Government Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	1,004	1,406	1,107	-	-
Inflows	-	-	-	400	461
Net Project Cash flows	(1,004)	(1,406)	(1,107)	400	461
Project IRR	16.76%				

Table 6.7.2-3 Project Cash flow & IRR - Government

Project Cash flow and IRR Statement - Private Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	1,004	1,406	1,107	-	-
Inflows	-	-	-	88	130
Net Project Cash flow	(1,004)	(1,406)	(1,107)	88	130
Project IRR	6.60%				

Table 6.7.2-4 Project Cash flow & IRR - Private

Researcher by comparing the above table, formed the opinion that, project is very profitable in case of Government model as project IRR stood at 16.76% which is very high. Further, project IRR was very low i.e. only 6.6% in case of Private Model which is very low by any Industry Standard. ***Therefore, from Project Return point of view Government model most suitable model between Private and Government Model.***

Equity Cash flow & IRR Statement - Government Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	351	492	387	-	-
Inflows	-	-	-	27	103
Net Project Cash flows	(351)	(492)	(387)	27	103
Equity IRR	22.57%				

Table 6.7.2-5 Equity Cash flow & IRR Statement - Government

Equity Cash flow & IRR Statement - Private Model

(Amount in Rs. Cr)

	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	351	492	387	-	-
Inflows	-	-	-	(286)	(228)
Net Equity Cash flow	(351)	(492)	(387)	(286)	(228)
Project IRR	5.81%				

Table 6.7.2-6 Equity Cash flow & IRR Statement - Private Model

For ready reference, the tables comparing the Equity IRR in Private and Government model are produced above.

It is evident from above that project is very profitable in case of Government Model, as equity IRR is 22.57% which is very high. Further, as discussed above for private model, equity IRR is very low i.e. only 5.81% which is very low by any Industry Standard.

Further, point may be noted that year wise Cash outflow is same for both the model; however due to very low cash inflows in case of private model, resulted low IRR. e.g. Rs 286 Cr negative inflow in case of Private model versus Rs 27 Cr positive inflow in case of Government model for the year 2014-15 of Equity cash flow statement.

Therefore, Researcher draws the conclusion from Project IRR and Equity IRR numbers that, Government model is far suitable than the Private Model.

6.7.3 PPP Model

Similar to above two model i.e. Private and Government discussed above, Researcher made an attempt to tabulate the same statements covering Project Cash Flow &its IRR, Equity Cash flow & its IRR, Profit & Loss, Balance Sheet, Debt Service Calculations. The detailed calculation for entire life of the project is placed at **Annexure no X**.

Profitability Statement – PPP Model

(Amount in Rs. Cr)

Year	2014-15	2015-16	2016-17	2017-18	2018-19
Revenue	627	732	837	941	1,046
Opex	254	268	283	299	316
Un accounted Loss	9	11	13	14	16
PBDIT	**364**	**453**	**541**	**627**	**713**
Depreciation	141	141	141	141	141
Interest	221	206	190	175	160
PBT	**3**	**107**	**209**	**312**	**413**
Tax	1	35	70	103	137
PAT	**2**	**71**	**140**	**208**	**276**

Table 6.7.3-1 Profitability Statement – PPP Model

PPP is a case of intermediate ownership, between Government Model and Private Model. That is the reason; such model is called as Pubic Private Partnership. On the one hand where Private Model where first year shows losses, and on the other hand Government shows huge profits and PPP shows mid way. PPP model, in the year inception of operation i.e. 2014-15 reflects just Rs. 2 Cr profit as compared to Government sector profit of Rs. 39 Cr. Private model has shown loss of Rs. 274 Cr. *Attention may please be give for expenditure which are same for all the three model, however difference in profit on account of lower margin due to higher Gas Cost.*

Balance Sheet – PPP Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Liabilities					
Share Capital	351	843	1,231	1,231	1,231
Reserves	-	-	-	1	47
Loan	653	1,566	2,286	2,133	1,981
Total - Liabilities	**1,004**	**2,410**	**3,517**	**3,366**	**3,259**
Assets					
Gross Block	-	-	-	3,517	3,517
Less Depreciation	-	-	-	141	281
Net Block	-	-	-	3,376	3,235
CWIP	1,004	2,410	3,517	-	-
Current Asset	-	-	-	(11)	24
Total - Assets	**1,004**	**2,410**	**3,517**	**3,366**	**3,259**

Table 6.7.3-2 Balance Sheet – PPP Model

An inference made by the Researcher, from the above table that, PPP model depicts a strong balance sheet as compared to private player but weaker than Government. Strong balance sheet is due to higher margin in PPP model Vs Private but weaker than Government model. In private model, negative reserves are depicted, where as positive reserves amount has been arrived in PPP model. **Thus, from profitability and Balance sheet point of view PPP model is better than Private model but marginally weaker than Government model.**

Project Cash flow & IRR Statement – PPP Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	1,004	1,406	1,107	-	-
Inflows	-	-	-	363	418
Net Project Cash flows	(1,004)	(1,406)	(1,107)	363	418
Project IRR	15.48%				

Table 6.7.3-3 Project Cash flow & IRR Statement – PPP

PPP model has shown the project IRR of 15.48%, which is a pretty good for any infrastructure projects. Project IRR in case of PPP model is far superior to Private Model which is only 6.6%. However,

the same marginally lower than Government Model which is 16.76%.

Equity Cash flow & Equity IRR Statement – PPP Model

(Amount in Rs. Cr)

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Outflow	351	492	387	-	-
Inflows	-	-	-	(10)	59
Net Project Cash flows	(351)	(492)	(387)	(10)	59
Equity IRR	20.34%				

Table 6.7.3-4 Equity Cash flow & Equity IRR – PPP

PPP model has shown Equity IRR of 20.34%, which is pretty good for any infrastructure projects. It is evident from Government model that project is very profitable as equity IRR is 22.57% which is very high. Further, as discussed above for private model, equity IRR is very low i.e. only 5.81% which is very low by any Industry Standard.

In view of above, Project IRR and Equity IRR score, the Government model and PPP model is far better then the Private Model for distribution of CNG along NH8.

6.7.4 Statement for Debt Service

The debt service coverage ratio (DSCR), also known as 'Debt coverage ratio,' is the ratio of cash available for debt servicing to interest, principal and lease payments. It is a popular benchmark used in the measurement of an entity's ability to produce enough cash to cover its debt payments. The higher this ratio is, the easier it is to obtain a loan.

The year wise debt service coverage ratio for the case of three execution model is given below:

Model	2014-15	2015-16	2016-17	2017-18	2018-19
Private	0.23	0.36	0.50	0.65	0.81
Government	1.07	1.29	1.52	1.77	2.04
PPP	0.97	1.17	1.37	1.60	1.84

Table 6.7.4-1 Debt Service Coverage Ratio

The instant study is to develop CNG distribution project which is an Infrastructure project. In case of Infrastructure project, the debt service has to be more than 1 i.e. Project should earn the so much of money that it at least suffice the obligation of Debt and Interest payment for that particular year.

Researcher observed from above table of DSCR that, Private model does not generate enough cash to support the Debt Service obligation. However, Government and PPP model stands close to each other. **Therefore, again Private Model fails to give financially strong result as compared to Government or PPP Model of project execution.**

6.7.5 Statement for Payback period for Customer

Payback period in capital budgeting refers to the period of time required for the return on an investment to repay the sum of the original investment. Payback period intuitively measures how long something takes to "pay for itself." All else being equal, shorter payback periods are preferable to longer payback periods. Payback period is widely used because of its ease of use to compare the model of execution.

Accordingly, Researcher made an attempt to calculate the payback period for CNG users to get back their investment amount on CNG conversion. The payback period in case of three execution model under study is given below:

Payback Period in Years	Private	Government	PPP
CV - Trucks/Buses	3.53	3.53	3.53
Cars – Diesel	1.19	1.19	1.19
Cars – Petrol	0.31	0.31	0.31

Table 6.7.5-1 Payback Period

The researcher also calculated the Discounted Payback period for all the model of project execution i.e Private, Public and PPP for various users of CNG i.e. Trucks and Cars (both Diesel and Petrol). Since the discounted cash flows takes into account of time value of money, the discounted payback period has increased from the absolute payback period.

Payback Period in Years	Private	Government	PPP
CV - Trucks/Buses	3.80	3.80	3.80
Cars – Diesel	1.79	1.79	1.79
Cars – Petrol	0.44	0.44	0.44

Table 6.7.5-2 Discounted Payback Period

It shows the accuracy for the calculation that since the price of CNG would be same for these three model, pay back periods would be same. However, it is discussed below under the heading of sensitivity analysis the impact on payback period to the customer.

6.7.6 Project Table Return

Researcher has prepared the summarized form of the above discussion in the following table:

Table 6.7.6-1 Project Return

	Unit	Private	Government	PPP
Project IRR	%	6.60	16.76	15.48
Equity IRR	%	5.81	22.57	20.34
Min DSCR	Times	0.23	1.07	0.97
Average DSCR	Times	1.48	3.68	3.31
Tolling Charge from Customer	Rs/MSCM	5,823	11,338	10,417
Tolling Charge from Customer	Rs/Kg	4.16	8.10	7.44
CNG Delivered Price	Rs/Kg	36.38	36.38	36.38
Discount on Diesel	%	10	10	10
Payback period for Customers				
CV - Trucks/Buses	Years	3.53	3.53	3.53
Cars – Diesel	Years	1.19	1.19	1.19
Cars – Petrol	Years	0.31	0.31	0.31

Researcher made an interpretation from the above table that, Government model is best suited for implementation of this project. Private may become a case of complete failure as returns are very low.

However, the researcher recalled the conclusion made from the analysis of Primary data at Question no. 11 of Section B, that Government has no interest to do this project solely.

Therefore, the inference has been made by the researcher from the analysis of Primary and Secondary data that, PPP is the most suitable model for CNG distribution along NH8.

6.7.7 Sensitivity Analysis

Sensitivity Analysis is the study to show how the variation (uncertainty) in the output of a mathematical model can be apportioned, qualitatively or quantitatively, to different sources of variation in the input of the model. Put it in another way, it is a technique for systematically changing parameters in a model to determine the effects of such changes. Sensitive analysis in

Financial Model is the part of capital budgeting decisions. A technique used to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumptions. Sensitivity analysis is a way to predict the outcome of a decision if a situation turns out to be different compared to the key prediction(s). Therefore, for Researcher, it becomes more pertinent to carry out Sensitivity Analysis over these three models and analyze the impact of uncertainties.

The Sensitivity is analyzed by changing the variables and analyzing the impact of the same on the output. The input variable considered for sensitivity analysis is as given below:

- Gestation Period
- Debt
- Equity
- Interest Cost
- Loan Repayment Period
- Project IRR
- Equity IRR
- Tolling Charge from Customer
- CNG Delivered Price
- Discount on Diesel

One by one each variable is changed by the Researcher, from the base case and the impact of the same is analyzed for arriving at best project execution model. The output template and input template has been prepared to analyze the impact.

- **If 14% Equity return is assured**

Sensitivity Case: The first sensitivity is done by considering the 14% equity IRR to all these three project executing agencies. As shown below in yellow marked field the Equity IRR made to 14% by changing tolling charges collected from the customer and rest all the elements or variable kept the same.

Sensitivity Analysis				
Input Sensitivity Parameters	**Unit**	**Private**	**Government**	**PPP**
Gestation Period	Years	3	3	3
Project Life Cycle	Years	28	28	28
Debt	Portion	65%	65%	65%
Equity	Portion	35%	35%	35%
Interest Cost	%	10%	10%	10%
Moratorium Period	Years	3	3	3
Loan Repayment Period	Years	15	15	15
Loan Tenor	Years	18	18	18
Sensitivity Output	**Unit**	**Private**	**Government**	**PPP**
Project IRR	%	11.72	11.72	11.72
Equity IRR	**%**	**14.00**	**14.00**	**14.00**
Min DSCR	Times	0.60	0.60	0.60
Average DSCR	Times	2.39	2.39	2.39
Tolling Charge from Customer	Rs/MSCM	8,111	8,111	8,111
Tolling Charge from Customer	Rs/Kg	5.79	5.79	5.79
CNG Delivered Price	Rs/Kg	40.51	30.57	32.23
Discount on Diesel	%	(0)	24	20
Payback period for Customer				
CV - Trucks/Buses	Years	(178.10)	1.45	1.74
Cars – Diesel	Years	(59.84)	0.49	0.58
Cars – Petrol	Years	0.42	0.22	0.24

Table 6.7.7-1 Sensitivity Analysis with fixed return

Analysis: As Equity Return in the three models kept the same, Project IRR, Debt Service Coverage Ratio, Tolling charges received from customers will be same.

However, it may be noted that CNG would be sold at around Rs. 40/Kg in Private case, around Rs.31/Kg in Government and Rs.32/Kg in PPP model. As discussed in Literature review the CNG price at Rs. 41/Kg are not prevailing in any city and may not be

available proposition. Further payback period doesn't exist in Private model. **Therefore, Private model is out of race if return is guaranteed at 14%.**

- **If Debt Equity Mix Changed**

Sensitivity Case: The Second sensitivity is done by changing the Debt Equity mix, as shown below in yellow marked field, considering the 90% debt to be used by Private players against 65% of Government and PPP.

Sensitivity Analysis				
Input Sensitivity Parameters	**Unit**	**Private**	**Government**	**PPP**
Gestation Period	Years	3	3	3
Project Life Cycle	Years	28	28	28
Debt	**Portion**	**90%**	**65%**	**65%**
Equity	Portion	10%	35%	35%
Interest Cost	%	10%	10%	10%
Moratorium Period	Years	3	3	3
Loan Repayment Period	Years	15	15	15
Loan Tenor	Years	18	18	18
Sensitivity Output	**Unit**	**Private**	**Government**	**PPP**
Project IRR	%	10.74	11.72	11.72
Equity IRR	%	14.00	14.00	14.00
Min DSCR	Times	0.36	0.60	0.60
Average DSCR	Times	1.58	2.39	2.39
Tolling Charge from Customer	Rs/MSCM	7,533	8,111	8,111
Tolling Charge from Customer	Rs/Kg	5.38	5.79	5.79
CNG Delivered Price	Rs/Kg	39.46	30.57	32.23
Discount on Diesel	%	2	24	20
Payback period for Customer				
CV - Trucks/Buses	Years	14.84	1.45	1.74
Cars – Diesel	Years	4.99	0.49	0.58
Cars – Petrol	Years	0.38	0.22	0.24

Table 6.7.7-2 Sensitivity Analysis with Debt Equity

Analysis: Keeping all the element same, except debt proportion of Private players, the scene of CNG delivered price has improved little bit from earlier case of around Rs.40/Kg to around Rs.39/Kg in Private case. **Again, CNG price at Rs. 39/Kg may not prevailing**

in any city of the country and may not be feasible proposition. Further payback period to the customer, is very high in Private model. Therefore, Private model is out of race in this case also.

- **If Project Gestation period changed**

Sensitivity Case: Sensitivity Case of different gestation period has been shown below with gestation period of 1, 2 & 3 year for Private, Government & PPP model respectively and rest variables are same.

Table 6.7.7-3 Sensitivity Analysis with gestation period

Sensitivity Analysis				
Input Sensitivity Parameters	**Unit**	**Private**	**Government**	**PPP**
Gestation Period	**Years**	**1**	**3**	**2**
Project Life Cycle	Years	26	28	27
Debt	Portion	65%	65%	65%
Equity	Portion	35%	35%	35%
Interest Cost	%	10%	10%	10%
Marotorium Period	Years	1	3	2
Loan Repayment Period	Years	15	15	15
Loan Tenour	Years	16	18	17
Sensitivity Output	**Unit**	**Private**	**Government**	**PPP**
Project IRR	%	12.38	11.72	12.03
Equity IRR	%	14.00	14.00	14.00
Min DSCR	Times	0.56	0.60	0.58
Average DSCR	Times	2.26	2.39	2.32
Tolling Charge from Customer	Rs/MSCM	7,278	8,111	7,701
Tolling Charge from Customer	Rs/Kg	5.20	5.79	5.50
CNG Delivered Price	Rs/Kg	39.01	30.57	31.49
Discount on Diesel	%	4	24	22
Payback period for Customer				
CV - Trucks/Buses	Years	10.05	1.45	1.60
Cars – Diesel	Years	3.38	0.49	0.54
Cars – Petrol	Years	0.37	0.22	0.23

Analysis: Keeping all the element same except gestation period, the scene of CNG delivered price has improved little bit from earlier case of around Rs.40/Kg to around Rs.39/Kg in Private case, and around Rs.31/Kg in Government and Rs.32/Kg in PPP model. Again, CNG price at Rs.39/Kg are not prevailing in any city and may not be a feasible proposition. Further payback period to the customer is

very high in Private model. **Therefore, Private model is again out of race in this case also.**

- **If Gestation Period & Debt Equity Changed**

Sensitivity Case: Sensitivity Case of different gestation period along with 90% debt of private model has been shown below. Gestation period of 1 year, 2 year & 3 year are considered for Private, Government and PPP model respectively and rest variables are same.

Table 6.7.7-4 Sensitivity Analysis with gestation & D:E

Sensitivity Analysis				
Input Sensitivity Parameters	**Unit**	**Private**	**Government**	**PPP**
Gestation Period	**Years**	**1**	**3**	**2**
Project Life Cycle	Years	26	28	27
Debt	**Portion**	**90%**	**65%**	**65%**
Equity	Portion	10%	35%	35%
Interest Cost	%	10%	10%	10%
Moratorium Period	Years	1	3	2
Loan Repayment Period	Years	15	15	15
Loan Tenor	Years	16	18	17
Sensitivity Output	**Unit**	**Private**	**Government**	**PPP**
Project IRR	%	11.72	11.72	12.03
Equity IRR	%	14.00	14.00	14.00
Min DSCR	Times	0.36	0.60	0.58
Average DSCR	Times	1.55	2.39	2.32
Tolling Charge from Customer	Rs/MSCM	6,963	8,111	7,701
Tolling Charge from Customer	Rs/Kg	4.97	5.79	5.50
CNG Delivered Price	Rs/Kg	38.44	30.57	31.49
Discount on Diesel	%	5	24	22
Payback period for Customer				
CV - Trucks/Buses	Years	7.18	1.45	1.60
Cars – Diesel	Years	2.41	0.49	0.54
Cars – Petrol	Years	0.35	0.22	0.23

Analysis: Keeping all the element same except gestation and Debt equity period, the scene of CNG delivered price has improved little bit from earlier case of around Rs.39/Kg to around Rs.38/Kg in Private case, Again, CNG price at Rs. 38/Kg may not prevailing in any city and may not be a feasible proposition. Further payback

period to the customer is very high in Private model. **Therefore, Private model is out of race in this case.**

Therefore, in view of Data analysis from Secondary Data, Researcher draws the conclusion that, Government Model would be the Most Suitable model, followed by PPP model and Private Model would be the complete failure.

Researcher, from the Analysis of Primary data, drawn the opinion that, the Government wants to distribute the CNG along NH8; However Government does not want to go solely for CNG distribution along National Highways.

Therefore, Researcher draws the conclusion from the analysis of Primary and Secondary data that, PPP is the most suitable model for CNG distribution along NH8.

7. SUMMARY, CONCLUSIONS AND SUGGESTIONS

The researcher after doing the in depth relevant Literature Survey, identified the objective of the research work. Accordingly, an analysis made based on Primary Data i.e. Survey Questionnaire and Financial Analysis based on Secondary data. Secondary data is used to prepare the Excel based complex financial model.

The researcher here attempted to draw the conclusion based on the various issued discussed throughout the thesis. Before putting up the conclusions, Researcher hopes that these suggestions would be accepted by the Industry or Policy Maker while evolvement of the CNG distribution along National Highways.

7.1 Summary

First Chapter of thesis is taking the geometric shape of Cone. The broad level business scene is discussed first and slowly step by step moved towards the finer details of the issues of the industry. Overview of Natural Gas Business has been discussed and how the same is used for several end use including CNG. As mentioned earlier, boarder perspective of CNG i.e. International CNG overview followed by evolution of CNG in India has deliberated in the suitable manner. The Key Milestones during CNG Evolution era has also been tabulated. The Indian CNG story is unfolded by providing CNG Network Basics and its Key Growth Drivers. The existing CNG setup in India, along with the quantitative information on Operations, Consumption, Demand, Supply, Pricing and Financing has been mentioned in this chapter. Further, CNG distribution is regulated business and hence Researcher is attempted to throw light on Regulatory Framework in India. At the end of this chapter Issues and Concerns were discussed with the special reference to Future Outlook and Projections.

Chapter 2 is concerned with the research methodology adopted for achievement of the objectives of the study undertaken. The chapter explains the Rationale of the Study. The chapter pin point the title of the thesis i.e. '**An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway**' and identified the Scope for the Study. Since it is pertinent to make boundary line to the study, Researcher prepared a well defined scope in two ways. One is Geographical Scope i.e Delhi-Mumbai National Highway (NH8) and Operational Scope which is limited to Project execution Model among Government, Private and PPP for distribution of CNG along NH8. The Objectives of the research study and other relevant details for Research Methodology like Review of Literature, Research Design, Sampling Procedure, Procedure for Data Collection, Secondary Data, Primary Data, Formulation of Hypothesis and Analysis and Interpretation has been discussed. The Researcher concluded this chapter with the limitations of the study.

The amount of Literature Review done by researcher is explained in **Chapter 3** of the thesis. The immense Literature Review gives an overview of the field of Natural Gas Industry, CNG Industry and other Project related issues. It basically explains what has already been said on the topic, who are the key writers, what are the prevailing theories and hypotheses, what questions are being asked, and what methodologies and methods are appropriate and useful. A critical literature review has shown how prevailing ideas is fitted in thesis, and how instant study agrees or differs from them.

Specifically, Review of Literature pertaining to Natural Gas Industry covers Natural Gas Basics, Global & Domestic Natural gas resources and trade, Global and Indian Scenario of Natural Gas Consumption, Sourcing of Gas through LNG, Pricing policy of Natural Gas Pricing in India, Government Gas Utilization Policy, List of Natural Gas Pipeline Infrastructure available in the country, the status of

LNG Infrastructure, and since Natural Gas is Regulated business the Regulatory Framework has also been discussed.

Second part of Literature Review, focus on important aspects CNG Distribution like Cost of Conversion for Different Types of Vehicles, status of existing Cities Covered under CNG Infrastructure, Entities Engaged in City Gas Distribution Business in India, CNG Activities in India. As CNG is termed as, the Clean and Green Fuel, quantitative terms of Pollution Reduction in CNG Fuelled Vehicles are also reviewed. The Vision of Ministry of Petroleum & Natural Gas and Plan of PNGRB for development of City Gas Distribution Network along with Cities Awarded by PNGRB are unveiled in this chapter. Further critical issues like Status of CNG Price, Breakup of Running Cost, Equity Structures of CNG Companies also have been reviewed.

Chapter 4 deals important part of the research. The systems require for providing the Natural Gas through CNG systems is discussed in-depth in this chapter. The chapter explains the need of Natural Gas Highway by mentioning the amount of Vehicular Pollution and availability of alternate fuels. Rational for Delhi Mumbai Natural Gas Highway for instant research in light of abundant Natural Gas availability and Gas transmission infrastructure of GAIL and GSPC in Gujrat.

Specifically, CNG distribution is Retail sales business of Natural Gas, therefore it become important to mentioned the CNG Station Location & its Spread, Ownership of retail outlets, Design and layout CNG Station, CNG station operations, CNG Equipment Supply & Station Maintenance, Financing of CNG Vehicle and easy CNG Conversion, Suppliers of CNG Kits, Installation and monitoring of CNG Kits, and therefore, an overall CNG station management system is discussed in this chapter.

Chapter 5 is the one of the most important chapter of the research study. This chapter provides the use of Primary data. This chapter dealt with the most important objective of the research.

The researcher in this chapter has made an attempt to achieve the objectives no. 2 & 3 stated in the chapter of Research Methodology by capturing the Opinion of Experts from the Oil & Gas Industry regarding the major aspects of the research.

Since success of all the projects depend upon the financial viability. Researcher in the **Chapter 6** has made an attempt to work out the financial feasibility for Distribution of CNG along NH8. Therefore, it becomes far more important to evaluate the project. The project is evaluated based on secondary data available for the study. The secondary data is taken from Annual Reports of the CNG companies, Research Report, Consultant Report, Study Report by the regulator etc. For working out the Financial Feasibility, the Excel based complex model is developed. The detailed working sheet of the model is discussed in the chapters. However, the same were also made as a part of annexure to the thesis.

This chapter finely throws the light on Financial Analysis for Natural Gas Highway. The most important part of any project is its Project Cost Estimates i.e. Capital Expenditure or Capex. The researcher covered the details for working out the Capex. The operations related issues like Cost of Feed Stock i.e Natural Gas cost, Sale Price of CNG, Operating Expenditures, Manpower Cost, Power Cost, Depreciation and Amortization, CNG Station Capacity Utilization, Project Financing, Demand Estimation, Steel Pipe Cost Estimation, CNG Station Assumptions etc has been deliberated in suitable depth in this chapter.

Financial Analysis has been made for the three project execution system i.e. Private, Government and PPP model. The Financial statement like Profit & Loss, Balance sheet, Project IRR, Equity IRR

has been shown along with Statement for Debt Service, Statement for Payback period for Customer and Project Return. Finally Sensitivity Analysis has been made.

The conclusion and Suggestion are presented in the Chapter 7. It discuss about the best Project Execution and Ownership model for distribution of CNG along National Highways among Government, Private and PPP model.

7.2 Conclusions:

On the basis of the study, the Researcher was able to reach the following conclusion:

1. **Environmental Consideration:** Pollution has definitely been a curse on contemporary society and is a hot topic of debate at all levels. In the last decade, the importance of environment conservation has assumed great significance. People and institutions have been battling it out for a cleaner and greener world. The strict application of the Euro norms and the drive for switchover to Compressed Natural Gas (CNG) as an alternative fuel are some of the examples of the endeavors made by the denizens of the capital towards creating a greater eco-friendly environment. Pollution due to petroleum products used in transportation is an ever-increasing problem. Pollution due to transportation can be divided into two main categories: air pollution and noise pollution. Some environmentalists also quote odour pollution as the third and major component. **Technical experts have suggested the use of CNG as an alternative fuel for automobiles.** They have estimated that apart from being less hazardous, it is also environment friendly, can help in reducing the levels of pollutant emissions and is quite cost effective.

2. **Gas utilization Policy:** Since natural gas is one of the core energy sectors, the government has brought out a Gas Utilization Policy for the allocation of gas from the KG-D6 reserves. The first priority was given to the existing plants in each of the priority sectors to ensure utilization of capacities already created and to obtain faster monetization of natural gas. The next priority was given for the replacement of liquid fuels in energy-intensive industries for both environmental and economic reasons. Next, existing plants in each of the priority sectors were given priority to meet their requirement of de-bottlenecking and expansions at the existing locations.

   Based on the above factors, the following order of allocation was decided:

   1) Fertilizer plants
   2) LPG and petrochemicals plants
   3) Power plants
   4) **City gas distribution**
   5) Refineries

   In view of saturation of demand from existing Fertilizer plants, LPG and petrochemicals plants, and Power plants, **a conclusion is drawn by the Researcher that any incremental Gas available in the country would be used for CNG distribution Project.**

3. **Supply of Natural Gas:** The success or failure of implementation of the CNG project depends on adequate availability of Natural Gas. The Mashlekar Committee report on Auto Fuel Policy has observed that the feasibility of using CNG as an alternative auto fuel would depend on the overall natural gas availability as well as availability of a strong natural gas transmission infrastructure connecting various regions. NH8 not only have connectivity to huge reserves of indigenous natural gas

but also two existing LNG regasification terminals present in Gujrat. Further a LNG terminal in Dabhol, Mahasratra and one in Gujrat (Mundra) is being developed. All these four terminal has connectivity with GAIL's system and will able to supply feed stock for the project.

Further, NH8 is well connected with GAIL's HVJ/DVPL and Vijaipur Kota connectivity is in the vicinity of NH8. Gujarat State Petronet Ltd. (GSPL), which is a subsidiary of Gujarat State Petroleum Corporation (GSPC), was incorporated to construct and manage a state-wide gas transmission network in Gujarat, connecting production centers and LNG terminals with major demand centers across the state. In view of this **connectivity of Natural Gas Pipelines of GAIL and GSPL, distribution of CNG along NH8 would be physically possible.**

4. **Government directives for creation of Demand of CNG along NH8:** The capital cost of CNG distribution project is recovered through toll/tariff charge included in CNG price from the customer. Therefore, early creation and monetization of demand will increase the feasibility of project drastically. Demand would be function of price discount over diesel. However, Government order for compulsion on conversion for commercial vehicle on CNG would change the face of this project. Further, from the analysis of Primary data, the researcher has drawn the conclusion that, Government has to issue directives for compulsory switching over to CNG in respect of commercial vehicles. Therefore, Government has to play key role in the project of CNG distribution along National Highways.

5. **Natural Gas Feed stock Price for CNG:** The natural gas pricing scenario in India is complex and heterogeneous in nature. There are wide varieties of gas price in the country. At present, there are broadly two pricing regimes for gas in the country - gas priced under Administered Price Mechanism (APM) and non-APM or free market gas. The price of APM gas is set by the Government. As regards non-APM/free market gas, this could also be broadly divided into two categories, namely, domestically produced gas from JV fields and imported LNG. The pricing of JV gas is governed in terms of the Production Sharing Contract (PSC) provisions. It is expected that substantial gas production would commence from the gas fields awarded by the Government under the New Exploration Licensing Policy (NELP). As regards LNG, while the price of LNG imported under term contracts is governed by the Sales & Purchase Agreement SPA between the LNG seller and the buyer, the spot cargoes are purchased on mutually agreeable commercial terms. Currently Natural Gas price is producer based. Natural Gas produced from state run enterprises like ONGC, OIL and major private player RIL is at $4.2/MMBTU while imported Natural Gas cost almost $6/MMBTU. However, for supply of Gas at Delhi Mumbai Highway the Delivered Price would be vary from $10/MMBTU to $16/MMBTU based on Gas source and project ownership and execution model. Therefore, from the analysis of the **Secondary data, Researcher drawn the conclusion that, Private Model for distribution of CNG along National Highway is unfeasible due to high Natural Gas Feed stock cost.**

6. **CNG Price to Consumers:** Price of CNG would be based on replacement cost of alternative fuel i.e. Diesel. to promote the CNG and give the incentive to incur additional cost for installation of CNG Kit, it is likely to provide 10% of discount over diesel price. Considering the CNG price with 10% discount

would provide payback period of 3 years & just over 1 years for truck operator and taxi operator respectively. Therefore, from the analysis of **Secondary data, the researcher drawn the conclusion that, Customer would not able to afford CNG conversion in Private model as there payback period for investment would be very high.**

After in depth analysis of the Primary and Secondary data, Researcher arrived at conclusion of the following important parameters for Successful implementation of CNG distribution project along NH8:

1) Assured Long term Secured Supply of Natural Gas
2) Allocation of APM or indigenous or cheaper feed stock price
3) As this project requires, multi state coordination, therefore Government support is a key for the project
4) Demand to be driven by Government compulsion for CNG conversion
5) Timely Implementation of Project
6) Project has High Gestation Period
7) The instant project is a Capital intensive Infrastructure project
8) Low return project
9) Low capability to service debts

In view above, Researcher draws the conclusion that, for successful implementation of CNG distribution project along NH8, requires Government support and expertise of Private Parties to execute the project. Therefore Public Private Partnership would be ideal entity to do this project. Further, it has been experienced that PPP is best suited for achieving Socio-commercial objective. Thus PPP model is recommended for Implementation of Socio-commercial project of supplying CNG along NH8.

7.3 Recommendations:

The **fourth objective** of the study was to form the Suggestive Framework for implementation of CNG Distribution Project along NH8. Accordingly, following framework has been suggested by the Researcher:

Role of Government in the instant PPP model would be act as a facilitator to this project by assuring:

1) Long Term Gas Supply
2) Clarity on Cost of Feed stock
3) Issue directions for compulsory switch over to CNG as a Fuel to commercial vehicle operators
4) Coordinator for State Government activity
5) Share the regulatory risk of the project
6) Provide guarantee for low cost of funding
7) Provide fast clearances for right of way acquisitions and environmental issues

While Private party would be acting as an executor for the project activities, the major role played by private parties are:

1) Execution of project without time and cost overrun
2) Operating and Maintaining the Infrastructure
3) Sharing the project completion risk
4) Arranging the financial closure
5) Initiatives for early CNG conversions.

In view of above, it is recommended that, **Implementation of CNG distribution Project along National Highways by PPP model will be a Win – Win situation for Government as well as Private Entrepreneurs and also achieving the Socio-Commercial Goal of Nation.**

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9. ANNEXURE

1 Annexure I: CNG Infrastructure in India

SI No.	State	City
1	Andhra Pradesh	Vijayawada
2		Hyderabad
3		Rajahmundery
4		Kakinada
5	Assam	Duliajan
6		Digboy
7		Tinsukia
8		Dibrugarh
9		Nahar Katia
10		Moran
11		Nazaria
12		Shivsagar
13	Delhi	Delhi
14	Gujarat	Anand city & Near by Village
15		Bharuch
16		Surat
17		Ankleswar
18		Vapi
19		Valsad
20		Navsari
21		Hazira
22		Sarigam
23		Nadiad
24		Khabmbhat
25	Gujarat	Chandkheda-Motera
26		Gandhinagar
27		Pethapur
28		Halol
29		Dahej
30		Uttarsanda
31		Vavol
32		Rajkot

33		Morbi
34		Surendranagar
35		Thangadh
36		Karjan
37		Palej
38		Morai
39		Gundalv
40		Kheda
41		Mehsana
42		Sabarkanth
43		Vadodara
44		Himat Nagar
45		Ahemdabad
46	Haryana	Gurgaon
47		Sonepat
48		Faridabad
49	Madhya Pradesh	Indore
50		Ujjain
51		Gwalior
52		Dewas
53	Maharastra	Mumbai
54		Mira Bhayandar
55		Thane
56		Navi Mumbai
57		Panvel
58		Pune
59	Rajasthan	Kota
60	Tripura	Agartala
61	Uttar Pradesh	Noida
62		Greater Noida
63		Kanpur
64		Bareilly
65		Agra
66		Lucknow
67		Moradabad
68		Ghaziabad
69		Mathura
70	West Bengal	Barkar
71		Asansol
72		Neamatpur
73		Durgapur
74		Raniganj
75		Hirapur
76	Daman & Diu	Daman

2 Annexure II: Cities identified by MONPNG

Sl. No.	State	City
1.	Andhra Pradesh	Kukatpally
2.		Lal Bahadur Nagar
3.		Qutubullapur
4.		Eluru
5.		Visakhapatnam
6.		Warangal
7.		Guntur
8.		Nellore
9.		Gajuwaka
10.		Ramagundam
11.		Nizambad
12.		Tirupati
13.		Kurnool
14.		Anantapur
15.		Karimngar
16.	Bihar	Patna
17.		Gaya
18.		Sasaram
19.		Aurangabad
20.		Barauni
21.		Bhagalpur
22.		Muzaffarpur
23.		Darbhanga
24.	Jharkhand	Jamshedpur
25.		Ranchi
26.		Bokaro Steel City
27.		Dhanbad
28.	West Bengal	Kolkata
29.		Hugli
30.		Durgapur
31.		Asansol
32.		Kulti
33.		Barddhaman
34.		Kharagpur
35.		Haldia
36.		Medinapur
37.	Punjab	Ludhiana
38.		Patiala
39.		Bathinda
40.		Khanna

41.		Amritsar
42.		Jalandhar
43.		Hoshiarpur
44.		Phagwara
45.		Kapurthala
46.		Sangrur
47.		Ropar
48.	Haryana	Panipat
49.		Hisar
50.		Karnal
51.		Yamunagar
52.		Bhiwani
53.		Ambala
54.		Rewari
55.		Kalka
56.		Rohtak
57.	Gujarat	Jamnagar
58.		Nadiad
59.		Bharuch
60.		Navsari
61.		Mahesana
62.		Godhra
63.		Kalol
64.		Dahod
65.		Halol
66.		Valsad
67.		Bhavnagar
68.		Gandhidham
69.		Bhuj
70.		Palanpur
71.		Patan
72.		Mahuva
73.		Junagadh
74.		Probandar
75.		Veraval
76.		Jetpur
77.	Karnataka	Bangaluru
48.		Hubli
79.		Mysore
80.		Belgaum
81.		Mangalore
82.		Davanagere

83.		Dharwad
84.		Anekal
85.		Gulbarga
86.		Bijapur
87.		Chitradurga
88.		Gadag-Betigeri
89.		Tumkur
90.		Bagalkot
91.		Harihar
92.		Ranibennur
93.		Hukeri
94.		Gokak
95.		Shimoga
96.		Bellary
97.	Goa	Margaon
98.		Panaji
99.	Kerala	Kochi
100.		Kozhikode
101.		Kanjirkod
102.		Thrissur
103.		Alappuzha
104.		Palakkad
105.		Kottayam
106.		Kanhangad
107.		Cherthala
108.		Thalassery
109.		Ponnani
110.		Malappuram
111.		Kasargod
112.		Thiruvanathapuram
113.		Kollam
114.		Kayankulam
115.	Tamil Nadu	Thiruvarur
116.		Pondicherry
117.		Cuddalore
118.		Combatore
119.		Salem
120.		Tiruppur
121.		Chennai
122.		Vellore
123.		Madurai
124.		Tiruchirappalli

125.		Tirunelveli
126.		Dindigul
127.		Kancheepuram
128.	Madhya Pradesh	Gwalior
129.		Guna
130.		Ratlam
131.		Bhind
132.		Bhopal
133.		Jabalpur
134.		Raipur
135.		Bhillai
136.		Chhindwara
137.		Vidisha
138.		Satna
139.		Rewa
140.		Hoshangabad
141.		Itarsi

Sl. No.	**State**	**City**
142.	Maharashtra	Nagpur
143.		Nashik
144.		Kolhapur
145.		Sangli-Miraj Kupwad
146.		Latur
147.		Chandrapur
148.		Ichalkaranji
149.		Satara
150.		Osmanbad
151.		Solapur
152.		Ahmadnagar
153.		Baramati
154.		Aurangabad
155.		Amravati
156.		Nanded
157.		Akola
158.		Jalgaon
159.		Jalna
160.		Malegaon
161.		Dhule
162.		Parbhani
163.	Orissa	Bhubaneswar

164.		Cuttack
165.		Berhampur
166.		Puri
167.		Balasore
168.		Bhadrak
169.		Raurkela
170.		Sambalpur
171.	Rajasthan	Bharatpur
172.		Alwar
173.		Neemrana
174.		Jaiselmer
175.		Bhiwadi
176.		Jaipur
177.		Ganganagar
178.		Jodhpur
179.		Udaipur
180.		Ajmer
181.		Bhilwara
182.	Uttar Pradesh	Shajahanpur
183.		Bulandshahr
184.		Modinagar
185.		Khurja
186.		Saharanpur
187.		Muzzaffarnagar
188.		Rampur
189.		Shamli
190.		Budhana
191.		Varanasi
192.		Aligarh
193.		Gorakhpur
194.		Murazpur-cum-Vindhyachal
195.	Uttarakhand	Haldwani-cum-Kathgodam
196.		Kashipur
197.		Rudrapur
198.		Sitarganj
199.		Dehradun
200.		Haridwar
201.		Roorkee

3 Annexure III: Route Survey of NH8

Route Survey of NH8

Phase	Sr No	Route Name	Distance (Km)	Cumulative Distance (KM)	P/L Not Rquired (Km)	P/L Rquired (Km)	Pipeline Status	CNG (Nos)	
1. Delhi - Jaipur	1	Head towards Vivekananda Rd north-west on Deen Dayal Upadhaya Marg Pass by Government Girls School (on the left)	0.28	0.28	23.00		No Pipeline Required	0	Already Covered under CNG
	2	Turn left at Krishnlal Dutta Chowk onto Vivekananda Rd Pass by SMSindra-Bulk SMS Service Delhi (on the left)	0.30	0.58					
	3	At the roundabout, exit onto Baba Kharak Singh Marg/NH 8 Go through 2 roundabouts Pass by Royal Resturant (on the left)	5.20	5.78					
	4	Turn right to stay on Baba Kharak Singh Marg/NH 8 Pass by Petrol Pump (on the right in 2.0 km)	6.40	12.18					
	5	Turn left to stay on Baba Kharak Singh Marg/NH 8 Pass by Petrol Pump (on the left in 800 m)	1.20	13.38					
	6	Turn left to stay on Baba Kharak Singh Marg/NH 8 Pass by Petrol Pump (on the left in 6.2 km)	7.20	20.58					
	7	Turn right to stay on Baba Kharak Singh Marg/NH 8 Continue to follow NH 8 Pass by Petrol Pump (on the right)	0.70	21.28					
	8	Sharp right at Gurgaon Rd/Swarna Jayanti Marg/NH 8 Pass by D. (on the right in 400 m)	1.50	22.78					
	9	Turn right at India Gypsum, Armstrong, Bioson Panel,Glasswool, POP, Partion Products, Gypstone onto National Highway 8/NH 8 Pass by Baba Narayan Das (on the left in 26.2 km)	51.60	74.38		150.00	Pipeline Required	4	CNG Station Required
	10	Slight left toward NH 8	0.65	75.03					
	11	Continue straight onto NH 8 Go through 1 roundabout Pass by Bharat Petroleum Outlet (on the right in 4.3 km)	182.00	257.03					
	12	Turn right at Surajpol Bazar Rd	1.40	258.43					
	13	Continue onto Ramganj Bazar Rd	0.80	259.23					
	14	Slight right at Tripolia Bazar/NH 11 Pass by Dhoom Textiles Pvt Ltd (on the left)	0.85	260.08	88.06		No Pipeline Required	0	No CNG Required
	15	Turn left at Kishanpol Bazar Rd Pass by Rajasthan Arts School (on the left in 450 m)	0.90	260.98					
	16	Turn left at M.I Rd/NH 8	0.04	261.02					
		Sub Total - Phase I	**261.02**						
2. Jaipur - Ajmer	1	Head towards Sawai Mansingh Rd/NH 12 east on M.I Rd/NH 8	0.04	261.07					
	2	Make a U-turn at Traffic Police Head Quarters Pass by Petrol Pump (on the right in 850 m)	1.50	262.57					
	3	Turn left toward Sardar Patel Rd	0.16	262.73					
	4	Take the 1st left onto Sardar Patel Rd	0.15	262.88					
	5	At the roundabout, take the 4th exit to stay on Sardar Patel Rd	0.20	263.08		135.00	Pipeline Required	4	CNG Station Required
	6	Turn left at NH 8 Pass by Gujrati Petrol Pump (on the left in 130 km)	132.00	395.08					
	7	Turn left at NH 79 Pass by Vijyanad Senior Secondary School (on the right)	0.13	395.21					
	8	Take the 1st right onto Indira Gandhi memorial Station Rd/Nasirabad Rd/NH 79 Pass by Government Girls College (on the left)	0.85	396.06					
		Sub Total - Phase II	**135.03**						
3A. Ajmer - Udaipur	1	Head south on Indira Gandhi memorial Station Rd/Nasirabad Rd/NH 79 Continue to follow NH 79 Pass by Toshniwal Industries Pvt. Ltd. (on the left in 4.1 km)	4.50	400.56		199.30	Pipeline Required	4	CNG Station Required
	2	At the roundabout, take the 3rd exit	8.90	409.46					
	3	Slight left at NH 8 Pass by Petrol Pump (on the left in 42.1 km)	44.90	454.36					
	4	Sharp right to stay on NH 8 Pass by Shri Gopal Marbles Pvt. Ltd. (on the left in 136 km)	141.00	595.36					

Route Survey of NH8

Phase	Sr No	Route Name	Distance (Km)	Cumulative Distance (KM)	P/L Not Rquired (Km)	P/L Rquired (Km)	Pipeline Status	CNG (Nos)	
3B. Ajmer - Udaipur	5	Keep left at the fork Pass by Swaminarayan Mandir (on the left in 19.9 km)	65.20	660.56					
	6	Turn right to stay on NH 8	0.75	661.31					
	7	Take the 1st left onto State Highway 32/NH 76/NH 8/SH 32 Go through 1 roundabout Pass by Fateh Pura (on the right)	4.10	665.41					
	8	Turn right toward Bapu Bazar Rd	0.12	665.53					
	9	Turn left at Bapu Bazar Rd Pass by Krishna Ritu Appt (on the left in 600 m)	0.80	666.33					
	10	Turn right	0.45	666.78					
	11	Take the 1st left	0.07	666.85					
		Sub Total - Phase III	270.79						
4. Udaipur - Gandhinagaer	1	Head north	0.07	666.92		204.48	Pipeline Required	4	CNG Station Required
	2	Turn left	0.35	667.27					
	3	Turn left toward State Highway 32/NH 76/NH 8/SH 32	1.00	668.27					
	4	Continue straight onto State Highway 32/NH 76/NH 8/SH 32 Pass by Vishal Megamart (on the right in 350 m)	4.80	673.07					
	5	Turn right to stay on State Highway 32/NH 76/NH 8/SH 32 Continue to follow NH 8	31.40	704.47					
	6	Keep left at the fork Go through 1 roundabout Pass by Bichhiwara police station (on the right in 67.9 km)	185.00	889.47					
	7	At the roundabout, take the 3rd exit onto SH 141	6.50	895.97			No Pipeline Required		No CNG Required
	8	At the roundabout, take the 2nd exit onto Rd No 7/SH 71	0.90	896.87					
	9	Turn left at CH 7 onto CH Rd	2.10	898.97	100.00			0	
	10	Turn right at CH 5 onto Rd No 5	0.40	899.37					
	11	Take the 1st left	0.17	899.54					
	12	Take the 1st right	0.30	899.84					
		Sub Total - Phase IV	232.99						
5. Gandhinagaer - Vapi	1	Head south-west	0.20	900.04			No Pipeline Required		Already covered under CNG
	2	Turn left toward CH Rd	0.65	900.69					
	3	Turn right at CH Rd	1.60	902.29					
	4	Turn left at Rd No 3	0.04	902.33					
	5	Turn right at CH 3	0.41	902.74					
	6	Take the 1st left onto CH Rd	2.00	904.74					
	7	At the roundabout, take the 2nd exit onto Gandhinagar Ahmedabad Rd Go through	8.90	913.64					
	8	At the roundabout, take the 1st exit onto Sardar Patel Ring Rd	4.40	918.04					
	9	At the roundabout, take the 3rd exit onto NH 8 Pass by HPCL CNG Mother Station	6.10	924.14					
	10	Slight left at Marigold Benquet Hall/Narol Naroda Rd/NH 8 Continue to follow Naro	7.50	931.64	386.19			0	
	11	Turn left to stay on Narol Naroda Rd/NH 8	1.00	932.64					
	12	Slight right to stay on Narol Naroda Rd/NH 8	0.30	932.94					
	13	Take the 1st left onto NE 1/Ahmedabad Vadodara Express Hwy Pass by Web dev	93.20	1,026.14					
	14	Continue straight onto NH 8 Go through 2 roundabouts Pass by Petrol Pump (on t	258.00	1,284.14					
	15	Turn right at Hotel Papillon onto Koparli Rd Pass by Bhavsar Cloth Stores (on the l	0.65	1,284.79					
	16	Continue onto Vapi Station Rd	0.90	1,285.69					
	17	Vapi Station Rd turns slightly right and becomes Road to Subway	0.26	1,285.95					
	18	Turn right	0.07	1,286.02					
		Sub Total - Phase V	386.19						
6. Vapi - Mumbai	1	Head towards Road to Subway south-east on Unknown road	0.07	1,286.10			Pipeline Required		CNG Station Required
	2	Turn left at Road to Subway	0.70	1,286.80					
	3	Road to Subway turns right and becomes Vapi Station Rd	0.45	1,287.25		48.97		2	
	4	Continue onto Koparli Rd Pass by Bhavsar Cloth Stores (on the right in 450 m)	0.65	1,287.90					
	5	Turn right at Hotel Papillon onto NH 8 Pass by Dayanand Hospital (on the left in 3	47.10	1,335.00					
	6	Keep left at the fork Continue to follow NH 8 Pass by CNG Gas Station (on the left	110.00	1,445.00			No Pipeline Required		Already Covered under CNG
	7	Slight right toward Western Express Hwy/NH 8	0.75	1,445.75					
	8	Continue straight onto Western Express Hwy/NH 8 Pass by St Joseph's (on the lef	5.70	1,451.45					
	9	Exit onto S V Rd Pass by Saraswati Dattatray Electricals & Co., (SDEC) (on the lef	1.00	1,452.45					
	10	Continue onto A S Gaya Marg/Lady Jamshedji Rd Pass by Petrol Pump (on the lef	1.10	1,453.55					
	11	Continue onto Lady Jamshedjee Rd Pass by Petrol Pump (on the left)	0.95	1,454.50	121.78			0	
	12	Turn left at Gadkari Chowk onto NC Kelkar Rd Pass by Dhyan Securities Pvt Ltd (	0.45	1,454.95					
	13	At the roundabout, take the 1st exit onto Tilak Bridge Pass by Vanmali Chk (on the	0.70	1,455.65					
	14	At the roundabout, take the 2nd exit onto Tilak Rd Pass by Bhavanji SC (on the lef	0.60	1,456.25					
	15	Turn left toward Road No 19	0.50	1,456.75					
	16	Take the 2nd right onto Road No 19	0.03	1,456.78					
		Sub Total - Phase VI	170.76						
		TOTAL ROUTE DISTANCE (I to VI)	1,456.78		719.03	737.75		18	
						1,456.78			

4 Annexure IV: Questionnaire

Questionnaire on:

"An Analysis to Identify Project Implementation Model for Distribution of Compressed Natural Gas (CNG) along the National Highway"

Dear Respondent,

This questionnaire is a part of doctoral research on 'An analysis to Identify Appropriate Project Execution Model among Government, Public Private Partnership and Private Companies for Distribution of Compressed Natural Gas along the Delhi-Mumbai National Highway (NH-8).' Research is being done under the guidance of Dr. Manvinder Singh Pahwa, Associate Professor, Department of Finance, College of Management & Economics Studies, University of Petroleum and Energy Studies, Dehradun and Dr. Ashutosh Karnatak, Executive Director (Projects), GAIL (India) Limited.

I request you to spare a few minutes and share views on this topic. This information will be used only for academic purpose and I assure you that the information provided by you will be kept confidential and reported only in summary form.

Though I appreciate your response to all questions, you may find a few questions of sensitive nature and some which you cannot reply due to lack of knowledge/exposure in a particular field; I appreciate your constraint of response to such question.

In case of any query please do not hesitate to contact me on:

E-mail: shivaraj@gail.co.in

Mobile. No.: 95400 17323.

Personal Information: (To be kept confidential)

Name:	Age:
Designation:	Phone number:
Organisation:	Address:
Years of experience:	

SECTION A

DISTRIBUTION OF COMPRESSED NATURAL GAS (CNG)

(Note: Please answer appropriately by placing a tick mark (√) or as required in the question concerned)

1. Some statements regarding CNG Business (not PNG and Industrial supply) are given below. Please place a tick mark (**√**) to indicate your agreement or disagreement with the statement.

S.NO	Statement Regarding CNG Business in India	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1.	India does not have enough gas for setting up new CNG projects.					
2.	Petrol/Diesel price sensitivity will hinder CNG business in development of new projects.					
3.	Lot of technical advancements will be needed for new projects in India.					
4.	LNG is an important source of CNG.					
5.	Regulated feedstock price will improve CNG business environment.					
6.	Prioritizing allocation of natural gas in CNG sector will not be beneficial.					
7.	CNG is a capital intensive project.					
8.	CNG has a low return business.					
9.	CNG is a business of long gestation period.					
10	Necessary policy changes have been made to encourage the usage of CNG.					
11.	The policy and strategy followed by public and private organization are different in context to CNG business.					
12.	Existing policy framework encourages private players to enter into CNG business.					
13.	Success of Indraprastha Gas limited (IGL) & Mahanagar Gas limited (MGL) is due to directives from Supreme Court & low feed stock price of Natural Gas					
14.	It is possible to supply CNG along major national highways.					

2. Please Rank the following aspects of CNG in order of your suitability on the present scenario. Rank them on 5 point scale in order of importance (5 being extremely important).

S.NO	Ranking the CNG fuel on the following determinants	1	2	3	4	5
1.	Eco- friendly.					
2.	Safer fuel.					
3.	Abundant and readily available.					
4.	Cheaper fuel.					
5.	Reduction in load carrying capacity of Goods carrier.					
6.	Reduction in maintenance cost.					
7.	Cargo space is reduced due to CNG cylinder in vehicles.					

SECTION B

Identify appropriate Project Execution model Government, Public Private Partnership (PPP) & Private Companies for distribution of CNG along Delhi - Mumbai National highway (NH-8)

(Note: Please answer appropriately by placing a tick mark (√) or as required in the question concerned)

1. Some statements regarding identification of appropriate Project Execution model for distribution of CNG along NH-8 are given below. Please place a tick mark (**√**) to indicate your agreement or disagreement with the statement.

S.NO	Statements regarding distribution of CNG along NH-8	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1.	Government wants to promote CNG along national highways.					
2.	NH-8 is the best route for such a project.					
3.	NH-8 is the major artery of public transport.					
4.	In a commercial vehicle with existing specification, vehicle cannot run more than 200km on CNG fuel.					
5.	CNG requires frequent fuel refuelling than Gasoline/Diesel.					
6.	Private companies would be interested if gas supply is assured by GOI.					
7.	Regulated low Natural Gas cost is the key for the project.					
8.	Current technology lacks in duel fuel mode in diesel engines in India.					
9.	Supreme Court will have to issue directives of compulsion to convert commercial vehicles on CNG engines.					
10.	CNG distribution along NH-8 is commercially feasible.					
11.	GOI has interest to do this project solely.					
12.	Inter state government relations will play a major role in the success of the project.					
13.	Current regulatory framework allows CNG distribution along NH-8.					

2. Please Rank the following aspects of distribution of CNG along NH-8 in order of your suitability on the present scenario. Rank them on 3 point scale in order of importance (1 being the best option followed by 2 and 3).

S.NO	Ranking of project execution model for CNG distribution along NH-8	GOI	PPP	Private
1.	Early Payback period.			
2.	Easy accessibility of gas along NH-8.			
3.	Feed stock Gas price secured.			
4.	Directives to convert diesel engines into CNG.			
5.	Ease of land acquisition for pipeline and CNG dispensing stations			
6.	Low cost for executing the project.			
7.	Consumer is best served.			

SECTION C

PROJECT EXECUTION MODEL

(Government/PPP/Private)

Some statements regarding Project Execution Model are given below. Please place a tick mark (**√**) to indicate your agreement or disagreement with the statement.

S.NO	Statement Regarding Project Execution Model in India	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1.	PPP is the best option as compared to JV or any other partnership model for infrastructure projects.					
2.	PPP attracts more tax exemptions/benefits, compared to private companies.					
3.	Allocation of risks in an optimal manner between the parties of PPP is the best way to manage risks.					
4.	Innovation and diversity is an added feather to the PPP project.					
5.	Financial rewards to the private party are proportionate with the achievement of pre-specified outputs in PPP.					
6.	Lack of capital is the sole reason of increased PPP model usage.					
7.	PPP alleviates/Improves the capacity constraints and bottleneck in the economy through higher productivity.					
8.	Government plays a vital role in success of PPP projects.					
9.	Government of India have the ability manage the PPP process.					
10.	PPP projects have easy access to long term finance at lower rates.					
11.	The profits made by the private-sector in PPP model come from increased efficiencies.					
12.	The need for public-private partnerships will increase as the economy improves.					
13.	Rigidness of partners affects the performance of PPP.					
14.	Infrastructure PPP projects will generate higher employment than private company.					
15.	PPP is the best solution for socio-commercial objectives.					
16.	All partners are equally benefitted in PPP.					
17.	Parties involved in PPP projects are complimentary to each other.					
18.	Public agents are willing to forgo traditional hierarchical models in PPP.					
19.	Private player is a project executer in PPP projects.					

1. Please Rank the following aspects of Project execution model in order of your suitability on the present scenario. Rank them from 1 to 3 point scale in order of importance (1 being the best option followed by 2 and 3).

S.NO	Ranking of Project execution model	Govt.	PPP	Private
1.	Low cost execution.			
2.	Risk management.			
3.	Efficient and faster execution.			
4.	Creation of added values.			
5.	Transparent process of implementation.			
6.	Accountability to the public of India.			
7.	Achievement of economies of scale.			
8.	Quality of service.			
9.	Achievement of socio commercial goals.			
10.	Cost of funding.			
11.	Dependence on political party.			
12.	Innovation in process.			
13.	Favour of regulatory framework.			

THANK YOU

5 Annexure V: Companies participated in the survey

1. Aavantika Gas Limited
2. Adani Gas Limited
3. Antique Research
4. ARROW ENERGY
5. Avantika Gas Limited
6. Birla SunLife Asset Management Company
7. Cairn India Limited
8. Citigroup
9. CLSA
10. ConocoPhillips
11. CRISIL Research
12. Edelweiss
13. GAIL (India) Ltd
14. GAIL GAS LTD.
15. GMR ENERGY LTD
16. Green Gas Ltd
17. Gujarat Gas Company Limited
18. Gujrat State Petroelum Corporation
19. HDFC Asset Management Company Ltd.
20. HSBC Securities
21. ICF International
22. ICICI SECURITIES
23. IDFC SECURITIES
24. Indian Oil Corporation
25. Indraprastha Gas
26. Isolux
27. J.P. Morgan
28. KNR Constructions Ltd
29. Kotak Mahindra Asset Management Co.
30. Macquarie Capital Securities
31. MAHANAGAR GAS LTD
32. Maharashtra Natural Gas Limited

33. Mercados Energy Markets India Private Limited
34. MF Global Sify
35. Motilal Oswal Securities
36. Oil & Natural Gas Corporation Limited
37. ONGC Videsh Ltd.
38. PINC Research
39. Pioneer Investcorp
40. Punj Lloyd Ltd.
41. Reliance Industries Ltd
42. SAP
43. UBS
44. UTI Asset Management Co. Ltd.
45. Vayam
46. Welspun Infratech

6 Annexure VI: Capital Expenditure

Details of Capital Expenditures					
Description of Items	**Unit**	**Quantity**	**Rate (Rs/Unit)**	**Amount (Rs Cr)**	**Remark**
High Presssure Pipeline Systems					
Steel Pipe (Kota to Ajmer)	Km	202	18,000,000	364	Benckmark by GAIL
Corridor Gate Station (CGS)					
Land - CGS	Ft^2	1500	200	0.03	
Mechanical				0.35	Lumpsum Contracts
Instrumentation				0.48	Lumpsum Contracts
Electrical				0.12	Lumpsum Contracts
Fire fighting system				0.01	Lumpsum Contracts
Erection				0.54	Lumpsum Contracts
Sub total - Corridor Gate Station				**1.53**	
Corridor Pipeline Systems					
Steel Pipes	Km	737	20,000,000	1,474	
District Regulatory Systems	Nos	4	3200000	1	
Sub total - Corridor Pipeline System				**1,475**	
CNG Station Parameters					
Land	M^2	16,200	2,153	3	Current Market Price
Buildings Cost	Rs/Ft^2	8,100	8,611	7	Current Market Price
Canope Cost	Rs/Ft^2	5,400	2,153	12	Current Market Price
Booster Compressors	Nos	198	22,500,000	446	Based on BGL PO
Car dispenser	Nos	108	1,604,903	173	As per MNGL PO
Back Up Power Generator	Nos	36	500,000	2	Current Market Price
Steel Tubing Works	Nos	108	672,354	73	As per PO issued to Rhino Services
Composite Work/Dispenser	Nos	108	2,000,000	22	Lumpsum contract
PMC/Stations	Nos	18	4,000,000	72	Lumpsum contract
CCTV (5 per 150 M^2)	Nos	900	5,000	5	Current Market Price
Fire Systems	Nos	18	10,000,000	180	Lumpsum contract
Sub Total - CNG Stations				**993**	
Other Costs					
Engineering Costs				142	
Start-up and commissioning expenses				60	
Contingencies and escalation				152	
Preliminary and pre-operative expenses				32	
Sub Total - Other Cost				**385**	
Line Pack					
Pressure - Saw Steel Pipe				6	
Pressure - Steel Pipes - PE Coated				17	
Sub Total - Line Pack				**23**	
Total Capex	Rs			**3,242**	

Summary of Capex	**(Rs in Cr)**	
Land	4	
Buildings	19	
Plant & Machinary	3,197	
Line Pack	23	
Total	**3,242**	

7 Annexure VII: Pipeline Diameter by 'Panhandle Equation'

Calculations for Estimation of Pipeline Diameters

Variable used in Estimation of Diameter by Panhandle Equation as prescribed by PNGRB				
Variable	Value	Unit	Description	
	Kota - Ajmer	For Corridor		
d : Section ID	16	12	Inches	Section Internal Diameter
L : Section Length	202	738	Km	Section Length
E : Efficiency Factor	1	1	-	Panhandle Equation Pipe Condition Flow Efficiency Factor (1 for Brand New Pipe)
P1 : Inlet Pressure	8825984	7845319	Pa	Fluid Inlet Absolute Pressure
P2 : Outlet Pressure	7845319	6864655	Pa	Fluid Outlet Absolute Pressure
Z : Compressibility Factor	0.998	0.998	-	Fluid Dimensionless Compressibility Z Factor (http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=41)
T1 : Fluid Temperature	25	25	C	Fluid Absolute Temperature
S : Fluid SG Gas	0.55	0.55		Fluid Gas Specific Gravity (http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=41)

8 Annexure VIII: Financial Analysis for Private Model

Private Model

Capital Phasing	30%	40%	30%	0%	0%												
Demand Builtup	0%	0%	0%	30%	35%	40%	45%	50%	55%	60%	65%	70%	80%	90%	100%
	-	-	-	1.65	1.93	2.20	2.48	2.75	3.03	3.30	3.58	3.85	4.40	4.95	5.50
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Project Cash Flows															
Outflow	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	88	130	172	212	252	291	329	366	401	490	455	507
Net Project Cashflows	(1,004)	(1,406)	(1,107)	88	130	172	212	252	291	329	366	401	490	455	507
Project IRR	6.60%														
Equity Cash Flows															
Outflow	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	(286)	(228)	(171)	(115)	(60)	(6)	47	99	150	254	234	301
Net Project Cashflows	(351)	(492)	(387)	(286)	(228)	(171)	(115)	(60)	(6)	47	99	150	254	234	301
Project IRR	5.81%														
Profit & Loss Statements															
Revenue	-	-	-	351	409	468	526	584	643	701	760	818	935	1,052	1,169
Opex	-	-	-	254	268	283	299	316	334	354	374	395	420	446	475
Un accounted Loss	-	-	-	9	11	13	14	16	17	19	21	22	25	28	32
PBDIT	-	-	-	88	130	172	212	252	291	329	366	401	490	577	663
Depreciation	-	-	-	141	141	141	141	141	141	141	141	141	141	141	141
Interest	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
PBT	-	-	-	(274)	(216)	(159)	(104)	(48)	6	59	111	162	266	368	469
Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	122	156
PAT	-	-	-	(274)	(216)	(159)	(104)	(48)	6	59	111	162	266	246	313
Appropriation															
Dividend	-	-	-	(82)	(65)	(48)	(31)	(15)	2	18	33	48	80	74	94
Dividend Tax	-	-	-	(14)	(11)	(8)	(5)	(2)	0	3	6	8	13	12	16
Reserves	-	-	-	(178)	(141)	(104)	(67)	(32)	4	38	72	105	173	160	204
Balance Sheet															
Laibilities															
Share Capital	351	843	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	-	-	-	(178)	(319)	(422)	(490)	(521)	(518)	(479)	(407)	(302)	(130)	30	234
Loan	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Total - Laibilties	**1,004**	**2,410**	**3,517**	**3,186**	**2,893**	**2,637**	**2,417**	**2,233**	**2,085**	**1,971**	**1,890**	**1,843**	**1,863**	**1,871**	**1,922**
Assets															
Gross Block	-	-	-	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	-	-	-	141	281	422	563	703	844	985	1,125	1,266	1,407	1,547	1,688
Net Block	-	-	-	3,376	3,235	3,095	2,954	2,813	2,673	2,532	2,391	2,251	2,110	1,969	1,829
CWIP	1,004	2,410	3,517	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	-	-	-	(190)	(342)	(458)	(537)	(580)	(588)	(562)	(501)	(408)	(247)	(99)	93
Total - Assets	**1,004**	**2,410**	**3,517**	**3,186**	**2,893**	**2,637**	**2,417**	**2,233**	**2,085**	**1,971**	**1,890**	**1,843**	**1,863**	**1,871**	**1,922**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Private Model

IDC Caluculations															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Capital Cost	972	1,297	972	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	972	1,361	1,072	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	632	885	697	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	340	477	375	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	**972**	**1,361**	**1,072**	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	32	44	35	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	21	29	23	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	11	15	12	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	**653**	**1,566**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**
Cumulative Equity Funding	**351**	**843**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**
Loan Schedule															
Openining Loan	-	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610
Addition	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	-	-	-	152	152	152	152	152	152	152	152	152	152	152	152
Closing Loans	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Intrest	33	111	193	221	206	190	175	160	145	130	114	99	84	69	53
Interest CWIP	33	111	193	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
Tax Calculations															
Reported PBT	-	-	-	(274)	(216)	(159)	(104)	(48)	6	59	111	162	266	368	469
Cumulative PBT	-	-	-	(274)	(490)	(650)	(753)	(802)	(796)	(737)	(627)	(465)	(199)	169	637
Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	122	156
DSCR Calculations															
Yearwise DSCR	-	-	-	0.23	0.36	0.50	0.65	0.81	0.98	1.17	1.37	1.60	2.07	2.06	2.46
Min DSCR	0.23														
Average DSCR	1.48														

Private Model															
Capital Phasing Demand Builtup	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Year	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41
Project Cash Flows															
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	486	464	442	421	402	382	360	338	315	290	264	237	209	-	-
Net Project Cashflows	486	464	442	421	402	382	360	338	315	290	264	237	209	-	-
Project IRR															
Equity Cash Flows															
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	296	289	282	421	402	382	360	338	315	290	264	237	209	-	-
Net Project Cashflows	296	289	282	421	402	382	360	338	315	290	264	237	209	-	-
Project IRR															
Profit & Loss Statements															
Revenue	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	1,169	-	-
Opex	498	523	549	577	606	636	668	701	736	773	812	852	895	-	-
Un accounted Loss	32	32	32	32	32	32	32	32	32	32	32	32	32	-	-
PBDIT	639	614	588	561	532	501	470	436	401	364	326	285	242	-	-
Depreciation	141	141	141	141	141	141	141	141	141	141	141	141	141	-	-
Interest	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
PBT	460	451	440	420	391	361	329	296	260	224	185	144	102	-	-
Tax	153	150	146	139	130	120	109	98	87	74	61	48	34	-	-
PAT	**307**	**301**	**294**	**280**	**261**	**241**	**220**	**197**	**174**	**149**	**124**	**96**	**68**	-	-
Appropriation															
Dividend	92	90	88	84	78	72	66	59	52	45	37	29	20	-	-
Dividend Tax	15	15	15	14	13	12	11	10	9	7	6	5	3	-	-
Reserves	200	196	191	182	170	157	143	128	113	97	80	63	44	-	-
Balance Sheet															
Laibilities															
Share Capital	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	434	629	820	1,002	1,172	1,329	1,472	1,600	1,713	1,810	1,890	1,953	1,997	1,997	1,997
Loan	305	152	-	-	-	-	-	-	-	-	-	-	-	-	-
Total - Laibilties	**1,969**	**2,012**	**2,051**	**2,233**	**2,403**	**2,560**	**2,702**	**2,831**	**2,944**	**3,041**	**3,121**	**3,184**	**3,228**	**3,228**	**3,228**
Assets															
Gross Block	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	1,829	1,969	2,110	2,251	2,391	2,532	2,673	2,813	2,954	3,095	3,235	3,376	3,517	3,517	3,517
Net Block	1,688	1,547	1,407	1,266	1,125	985	844	703	563	422	281	141	-	-	-
CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	281	465	644	967	1,278	1,575	1,858	2,127	2,381	2,619	2,840	3,043	3,228	3,228	3,228
Total - Assets	**1,969**	**2,012**	**2,051**	**2,233**	**2,403**	**2,560**	**2,702**	**2,831**	**2,944**	**3,041**	**3,121**	**3,184**	**3,228**	**3,228**	**3,228**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Private Model

IDC Caluculations	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41
Capital Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286
Cumulative Equity Funding	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Loan Schedule															
Openining Loan	457	305	152	-	-	-	-	-	-	-	-	-	-	-	-
Addition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	152	152	152	-	-	-	-	-	-	-	-	-	-	-	-
Closing Loans	305	152	-	-	-	-	-	-	-	-	-	-	-	-	-
Intrest	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
Interest CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
Tax Calculations															
Reported PBT	460	451	440	420	391	361	329	296	260	224	185	144	102	-	-
Cumulative PBT	1,098	1,548	1,988	2,408	2,799	3,160	3,488	3,784	4,044	4,268	4,453	4,598	4,699	4,699	4,699
Tax	153	150	146	139	130	120	109	98	87	74	61	48	34	-	-
DSCR Calculations															
Yearwise DSCR	2.55	2.65	2.76	-	-	-	-	-	-	-	-	-	-	-	-
Min DSCR															
Average DSCR															

9 Annexure IX: Financial Analysis for Government Model

Government Model

Capital Phasing	30%	40%	30%	0%	0%										
Demand Builtup	0%	0%	0%	30%	35%	40%	45%	50%	55%	60%	65%	70%	80%	90%	100%
	-	-	-	1.65	1.93	2.20	2.48	2.75	3.03	3.30	3.58	3.85	4.40	4.95	5.50
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Project Cash Flows															
Outflow	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	400	461	520	579	638	696	753	810	865	993	1,120	1,246
Net Project Cashflows	(1,004)	(1,406)	(1,107)	400	461	520	579	638	696	753	810	865	993	1,120	1,246
Project IRR	16.76%														
Equity Cash Flows															
Outflow	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	27	103	178	252	326	399	471	543	614	757	899	1,041
Net Project Cashflows	(351)	(492)	(387)	27	103	178	252	326	399	471	543	614	757	899	1,041
Project IRR	22.57%														
Profit & Loss Statements															
Revenue	-	-	-	683	797	910	1,024	1,138	1,252	1,366	1,479	1,593	1,821	2,048	2,276
Opex	-	-	-	254	268	283	299	316	334	354	374	395	420	446	475
Un accounted Loss	-	-	-	9	11	13	14	16	17	19	21	22	25	28	32
PBDIT	-	-	-	420	518	615	711	806	900	993	1,085	1,176	1,376	1,574	1,770
Depreciation	-	-	-	141	141	141	141	141	141	141	141	141	141	141	141
Interest	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
PBT	-	-	-	58	171	283	395	505	615	723	830	937	1,151	1,364	1,576
Tax	-	-	-	19	57	94	131	168	204	240	276	311	382	453	523
PAT	-	-	-	39	114	189	264	337	410	483	555	625	769	911	1,052
Appropriation															
Dividend	-	-	-	12	34	57	79	101	123	145	166	188	231	273	316
Dividend Tax	-	-	-	2	6	9	13	17	20	24	28	31	38	45	52
Reserves	-	-	-	25	74	123	171	219	267	314	361	407	500	592	684
Balance Sheet															
Laibilities															
Share Capital	351	843	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	-	-	-	25	100	223	394	613	880	1,194	1,555	1,961	2,461	3,054	3,738
Loan	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Total - Laibilties	**1,004**	**2,410**	**3,517**	**3,390**	**3,312**	**3,282**	**3,301**	**3,368**	**3,483**	**3,644**	**3,852**	**4,106**	**4,454**	**4,894**	**5,426**
Assets															
Gross Block	-	-	-	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	-	-	-	141	281	422	563	703	844	985	1,125	1,266	1,407	1,547	1,688
Net Block	-	-	-	3,376	3,235	3,095	2,954	2,813	2,673	2,532	2,391	2,251	2,110	1,969	1,829
CWIP	1,004	2,410	3,517	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	-	-	-	14	76	187	347	555	810	1,112	1,461	1,856	2,344	2,925	3,597
Total - Assets	**1,004**	**2,410**	**3,517**	**3,390**	**3,312**	**3,282**	**3,301**	**3,368**	**3,483**	**3,644**	**3,852**	**4,106**	**4,454**	**4,894**	**5,426**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Government Model													
Capital Phasing													
Demand Builtup	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
	16	17	18	19	20	21	22	23	24	25	26	27	28
Year	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39
Project Cash Flows													
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	1,226	1,204	1,181	1,160	1,141	1,121	1,100	1,077	1,054	1,029	1,004	976	948
Net Project Cashflows	1,226	1,204	1,181	1,160	1,141	1,121	1,100	1,077	1,054	1,029	1,004	976	948
Project IRR													
Equity Cash Flows													
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	1,035	1,029	1,021	1,160	1,141	1,121	1,100	1,077	1,054	1,029	1,004	976	948
Net Project Cashflows	1,035	1,029	1,021	1,160	1,141	1,121	1,100	1,077	1,054	1,029	1,004	976	948
Project IRR													
Profit & Loss Statements													
Revenue	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276	2,276
Opex	498	523	549	577	606	636	668	701	736	773	812	852	895
Un accounted Loss	32	32	32	32	32	32	32	32	32	32	32	32	32
PBDIT	1,746	1,721	1,695	1,668	1,639	1,609	1,577	1,543	1,508	1,471	1,433	1,392	1,350
Depreciation	141	141	141	141	141	141	141	141	141	141	141	141	141
Interest	38	23	8	-	-	-	-	-	-	-	-	-	-
PBT	1,567	1,558	1,547	1,527	1,498	1,468	1,436	1,403	1,368	1,331	1,292	1,252	1,209
Tax	521	517	514	507	498	488	477	466	454	442	429	416	402
PAT	**1,047**	**1,040**	**1,033**	**1,020**	**1,000**	**980**	**959**	**937**	**913**	**889**	**863**	**836**	**807**
Appropriation													
Dividend	314	312	310	306	300	294	288	281	274	267	259	251	242
Dividend Tax	52	52	51	51	50	49	48	47	46	44	43	42	40
Reserves	681	676	672	663	650	637	624	609	594	578	561	543	525
Balance Sheet													
Laibilities													
Share Capital	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	4,418	5,095	5,766	6,429	7,080	7,717	8,341	8,950	9,544	10,121	10,682	11,226	11,751
Loan	305	152	-	-	-	-	-	-	-	-	-	-	-
Total - Laibilties	**5,954**	**6,478**	**6,997**	**7,660**	**8,311**	**8,948**	**9,572**	**10,181**	**10,774**	**11,352**	**11,913**	**12,457**	**12,982**
Assets													
Gross Block	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	1,829	1,969	2,110	2,251	2,391	2,532	2,673	2,813	2,954	3,095	3,235	3,376	3,517
Net Block	1,688	1,547	1,407	1,266	1,125	985	844	703	563	422	281	141	-
CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	4,266	4,931	5,591	6,394	7,185	7,963	8,728	9,477	10,212	10,930	11,632	12,316	12,982
Total - Assets	**5,954**	**6,478**	**6,997**	**7,660**	**8,311**	**8,948**	**9,572**	**10,181**	**10,774**	**11,352**	**11,913**	**12,457**	**12,982**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-

Government Model

IDC Caluculations															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Capital Cost	972	1,297	972	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	972	1,361	1,072	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	632	885	697	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	340	477	375	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	**972**	**1,361**	**1,072**	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	32	44	35	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	21	29	23	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	11	15	12	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	**653**	**1,566**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**
Cumulative Equity Funding	**351**	**843**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**
Loan Schedule															
Openining Loan	-	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610
Addition	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	-	-	-	152	152	152	152	152	152	152	152	152	152	152	152
Closing Loans	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Intrest	33	111	193	221	206	190	175	160	145	130	114	99	84	69	53
Interest CWIP	33	111	193	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
Tax Calculations															
Reported PBT	-	-	-	58	171	283	395	505	615	723	830	937	1,151	1,364	1,576
Cumulative PBT	-	-	-	58	229	513	907	1,412	2,027	2,750	3,580	4,517	5,668	7,033	8,608
Tax	-	-	-	19	57	94	131	168	204	240	276	311	382	453	523
DSCR Calculations															
Yearwise DSCR	-	-	-	1.07	1.29	1.52	1.77	2.04	2.34	2.67	3.04	3.44	4.21	5.07	6.06
Min DSCR	1.07														
Average DSCR	3.68														

Government Model

IDC Caluculations													
	15	16	17	18	19	20	21	22	23	24	25	26	27
	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39
Capital Cost	-	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286
Cumulative Equity Funding	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Loan Schedule													
Openining Loan	457	305	152	-	-	-	-	-	-	-	-	-	-
Addition	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	152	152	152	-	-	-	-	-	-	-	-	-	-
Closing Loans	305	152	-	-	-	-	-	-	-	-	-	-	-
Intrest	38	23	8	-	-	-	-	-	-	-	-	-	-
Interest CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	38	23	8	-	-	-	-	-	-	-	-	-	-
Tax Calculations													
Reported PBT	1,567	1,558	1,547	1,527	1,498	1,468	1,436	1,403	1,368	1,331	1,292	1,252	1,209
Cumulative PBT	10,176	11,734	13,280	14,807	16,306	17,773	19,209	20,612	21,980	23,310	24,603	25,854	27,063
Tax	521	517	514	507	498	488	477	466	454	442	429	416	402
DSCR Calculations													
Yearwise DSCR	6.43	6.87	7.38	-	-	-	-	-	-	-	-	-	-
Min DSCR													
Average DSCR													

PPP Model															
Capital Phasing	30%	40%	30%	0%	0%										
Demand Builtup	0%	0%	0%	30%	35%	40%	45%	50%	55%	60%	65%	70%	80%	90%	100%
	-	-	-	1.65	1.93	2.20	2.48	2.75	3.03	3.30	3.58	3.85	4.40	4.95	5.50
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Project Cash Flows															
Outflow	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	363	418	471	524	576	628	679	729	779	895	1,009	1,123
Net Project Cashflows	(1,004)	(1,406)	(1,107)	363	418	471	524	576	628	679	729	779	895	1,009	1,123
Project IRR	15.48%														
Equity Cash Flows															
Outflow	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	-	-	-	(10)	59	128	196	264	331	397	463	527	658	788	917
Net Project Cashflows	(351)	(492)	(387)	(10)	59	128	196	264	331	397	463	527	658	788	917
Project IRR	20.34%														
Profit & Loss Statements															
Revenue	-	-	-	627	732	837	941	1,046	1,150	1,255	1,359	1,464	1,673	1,882	2,091
Opex	-	-	-	254	268	283	299	316	334	354	374	395	420	446	475
Un accounted Loss	-	-	-	9	11	13	14	16	17	19	21	22	25	28	32
PBDIT	-	-	-	364	453	541	627	713	798	882	965	1,047	1,228	1,407	1,585
Depreciation	-	-	-	141	141	141	141	141	141	141	141	141	141	141	141
Interest	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
PBT	-	-	-	3	107	209	312	413	513	612	710	807	1,003	1,198	1,391
Tax	-	-	-	1	35	70	103	137	170	203	236	268	333	398	462
PAT	**-**	**-**	**-**	**2**	**71**	**140**	**208**	**276**	**343**	**409**	**474**	**539**	**670**	**800**	**929**
Appropriation															
Dividend	-	-	-	1	21	42	62	83	103	123	142	162	201	240	279
Dividend Tax	-	-	-	0	4	7	10	14	17	20	24	27	33	40	46
Reserves	-	-	-	1	46	91	135	179	223	266	308	351	436	520	604
Balance Sheet															
Laibilities															
Share Capital	351	843	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	-	-	-	1	47	138	274	453	676	941	1,250	1,600	2,036	2,556	3,160
Loan	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Total - Laibilties	**1,004**	**2,410**	**3,517**	**3,366**	**3,259**	**3,198**	**3,181**	**3,208**	**3,278**	**3,391**	**3,547**	**3,745**	**4,029**	**4,397**	**4,848**
Assets															
Gross Block	-	-	-	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	-	-	-	141	281	422	563	703	844	985	1,125	1,266	1,407	1,547	1,688
Net Block	-	-	-	3,376	3,235	3,095	2,954	2,813	2,673	2,532	2,391	2,251	2,110	1,969	1,829
CWIP	1,004	2,410	3,517	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	-	-	-	(11)	24	103	227	394	605	859	1,156	1,495	1,919	2,427	3,020
Total - Assets	**1,004**	**2,410**	**3,517**	**3,366**	**3,259**	**3,198**	**3,181**	**3,208**	**3,278**	**3,391**	**3,547**	**3,745**	**4,029**	**4,397**	**4,848**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PPP Model

Capital Phasing															
Demand Builtup	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Year	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41
Project Cash Flows															
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	1,102	1,080	1,058	1,037	1,018	998	976	954	931	906	880	853	825	-	-
Net Project Cashflows	1,102	1,080	1,058	1,037	1,018	998	976	954	931	906	880	853	825	-	-
Project IRR															
Equity Cash Flows															
Outflow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inflows	912	905	898	1,037	1,018	998	976	954	931	906	880	853	825	-	-
Net Project Cashflows	912	905	898	1,037	1,018	998	976	954	931	906	880	853	825	-	-
Project IRR															
Profit & Loss Statements															
Revenue	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	2,091	-	-
Opex	498	523	549	577	606	636	668	701	736	773	812	852	895	-	-
Un accounted Loss	32	32	32	32	32	32	32	32	32	32	32	32	32	-	-
PBDIT	1,561	1,536	1,510	1,483	1,454	1,424	1,392	1,359	1,323	1,287	1,248	1,207	1,165	-	-
Depreciation	141	141	141	141	141	141	141	141	141	141	141	141	141	-	-
Interest	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
PBT	1,383	1,373	1,362	1,342	1,313	1,283	1,251	1,218	1,183	1,146	1,107	1,067	1,024	-	-
Tax	459	456	452	446	436	426	416	405	393	381	368	354	340	-	-
PAT	**923**	**917**	**910**	**896**	**877**	**857**	**836**	**813**	**790**	**765**	**740**	**712**	**684**	**-**	**-**
Appropriation															
Dividend	277	275	273	269	263	257	251	244	237	230	222	214	205	-	-
Dividend Tax	46	46	45	45	44	43	42	41	39	38	37	35	34	-	-
Reserves	600	596	591	583	570	557	543	529	514	498	481	463	445	-	-
Balance Sheet															
Laibilities															
Share Capital	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Reserves	3,761	4,357	4,948	5,531	6,101	6,658	7,202	7,730	8,244	8,742	9,222	9,686	10,130	10,130	10,130
Loan	305	152	-	-	-	-	-	-	-	-	-	-	-	-	-
Total - Laibilties	**5,296**	**5,740**	**6,179**	**6,762**	**7,332**	**7,889**	**8,432**	**8,961**	**9,475**	**9,972**	**10,453**	**10,916**	**11,361**	**11,361**	**11,361**
Assets															
Gross Block	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Less Dep	1,829	1,969	2,110	2,251	2,391	2,532	2,673	2,813	2,954	3,095	3,235	3,376	3,517	3,517	3,517
Net Block	1,688	1,547	1,407	1,266	1,125	985	844	703	563	422	281	141	-	-	-
CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current Asset	3,608	4,193	4,772	5,496	6,207	6,904	7,588	8,258	8,912	9,550	10,172	10,776	11,361	11,361	11,361
Total - Assets	**5,296**	**5,740**	**6,179**	**6,762**	**7,332**	**7,889**	**8,432**	**8,961**	**9,475**	**9,972**	**10,453**	**10,916**	**11,361**	**11,361**	**11,361**
Recon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PPP Model

IDC Caluculations															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26
Capital Cost	972	1,297	972	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	972	1,361	1,072	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	632	885	697	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	340	477	375	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	**972**	**1,361**	**1,072**	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	32	44	35	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	21	29	23	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	11	15	12	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	1,004	1,406	1,107	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	351	492	387	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	**653**	**1,566**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**	**2,286**
Cumulative Equity Funding	**351**	**843**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**
Loan Schedule															
Openining Loan	-	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610
Addition	653	914	720	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	-	-	-	152	152	152	152	152	152	152	152	152	152	152	152
Closing Loans	653	1,566	2,286	2,133	1,981	1,829	1,676	1,524	1,372	1,219	1,067	914	762	610	457
Intrest	33	111	193	221	206	190	175	160	145	130	114	99	84	69	53
Interest CWIP	33	111	193	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	-	-	-	221	206	190	175	160	145	130	114	99	84	69	53
Tax Calculations															
Reported PBT	-	-	-	3	107	209	312	413	513	612	710	807	1,003	1,198	1,391
Cumulative PBT	-	-	-	3	109	319	630	1,043	1,556	2,168	2,878	3,686	4,689	5,887	7,278
Tax	-	-	-	1	35	70	103	137	170	203	236	268	333	398	462
DSCR Calculations															
Yearwise DSCR	-	-	-	0.97	1.17	1.37	1.60	1.84	2.11	2.41	2.73	3.10	3.79	4.57	5.46
Min DSCR	0.97														
Average DSCR	3.31														

PPP Model

IDC Caluculations															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41
Capital Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capital Cost after Escaltion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Check for Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IDC - Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capex Including IDC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equity Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative Debt Funding	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286	2,286
Cumulative Equity Funding	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231
Loan Schedule															
Openining Loan	457	305	152	-	-	-	-	-	-	-	-	-	-	-	-
Addition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayments	152	152	152	-	-	-	-	-	-	-	-	-	-	-	-
Closing Loans	305	152	-	-	-	-	-	-	-	-	-	-	-	-	-
Intrest	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
Interest CWIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest P&L	38	23	8	-	-	-	-	-	-	-	-	-	-	-	-
Tax Calculations															
Reported PBT	1,383	1,373	1,362	1,342	1,313	1,283	1,251	1,218	1,183	1,146	1,107	1,067	1,024	-	-
Cumulative PBT	8,661	10,034	11,396	12,738	14,051	15,335	16,586	17,804	18,986	20,132	21,240	22,307	23,331	23,331	23,331
Tax	459	456	452	446	436	426	416	405	393	381	368	354	340	-	-
DSCR Calculations															
Yearwise DSCR	5.79	6.17	6.61	-	-	-	-	-	-	-	-	-	-	-	-
Min DSCR															
Average DSCR															

Personal Resume

Shivaraj Bhor,

Qualified Cost Accountant with Graduation in Engineering & PG from NITIE

Professional Summary

- **Management Accounting** – MIS, Profit Projection, Costing, Variance Analysis, Revenue Maximization
- **Finance Management** - Budgeting, Financial Modelling, Investor Relations, Project Appraisal
- **Strategy Development** - Corporate Planning, Environmental Scanning, Strategic Planning

IT Skills

- ERP – **SAP User**
- Excellent **Microsoft Excel and Power Point Presentation** Skills
- **Ideas – 8** (CAD/CAM)
- **AutoCAD R-14** (for drafting)

Professional Experience

» **GAIL (India) Limited, Delhi, India**

Deputy Manager – Management Accounting

(A Dept of Corporate F&A for enabling quickly analyze/present business performance. This function delivers the necessary, timeliness & Quality Data/Information to Management for decision making)

Tenure: From April 2003 to Till Date

GAIL (India) Limited, is India's flagship Natural Gas company, integrating all aspects of the Natural Gas value chain (including Exploration & Production, Processing, Transmission, Distribution and Marketing) and its related services. (www.gailonline.com)

Key Responsibility Areas:

- **Data Manager:** To mange & Provide the company data to the management as and when required
- **MIS & Reporting** - Monthly, Quarterly, Annual Review
- **Analysis of Business Segments:** Collecting and analyzing the financial and physical performance.

- **Corporate Planning / Budgeting:** Cross functional activity for Planning & achieving the company's Mission & Vision
- **Annual Report Preparation:** Directors Report and Management Discussion & Analysis preparation
- **Strategy & Scenario development:** By providing time focus historic data and analysis, to develop the short and long term strategies.
- **Project Evaluation:** Evaluation of Project Proposals for putting up to Board for Investment Decisions.
- **Effort for profit maximization:** Tracking the revenue and expenses periodically w.r.t. previous period & Budget for profit maximization
- **Cost Reduction:** Suggest technically, economically feasible and plausible solutions for cost reduction.
- **Analysis of impact of external environment on Business & Operations:** Impact of fluctuation in Exchange rate, Product Prices & Government Budget, Tax etc on Business.
- **Investor Relations:** Presentations to Analysts, Fund Managers, Investors etc
- **Financial Statement Analysis:** In-depth & Critical analysis of financial position of the organization.

Key Achievements:

- **Management Information Specialist** – Providing/Analyzing Quick diversified data on Business Performance
- **Developed excel based models for MIS like** Profitability, Cost, Debtors, Variance Analysis etc
- Developed 10 year **Business Plan** for GAIL
- Developed **Revenue Maximization** Model for GAIL
- **Developed Excel based Business Intelligence Software (BIS) Model** which provides drill down real time data
- **CARR & Cost Audit**: Coordinated for CARR implementation & Cost Audit in LPG recovery plant
- Entry Prepared for GAIL to **Won ICWAI National Award for Excellence in Cost Management**
- **Resourceful personality** by communicating effectively with various department and agencies of GAIL and GoI

» **Jaya Hind Industries Limited, (A Sister concern of Baja Tempo Ltd) Pune**

Engineer

Tenure: From October 1999 to June 2001

Jaya Hind Industries Limited (JHIL) is a sister concern of commercial vehicles major, Force Motors which is into auto-component division for Force Motors manufacturing world class foundry products, Electronic & transmission parts for automotive industry.

(www.jayahind.com)

Key Responsibility Areas:

- **Product Design and Development:** Designing of clutches for all vehicles manufactured by JHI, and other four wheeler manufacturers.
- **Product Feasibility Reports (PFR):** Deciding basic specifications, time schedule, technology & technology provider, nature of work required, capacity, raw material, location, resources etc
- **Project Planning:** Planning of R&D activities for forthcoming products
- **Process Planning:** Shop floor process planning of the assembly lines.
- **Tool design:** Press tools, Gauges and Fixtures designing, required for the production of clutches
- **Testing:** Testing of Products for endurance, fatigue, and static test for assembly fittings, individual part testing for life estimation
- **Value engineering: V**alue engineering on Trax and Travaller (4 - wheeler L.C.V.)
- **Reverse Engineering:** Develop the proved design of other brands, covering all the activities from assembly drawing to end product testing on the vehicle.
- **Data Analysis:** Data related to quality, performance, failure analysis, etc
- **ISO 9000:** Drafting, Maintaining, Reviewing
- Creation of **Bill of Material** for various Clutches
- **MRP:** Material requirement planning for Pilot design.
- **DQM:** Drafting, Maintaining, Reviewing, and updating of departmental quality manual
- **Warranty analysis:** Analyzing the warranty rejection of clutches and taking necessary correctives measures

Key Achievements:

- **Product design:** Worked as a product designer for clutches Minidor (3 - wheeler), Excel-6 (4-wheeler L.C.V.) and Mirador (3-wheeler C.N.G.) of BTL & Maruti – 800, Mahindra-Commander
- **Project Feasibility Report:** Maruti 800- Ø160 clutch manufacturing & supplying it to western region.
- Lead assessor for ISO 9002 audit

Professional Training Undertaken at GAIL (India) Limited

Microsoft Office, October 2005

Finance for Managers, January 2008

Creativity & Innovation, March 2009

International Financial Reporting Standards, November 2009

Education Qualifications

Pursing PhD from University of Petroleum and Energy Studies

Cost/Management Accountancy, 2008

Institute of Cost & Work Accountants of India

Post Graduate Diploma in Industrial Engineering, 2003

National Institute of Industrial Engineering - First Class

Mechanical Engineering, 1999

Pune University, Pune – Distinction

Personal Information

Father's Name: Shri Namdeo Bhor

Date of Birth: 7th March 1978

(Shivaraj Bhor)

Date: 21st March 2011 **Place:** New Delhi