

A REPORT
ON
**IMPLEMENTATION OF CNG PROJECTS
IN GUJARAT**

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IMPLEMENTATION OF CNG PROJECTS IN GUJARAT

Chapter 1

INTRODUCTION

CNG appears to be a writing on the wall in Gujarat, at least as far as the cities of Ahmedabad, Surat and Vadodara are concerned. As may be seen from Table-1 below, with the increase in overall vehicle population exceeding that of Delhi and Mumbai, it was only to be expected that Ahmedabad will be identified as one of the "dirty" cities in the country requiring urgent action plans for compulsory switch over of all motor vehicles to CNG / LPG under the directions of the Supreme Court of India by the Central Government.

Table-1

Percentage increase in vehicle population (1985-2001).	
Ahmedabad	490
Delhi	422
Mumbai	335

Source : Mashelkar Committee Report, 2002 on Autofuels.

The story is more alarming in the Districts of Surat and Vadodara where the overall growth in vehicle population in the comparative period 1985-2001 has exceeded not only Delhi and Mumbai, but Ahmedabad also in case of Surat and comparable to Ahmedabad in case of Vadodara, as may be seen from the Table-2 below :

Table-2

Percentage increase in vehicle population (1985-2001).	
Ahmedabad	490
Surat	782
Vadodara	472

High proportion of two-wheelers in India and Gujarat.

There is a high proportion of two-wheelers in all major cities of Asia, India in particular and Gujarat more so as may be seen from Table-3 below :

Table-3

Proportion of Different Vehicles in Delhi, Mumbai, Ahmedabad, Surat and Vadodara.						
City	Two Wheelers	Three Wheelers	Cars / Cabs	Buses	Tractors/ Others	Goods Carriages
Delhi	63.8	2.5	27.9	1.3	-	4.6
Mumbai	46.2	12.5	32.2	1.2	0.5	7.3
Ahmedabad	71.5	5.2	12.9	1.7	5.1	3.5
Surat	80.1	4.4	8.8	0.2	1.7	4.5
Vadodara	75.2	3.6	9.8	0.2	5.1	6.0

Source : Mashelkar Committee Report.

Table-4 depicts the increase in different types of vehicles for the past 10 years in the cities of Delhi, Mumbai, Ahmedabad, Surat and Vadodara. It may be seen that Surat has registered spectacular rise in all types of vehicles.

Table-4

Increase in Different Vehicle Types in Last 10 Years				
City	Two Wheelers	Three Wheelers	Cars	Buses
Delhi	391	290	595	352
Mumbai	471	658	232	Reduction
Ahmedabad	612	301	529	47
Surat	888	602	851	1128
Vadodara	538	240	576	401

Source : Mashelkar Committee Report.

Chapter 2

OVERVIEW OF VEHICULAR POLLUTION IN GUJARAT

- 2.1 The Central Pollution Control Board (CPCB) has estimated that between 50 and 70% of the air pollution in most cities is caused by vehicles.

It is well known that the chief pollutants of vehicular exhaust are carbon monoxide (CO) and nitrogen oxide (NOx) and respirable suspended particulate matter (RSPM). A fact, little appreciated, is that out of these pollutants, carbon monoxide (CO) is more hazardous from the health point of view and then NOx and then RSPM (in that order). A high proportion of CO in automobile exhaust is indicative of inefficient combustion.

The irritation in the eyes is a common experience at traffic junctions in all our major cities. This eye irritation is mainly caused by NOx and CO. **Annexure-1** lists the effects of various vehicular pollutants on humans.

From the Annexure, it may be seen that carbon monoxide aggravates heart disorders and impairs oxygen carrying capacity of the blood besides the irritation of respiratory tract, NOx and the hydro carbon emission result in drowsiness, eye irritation, coughing etc. – experienced so commonly in Ahmedabad, Surat and Vadodara.

2.2 Contribution of Vehicle Exhaust to Air Pollution

Various studies have been carried out in India and abroad for the contribution of vehicular exhaust to air pollution. Table-5 indicates the contribution of various pollutants in countries like UK, USA, Delhi and Mumbai.

Table-5

Contribution of vehicular exhaust to air pollution in per cent.				
	U.K.	U.S.A.	Delhi	Mumbai
CO	90	70	76 – 90	92
Nox	51	39	66 – 74	60
PM ₁₀ (RSPM)	-	32	3 - 22	0- 16
For achieving significant reductions in CO, transport sector needs to be targeted.				

Source : Central Pollution Control Board (CPCB)

The Central Pollution Control Board of India has stated that for achieving significant reductions in CO and NOx, transport sector needs to be targeted.

2.3 Annual Levels of Pollutants in Gujarat Cities.

Table-6 depicts the annual average concentration of various pollutants in the ambient air in residential areas of Delhi, Ahmedabad, Surat and Vadodara against the backdrop of the respective national standards shown.

Table-6

Annual average concentration in ambient air in residential areas in the year 2000.					
	National standard	Delhi	Ahmedabad	Surat	Vadodara
SPM mg/m ³	140	368	272	274 (1995)	256 (1995)
RSPM	60	180	198	-	48 (2001)
Nox	60	33.7	35.2	20.4	20.4 (1995)
CO	Not monitored				

From the table, it may be seen that CO, the most harmful of the pollutants is not being monitored on a regular basis in the Country and also in Gujarat.

However, it is well known that CO is primarily contributed by the transport sector. Even in European countries, it used to be as high as 60% in 1995 when Euro-II standards were introduced. Limited studies for Delhi and Mumbai show much higher contribution of CO i.e of the order of 90 per cent. Ahmedabad, Surat, Vadodara can be no different, if not worse. This fact underscores the need for monitoring CO at important locations.

Further, it may be seen that the SPM and RSPM levels are quite high in the cities of Ahmedabad, Surat and Vadodara and that the RSPM level in Ahmedabad is much higher than the national standard, but also higher than Delhi.

Oxygen Bars launched at Ahmedabad

It is a well known fact that Ahmedabad Traffic Department of Police had to launch Oxygen Bars in December, 2002 for the public and the traffic policemen at various cross roads and kerb junction.

- 2.4** From the foregoing, it may be seen that the cities of Ahmedabad, Surat and Vadodara are highly polluted and there is an urgent need for switch over of the autofuels to CNG/LPG, especially with the enforcement of Euro-II (Bharat Stage-II) standard for auto emissions.

CNG & OTHER AUTOFUELS

Before embarking upon any planning exercise for CNG in Gujarat, it will be worthwhile if a brief description of other alternative fuels is given.

3.1 Alternative Autofuels.

U.S. Dept. of Energy recognises Methanol, Denatured Ethanol as Alcohol Fuels (alcohol mixtures that contain not less than 70% of the alcohol fuel), Natural Gas (compressed or liquified), Liquified Petroleum Gas, Hydrogen (Fuel Cell), Coal derived Liquid Fuels, Fuels derived from Biological Materials, Electricity (including Solar Energy).

As against this, in India, we may state that any fuel, which is more environment friendly than the presently available fuels, can be termed as Alternative Fuel. In order of environment friendliness, various Autofuels may be ranked as follows :

- Fuel Cell
- CNG
- LPG
- Ethanol
- Ethanol mixed Petrol
- Unleaded Petrol
- Petrol
- Low Sulphur Diesel
- Diesel.

Electricity and Solar energy will also be more environment friendly, though not in vogue presently.

3.2 Fuel Cell

Fuel Cells run on hydrogen are stated to have a zero pollution factor and termed to be the ultimate in terms of technology as far as autofuels are concerned. The research for this technology which has now been commercialised was funded by the U.S. Department of Energy and well known Automakers like Mitsubishi, Daimler-Chrysler, Ford, etc.

Annexure-2 depicts Toyota of Japan and Nissan Auto Company embarking upon fuel cell vehicles.

Fuel Cell News - November, 2002

In November, 2002, the City of Los Angeles became USA's first customer for fuel cell car when the City Mayor received a fuel cell car. Further, the City of Los Angeles took delivery of first five vehicles by the end of December, 2002. The Honda FCX used by the City of Los Angeles has been certified by the California Air Resources Board and EPA as a zero emission vehicle. It uses hydrogen supplied to a fuel cell stack to generate electricity and power its electric motor. With a maximum output of 80 horsepower and 201 foot-pounds of torque, acceleration is similar to a Honda Civic. The FCX has a possible range of 220 miles and seats four people.

Honda plans to lease about 30 fuel cell cars in California and Japan during the next two to three years, but has no plans for mass-market or individual sales.

In India, several agencies, principally MNES have supported projects on different types of Fuel Cell technology with the involvement of National Laboratories, Research Institutions, Universities and Industries with an aim to develop suitable material, catalysts and components and to strengthen manufacturing base for production of Fuel Cells in the country. Efforts are being made towards development and demonstration of application of fuel cell systems for decentralised power generation and automobile applications.

However, it can be concluded that Fuel Cell is a futuristic technology as far as India is concerned.

We, as project and management consultants, have been advocating pilot plan trials in Gujarat for Fuel Cells not only in Buses and Transport Vehicles, but also for Decentralised Generation of Power. There are only two companies in the world producing Fuel Cell and we are in intimate contact with one of them, the Fuel Cell Energy Company at Danbury, USA.

3.3 Other Autofuels

As stated in the foregoing, other autofuels such as LPG, Ethanol, Ethanol Mixed Petrol etc. rank lower in terms of environment friendliness compared to CNG.

3.4 Compressed Natural Gas (CNG)

Compressed Natural Gas, therefore, is the best available environment friendly autofuel in India, for Western India in particular (and hopefully in Eastern India in near future) with the availability of natural gas and the long coastline permitting the import of LNG. This is in line with the thinking of the Mashelkar's Committee on Autofuels which has stated that the choice of Autofuel and the Autofuel Policy should be region specific.

3.5 Advantages of CNG

CNG has a number of advantages over the conventional fuels as listed below :

- CNG is the most economical and environment friendly fuel available.
- Though the initial cost of conversion kit may seem to be high, the same can be recovered in less than 2 years because of low operating cost.
- CNG is environment friendly. No cancer causing particulates, less carbon monoxide and hydro carbon emissions, less ground level ozone contamination and Green House gases effects.

- CNG is much safer than Gasolene, Diesel fuels or LPG. If released, CNG does not liquify or accumulate. It dissipates natural gas lighter than air and thus less prone to ignite or explode.
- CNG reduces engine wear, more than doubling engine life because CNG burns clean and leaves no carbon deposits.
- CNG offers lower maintenance cost. It is a dry gaseous fuel and does not dilute the lubricating oil, thus saving on oil filters and oil changing. Intervals between tune ups for CNG vehicles are stated to be more than 70,000 kms.
- If CNG is used, there is complete freedom from adulteration by solvents, kerosene or any other harmful substance.
- Because CNG is already in a gaseous state, it offers superior drivability even under severe hot and cold weather conditions.
- CNG has a high Octane number when compared with Petrol/Diesel which makes it superior in terms of combustion efficiency.
- Per unit of energy natural gas contains less carbon than any other fossil fuel and therefore produces lower CO₂ emission per vehicle k.m. travelled.
- World-wide it is believed that Natural Gas costs 1/3rd less than conventional gasoline.

3.6 Emissions with CNG V/s Conventional Fuels

Various studies and reports by agencies like Centre for Science and Environment (CSE), ARAI and VRDE have corroborated and reinforced the fact that CNG is a clean fuel.

Table-7 indicates typical emissions reduction in CNG bus compared to a diesel bus.

Table-7

Typical Emission Reduction in CNG Bus Compared to a Diesel Bus.	
Effluent	Percentage Reduction
Carbon Monoxide	56%
Hydro Carbons	55%
Nitrogen Oxide	56%
Particulates	86%

Similarly, Table-8 and 9 show similar reduction in emission with CNG retrofitted conversion kits for some of the Indian models of cars and auto rikshaws as certified by ARAI and VRDE.

Table-8

Emission Reduction in Passenger Car (Petrol)		
Vehicle	Pollutant (Gm/Km)	% Reduction in Gm/Km with CNG use.
Maruti Omni	CO	97
	HC	11
Maruti Gypsy	CO	88
	HC	24
Premier Padmini	CO	95
	HC	28
Premier 118 NE	CO	87
	HC	25
Ambassador	CO	98
	HC	32

Table-9

Emission Reduction in Autorikshaws (Petrol)		
Vehicle	Pollutant (Gm/Km)	% Reduction in Gm/Km with CNG use.
Bajaj Three-Wheelers	CO	63.19
	HC	71.35
	CO ₂	41.82
	Nox	20.00

3.7 CNG V/s LPG

It is a debatable matter whether LPG can be a competing fuel or a complementary fuel vis-à-vis CNG from the strategy point of view not only for GSPC, but also for the State Govt. from the policy stand-point. However, the Supreme Court / the Central Govt. seem to have advocated the use of both LPG and CNG as alternative auto fuels. This report is primarily dealing with the implementation of CNG in Gujarat because the plans for use of LPG will require a separate exercise.

However, it will not be out of place to compare these two fuels from the Gujarat stand-point.

Sr. No.	CNG	LPG
1.	CNG will be better off in terms of combustion efficiency i.e. environmentally more desirable.	Comparative combustion efficiency is less.
2.	CNG will require pipeline network (Gujarat is well placed in this regard).	Pipeline network not required.
3.	In comparative terms, CNG is less costly.	LPG is more costly because its higher up in value addition chain of hydrocarbons and a processed / manufactured item. On import parity basis, Mashelkar Committee now clearly stated that LPG is a costlier proposition as Autofuel.
4.	CNG prices are comparatively more stable.	LPG prices are likely to fluctuate.
5.	From the supply stand-point, CNG will be easily available in most parts of western India and some parts of eastern Indian in near future.	The Central Govt. in the Ministry of Petroleum and Natural Gas has indicated that there is no enough LPG and that the gap will increase in the foreseeable future.

6.	From the safety stand-point, CNG is more safe to use when compared with LPG.	LPG is comparatively less safe.
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In this regard, it is important to note that a high level US delegation, supported by USEAP visited India as recently as December, 2002 to promote the use of LPG in India.

Taking into consideration the Mashelkar Committee view that the choice of autofuel should be region specific, it is our view that wherever Natural Gas is available, CNG should be promoted as autofuel and for the regions where Natural Gas is not available such as states like Madhya Pradesh, Chatisgarh, Bihar etc., LPG may be used.

3.8 The following is the list of some useful organizations / websites in connection with CNG.

1. Clean Cities Programme of USA.
2. USAEP
3. USEPA
4. NGVC
5. Clean Air Asia
6. CSE

Annexure-8 contains some interesting news clippings in connection with CNG.

GLOBAL SCENARIO OF CNG

The concept of Natural Gas as an automotive fuel started around 1930. Today, there are over 2.0 million vehicles using CNG worldwide, out of which 1.3 million CNG vehicles are in the US and 370,000 in comparatively a small country like Italy. CNG vehicles are also known as Natural Gas Vehicles (NGVs). Table-10 below indicates the top 5 countries in the field of CNG :

Table-10

Top 5 NGV Markets		
Country	Vehicles	Refuelling Station
Argentina	686,496	896
Italy	370,000	355
Pakistan	200,000	200
Brazil	120,000	131
United States	1300,000	1250

It may be noted that after Argentina and Italy, it is Pakistan which has successfully adopted the use of CNG with 200,000 vehicles using CNG. It has been reported that 35,000 Autorikshaws in Lahore have been converted for the use of CNG with Asian Development Bank (ADB) help.

In view of such a high number of CNG vehicles spread across USA, Argentina, Italy, Brazil, Pakistan, Thailand, Iran, Australia etc., the technology is highly established. There are around 1,95,000 websites for CNG. This fact also indicates that this is a highly established technology which is being used world over for the past more than 70 years.

Annexure-3 contains answers to some of the Frequently Asked Questions (FAQs) on CNG, from which it may be noted that it is not difficult to switch over to the use of CNG as an autofuel and that the transition can be managed, with appropriate strategy and planning for implementation.

CNG SCENARIO IN INDIA

5.1 Indian exposure to the use of CNG is comparatively recent. A total of 95,000 vehicles have so far been converted mainly in the National Capital Region of Delhi and Greater Mumbai. The Metropolitan city of Delhi was forced to adopt CNG in public transport vehicles and Mumbai has adopted it so far, in a limited way.

It must however be stated CNG was launched in India on a trial basis by GAIL way back in 1992-93 in Delhi, Mumbai and Vadodara. Gujarat Gas Co. Ltd. also established a few CNG stations in Surat and Ankleshwar.

Annexure-4 gives the details of Indraprastha Gas Limited, the operating agency for CNG in Delhi and Annexure-5 gives similar details for Mahanagar Gas Limited, the operating agency for CNG in Mumbai.

5.2 Indraprastha Gas Limited

Indraprastha Gas Limited (IGL) is a joint venture between GAIL, BPCL and Govt. of Delhi, which has established 121 CNG stations with an overall investment of Rs. 208 Crores and is actively implementing a further investment of Rs.63 Crores. It is also engaged in supplying piped natural gas in the city of Delhi.

IGL has a total equity of Rs. 140 Crores and it has made a modest profit in the past 3 years, a difficult achievement for infrastructure projects.

IGL will be ready for 16.1 Lacs kg. of CNG per day i.e. Rs.2.88 Crores per day of turnover by June, 2003.

Environment is always a debatable subject. However, a vast majority of experts and citizens feel that there has been a positive impact of CNG in the environment of Delhi.

5.3 Mahanagar Gas Limited

Mahanagar Gas Limited (MGL) is a joint venture between GAIL and British Gas. It has established 29 retail outlets so far and is planning to add 16 more in the year 2003. MGL presently has around 39000 vehicles running on CNG.

5.4 Potential of CNG in India

Thus, it may be seen that much more remains to be done in the field of CNG in India which has an experience of just around 6-7 years in this field as against more than 70 years elsewhere in the world.

All the leading automobile manufacturers and members of SIAM (Society of Indian Automobile Manufacturers) such as Bajaj Auto, Ashok Leyland,

Telco, Maruti Udyog, etc. have geared themselves to make engines fitted for the use of CNG (dual fuel mode) available in their vehicles and therefore there should be no difficulty in the availability of CNG compatible new vehicles in India.

Similarly, for the old vehicles, there are many companies which can retrofit the engines and conversion kits are available albeit much less in number than the expected demand growth for CNG.

With the ever expanding vehicle population and Compounded Average Growth Rate (CARG) of more than 6% annually of petroleum consumption, CNG therefore has a vast unexplored potential in India.

CNG TECHNOLOGY

6.1 The discussion on technology for CNG can be divided in two categories :

1. Supply side CNG Technology
2. Consumer side CNG Technology

6.2 Supply Side CNG Technology

CNG technology is comparatively a simple affair. Low pressure natural gas is compressed to a pressure of 250 kg/cm² in what are known as Mother Stations from where the vehicle cylinder can directly be filled through a dispenser at 200 kg/cm² as also LCV mounted Daughter Stations can pick up gas for delivery and dispensation of CNG at other locations by the Daughter Stations.

Both "Fast Fill" and "Slow Fill" (also known as "Trickle Fill") technology are available depending on the customer requirements. Generally, "Fast Fill" technology is adapted at CNG Dispensing Stations and "Slow Fill" technology is used by some fleet operators and for filling CNG at home.

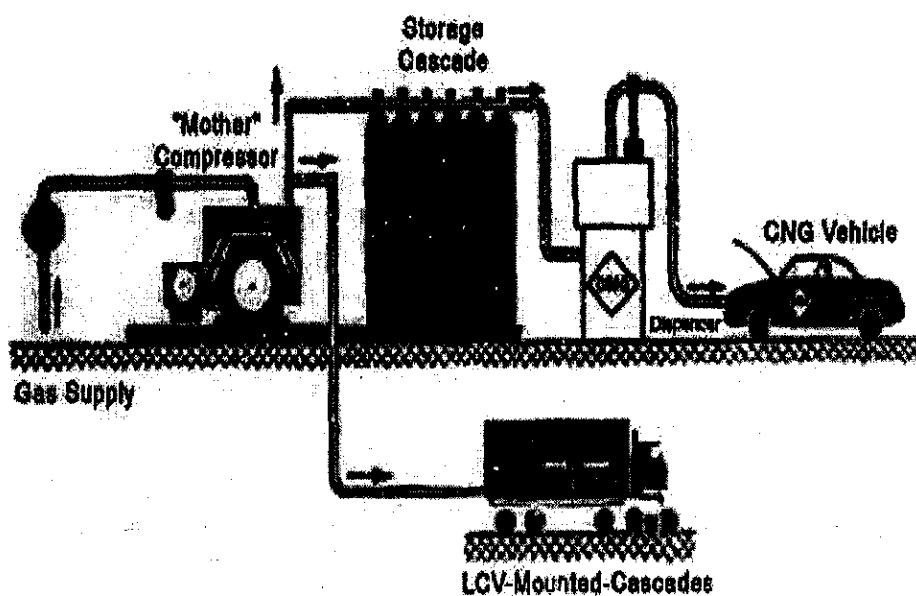
CNG stations need to be connected to the pipeline either directly or indirectly to make CNG continuously available for dispensing. Based on factors such as connectivity to pipeline, presence of compressors, size of compressors and facility for filling cascade stations can be broadly categorized into 4 different segments :

6.3 Mother Stations

Mother Stations are connected to the pipeline and have high compression capacity. As shown in **Figure-1**, these Mother Stations supply CNG to both vehicles and Daughter Stations (through mobile cascades). Typically they have the facility of filling all types of vehicles – Buses / Autos / Cars. The Mother Station requires heavy investment of the order of Rs. 5 up to 7 crores toward's compressors, dispensers, cascades, pipelines, tubing etc.

Figure-1

CNG MOTHER STATION



6.4 Daughter Stations

Daughter Stations are small stations catering to the needs of even those areas where pipeline cannot reach. Daughter Stations dispense CNG using mobile cascades. These mobile cascades at daughter stations are replaced when pressure falls and the pressure depleted mobile cascade is refilled at the Mother Station. The investment in a Daughter Station is the least to the tune of Rs. 80 lacs among all kinds of CNG stations.

There is a reduction in storage pressure at Daughter Stations with each successive fill. Once the storage pressure drops, the refuelling time increases, while the quantity of CNG dispensed to vehicle also decreases.

6.5 Daughter Booster Stations

Installing a booster compressor can eliminate drawbacks of Daughter Stations. The mobile cascade can be connected to the dispensing system through a booster. Daughter booster (compressor) is designed to take variable suction pressure and discharge at constant pressure of 200 bars to the vehicle being filled with CNG. The investment in a Daughter Booster Station is slightly higher than that of Daughter Station, to the tune of Rs. 1.0 Crore.

6.6 Online Stations

CNG vehicle storage cylinders need to be filled at a pressure of 200 bar.

"On-line Stations" are equipped with a compressor, which compresses low-pressure pipeline gas to the pressure of 250 bar for dispensing CNG to the vehicle cylinder. On-line Stations are the same as Mother Stations except that they do not have the Cascade filling facility. The investment in an online station is midway between Daughter Station and Mother Station i.e of the order of Rs. 3.5 Crores depending on the facilities created.

CNG dispensing operates on the principle of equalising pressure between the storage cascade and vehicle's On-board cylinder. CNG is sold on retail from the dispenser using direct mass flow meters while refuelling and is measured in Kilogram units.

6.7 CNG Vehicle Filling At Home

Available information from the U.S. Environment Protection Agency (USEPA) clearly indicates that CNG vehicle owners can refuel their cars at home by installing small compressors connected directly to the home's natural gas supply. Similar arrangement is possible for Transport Fleet Owners, who can go for their own arrangement of refuelling their Fleet Vehicles.

THIS INTERESTING POSSIBILITY OF FILLING UP VEHICLES AT HOME CAN BE A DREAM PROJECT WORTH EXPLORING FOR GUJARAT.

The check should include audit of the electrical system, ignition, valve clearances, cylinder compressions, exhaust gas analysis and the condition of the air cleaner. It is best to check fuel consumption, power output and vehicle performance on starting, idling and running. Fuel emission should also be checked both before and after conversion on CNG as well as on petrol separately.

Sometimes there can be additional expenses initially for replacing batteries, ignition circuits etc. This is because the ignition temperature for CNG is much higher than for petrol and a much stronger spark is needed to ignite CNG, even though the earlier spark strength may have been acceptable for petrol running.

The conversion kits for the following car models are already Type Approved in India :

- Maruti 800, Maruti Gypsy, Maruti Esteem, Maruti Zen, Maruti Van.
- Premier Padmini
- Ambassador Nova
- Ambassador ISZ 1800
- Contessa
- NE 118
- Cielo

CNG/LPG Conversion of Two-Wheelers.

Presently it is a generally accepted fact that two-wheelers cannot be converted to CNG. This is mainly because two-wheelers are 2 stroke engines and the CNG tank may be heavy.

However, TVS Suzuki and Kinetic Engg. have plans to launch LPG and bi-fuel scooters using Lovato technology of Italy.

More research is needed in this important area of converting two-wheelers to the use of CNG/LPG in view of the high proportion of two-wheelers in major Indian cities.

6.9 Technology Suppliers

There are many leading technology suppliers who have the necessary experience of equipments for Mother Stations, Daughter Stations and dispensing of compressed natural gas. The following are leading suppliers of such technology :

1. Pinnacle CNG Systems, LLC, California, USA.
2. Autogas, Italia.
3. GNC Galileo Group, Argentina
4. Southern California Gas Company, USA
5. Kingdom Group, New York, USA

6. Trillium, USA
7. Tokyo Gas Company, Japan.
8. Yogo Tech, Canada
9. Korean Gas Company, KOGAS of Korea.
10. Intermech of Auckland, New Zealand etc.
11. High Hopes International of China.

Annexure-6 contains a list of useful contacts, in the CNG Industry.

6.10 Conversion Kit

There are several conversion kit manufacturers and suppliers throughout the world. Some examples are :

Manufacturers/Suppliers of CNG Conversion Kits

1. Trans Energy Limited (TVS Group, Chennai)
2. Nu Gas India Ltd., New Delhi
3. Autogas India
4. Cal Start
5. Hendrix Industrial Gas Company, USA.
6. Minda Impco Systems.

Annexure-7 contains the list of some of the type approved kit suppliers and their contact details including one Ahmedabad based supplier.

Once the demand for CNG picks up, there will be a surge in conversion kit suppliers.

OVERALL PLAN FOR STATE-WIDE USE OF CNG IN GUJARAT

- 7.1 With the scenario of ever rising vehicle population and disturbing levels of pollution parameters with potentially grave consequences for Public Health, as far as Gujarat is concerned, it is imperative that the State should prepare an urgent action plan for the use of CNG.

It will not be desirable to implement the CNG plan on a piece-meal basis or in an isolated manner for the cities of Ahmedabad, Surat and Vadodara. Any worthwhile plan for CNG should cover the entire State.

In this context, it is interesting to note that the Mashelkar Committee appointed by the Govt. of India, to evolve a new autofuel policy for the country, has observed that the feasibility of using CNG as an alternative auto fuel would depend not so much upon the overall natural gas availability, but the feasibility of laying of natural gas pipelines connecting various cities.

Fortunately, Gujarat is favourably placed with regard to both the availability of Natural Gas and the Natural Gas Pipeline Infrastructure.

Gujarat is fortunate in one more aspect. The compression requirement is considerably reduced in Gujarat because the natural gas received is already compressed to a level of nearly 50 kg/cm².

7.2 Availability of Natural Gas

Table-11 depicts the Natural Gas availability in Gujarat over the next 10 years.

From the table, it may be noted that the overall availability of Natural Gas will substantially increase to the level of 6.6 mcmd in 2003-4 and further to 12.1 mcmd in 2004-5 with the commissioning of Petronet LNG.

It is interesting to note that there will be more players in the field breaking the present monopolistic situation and many suppliers of Natural Gas such as Cairns Energy, Shell-LNG, Petronet-LNG, as also the potential supply of Coal Bed Methane in near future.

7.3 Natural Gas Pipeline Infrastructure

Gujarat State Petronet Ltd. (GSPL) has aggressive plans under implementation for laying natural gas pipelines in Gujarat. **Figure-2** depicts the overall picture of Natural Gas Pipeline already laid and planned to be completed in near future. It can be easily seen that Gujarat is well prepared with respect to the laying of the pipelines, a key factor in the use of CNG as autofuel.

REVIEW OF MARKET POTENTIAL

8.1 Estimating Market Potential

If we take into consideration only the three cities of Ahmedabad, Surat and Vadodara, not considering the large number of vehicles being added every year, the vehicles that can be converted to CNG can be estimated from Table-12 below :

Table-12

Category-wise population of different vehicles in Ahmedabad, Surat and Vadodara as in April, 2002.					
City	Autos/ Tempos	Cars/ Cabs	Buses	Goods Carriages	Tractors/ Others
Ahmedabad	68064	168833	22106	46138	67137
Surat	38275	76456	1399	41529	14969
Vadodara	22025	59623	1478	36144	31177
	128364	304912	24983	123811	113283

8.2 From Table-12, it may be seen that there are more than 8,95,000 vehicles (excluding two wheelers) which have the potential of being converted in Ahmedabad, Surat and Vadodara alone as summarised below.

From the table, it may be noted that the overall availability of Natural Gas will substantially increase to the level of 6.6 mcmd in 2003-4 and further to 12.1 mcmd in 2004-5 with the commissioning of Petronet LNG.

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If we take into consideration only the three cities of Ahmedabad, Surat and Vadodara, not considering the large number of vehicles being added every year, the vehicles that can be converted to CNG can be estimated from Table-12 below :

Table-12

Category-wise population of different vehicles in Ahmedabad, Surat and Vadodara as in April, 2002.					
City	Autos/ Tempos	Cars/ Cabs	Buses	Goods Carriages	Tractors/ Others
Ahmedabad	68064	168833	22106	46138	67137
Surat	38275	76456	1399	41529	14969
Vadodara	22025	59623	1478	36144	31177
	128364	304912	24983	123811	113283

8.2 From Table-12, it may be seen that there are more than 8,95,000 vehicles (excluding two wheelers) which have the potential of being converted in Ahmedabad, Surat and Vadodara alone as summarised below.

Potential for CNG conversion :

Cars/Cabs	3,04,912
Autos/Tempos	1,28,364
Buses	24,983
Goods Carriages	1,23,811
Tractors/Others	<u>1,13,283</u>
Total	<u>8,95,353</u>

It is to be noted that the above number of 8,95,000 does not include the large number of vehicles being added every year.

If we add to this number, the vehicles that can be converted to CNG in the cities of Vapi, Valsad, Navsari, Bilimora, Bharuch-Ankleshwar, Anand, Nadiad, Gandhinagar, Mehsana, Kalol, Bhavnagar, Rajkot, Jamnagar etc. the potential market is huge.

This is further corroborated by the Ministry of Petroleum & Natural Gas, Govt. of India figures which show that Gujarat consumes over Rs. 5,200 Crores worth of petrol and diesel, and that the compounded average rate of growth in consumption of these fuels is of the order of 8 – 10 per cent.

8.3 As mentioned earlier in the report, CNG is a writing on wall for Gujarat from the present parameters of pollution control and environment point of view alone. Further, with the introduction of Bharat-II (equivalent to Euro-II) by 2004 and similar stringent measures being introduced, it is estimated that CNG will have a large market with obvious riders like careful marketing, consumer education, appropriate legislation and some fiscal incentives. Thus, it can be safely stated that there is a vastly untapped potential for CNG in Gujarat.

SPECIFIC PLANS FOR GUJARAT

9.1 The specific plans for Gujarat should address the following issues :

1. Configuration and location of Mother Stations and Daughter Stations.
2. Strategy for implementation.
3. Enlisting support of the State and Central Government as also other International agencies.

9.2 Configuration of Mother Stations and Daughter Stations

From the supply point of view, selection of appropriate locations and proper configuration of Mother and Daughter Stations will play a crucial role. Any short coming in this regard can lead to a serious disruption of supply and the credibility of CNG as an alternative will be adversely affected.

For the Gujarat situation, it will be desirable that the Mother CNG Stations are located near the cities along the gas pipeline route, at the 27 locations as shown in Figure-3. These Mother Stations should be equipped with adequate number of dispensers and facilities for filling up LCV or Truck

mounted cascades to cater to the requirements of nearby Daughter Stations. A typical layout of a Mother Station was already depicted in Figure-1, in Chapter-6.

These Mother Stations should cater to the requirement of the individual city/region where further distribution can be planned through LCV or Truck mounted Daughter Stations which can be installed in existing Petrol Stations, if the space so permits. Otherwise and in addition further CNG can be dispensed through Daughter Stations at individual Franchisee locations.

The above arrangement, in our opinion, will provide the least cost option within the cities where space constraint can create a bottleneck in the growth of the use of CNG.

9.3 Learning from the Experience of Delhi and Mumbai.

Amongst the complaints commonly heard in Delhi and Mumbai in the first 2 – 3 years of implementation of CNG projects were :

- (a) Inadequate supply of CNG.
- (b) Long queues at CNG dispensing stations.
- (c) Inadequate supply of conversion kits.
- (d) Inadequate training and awareness amongst auto-rikshaw and bus drivers, other users, technicians and mechanics.
- (e) Frequently changing policies of the Government.

In Gujarat, we must therefore plan well in advance to ensure adequate supply of CNG, adequate number of outlets, ensure adequate availability of conversion kits, proper training and awareness amongst all stakeholders and a clear cut policy of the government.

We must also adopt a proper "Fast Fill" or "Quick Fill" technology at the CNG dispensing stations to ensure quick delivery.

It will also be appropriate to plan CNG stations as one stop shop for all CNG related requirements. In tandem with "Fast Fill" technology, the "Slow Fill" technology or the technology of CNG filling at home should be planned for smooth and easy delivery of CNG to the customers.

9.4 Strategy for Implementation of CNG Projects

As far as the implementation is concerned, it will be desirable to explore the following options :

1. Joint Venture Arrangement
2. Franchisee Arrangement

9.5 Joint Venture Arrangement

Under the joint venture arrangement, it is envisaged that GSPC forms a separate company for distribution of Compressed Natural Gas in Gujarat and identify a suitable joint venture partner, with necessary expertise and management.

The equity pattern may be :

(a)	GSPC & Associates	11%
	Joint Venture Partner	40%
(b)	GSPC & Associates	25%
	Joint Venture Partner	26%

with a stipulation that GSPC at its option, may later dilute the equity to 11% or even less.

9.6 Franchisee Arrangement

Under the Franchisee arrangement also, GSPC should form a separate company for distribution of Compressed Natural Gas in Gujarat. This newly formed company should arrange for supply and distribution of Natural Gas and create the bear minimum infrastructure of Mother Stations at key locations along the pipeline route and then appoint Franchisees for further sub-distribution and dispensation of CNG at retail outlets.

Both the above arrangements are eminently workable. The Joint Venture arrangement has the advantage of achieving the same purpose of ensuring CNG distribution in Gujarat at the least cost to GSPC in terms of investment and the responsibility of implementation and smooth running of the project shifting to the Joint Sector Partner. This will necessitate a

careful selection of Joint Venture partner. However, this exercise will take some time and if one waits for selection of partner, the implementation will get delayed.

Further, it is to be noted that this project will require some fiscal incentives and Govt. support - even international agency's support. Whether such incentives and support can be obtained under Joint Venture arrangement needs to be carefully weighed.

As far as Franchisee Arrangement is concerned, in view of GSPC already owning the pipeline, it will be quicker and easier to implement and it still involves private sector participation. In fact, this arrangement will help in creating more entrepreneurs in terms of Franchisees and it will help smaller and medium sized players.

Under the Franchisee Arrangement, it will be possible for GSPC to collect appropriate deposits and reduce its financial burden to that extent.

It may also be envisaged that after implementing the project under the Franchisee Arrangement, GSPC may at an appropriate time divest its stake in favour of a suitable strategic partner, at a later date.

9.7 Fiscal Incentives & Govt. Support.

CNG is essentially an infrastructure project. CNG is essentially an Environment project.

It has implications not only on environment but directly on Public Health. Moreover, it saves precious foreign exchange to the extent that it substitutes imported petroleum products.

The governments world over have been giving fiscal incentives for use of CNG and other Alternative Fuels. Not only Developed countries but also Developing countries give these incentives for better environment.

Some examples of incentives given by various countries are given below :

- | | | |
|---------------------------|---|---|
| Pakistan | : | Exemption from import duty and Sales Tax on CNG conversion kits, import of CNG related machineries, cylinders etc. |
| Malaysia | : | Incentives through Tax exemption on conversion kits, Road Tax reduction etc. |
| Seoul city
South Korea | : | Subsidies and Tax incentives to introduce CNG. |
| Tokyo, Japan | : | Assistance and accommodation of funds for PM reduction devices being implemented. |
| USA | : | Besides the incentive of deduction in Federal Tax (Income Tax) various states are giving incentives in terms of Sales Tax and other benefits. |

9.8 Environment Budget

It will be desirable that the country and the state should have an Environment Budget. Such a budget should be used to support initiatives for betterment of environment. CNG should find a prominent place in the Environment Budget.

Specifically, the following support may be enlisted from the State and Central Governments :

9.9 State Government :

1. Interest subsidy of 4% for purchase of Conversion Kit, by individuals.
2. Interest subsidy of 4 + 2% for Auto Rikshaws.
3. Interest subsidy of 4 + 1% for recognised Fleet Owners.
4. Sales Tax exemption for 5 years for conversion kit and all CNG related equipments.
5. Encouraging and recognising Municipal Corporations and local bodies achieving excellence in Emission levels.

9.10 Central Government :

The Central Government is already encouraging the import of CNG conversion kits and equipments for CNG with concessional duties. This encouragement should continue as recommended by the Mashelkar Committee. However, following specific measures by the Central Govt.

will help in expeditious conversion of vehicles and cleaning the most polluted – “dirty cities” like Ahmedabad, Surat, Lucknow, Kanpur etc.

1. All Banks to give a soft loan at 9% for purchase of conversion kits. Loan repayable in 7 years.
2. Similar loan for purchase of CNG fitted new vehicles.
3. Concessional excise duty (50% of existing level) for CNG fitted engines for 5 years.
4. Import Duty waiver for 5 years for all CNG related equipment (to be specified) being imported by OEM Automobile Manufacturers, recognised conversion kit suppliers etc.
5. Automobile Manufacturers may be encouraged to announce Buy Back Scheme for vehicles older than 10 years.

9.11 Support from Multilateral Agencies :

Some of the multilateral agencies supporting the use of CNG are :

1. The Asian Development Bank
2. United States – Asian Environment Partnership (USAEP) in conjunction with United States Environment Protection Agency.
3. Japan Special Fund, funded by Govt. of Japan.
4. UNDP's Global Environmental Facility (GEF) Programme.
5. Canada's Technology Early Action Measures fund (TEAM) and Canadian International Development Agency (CIDA).

It may be recalled that incentives were given country-wide when LPG was introduced 30 years ago to replace the inefficient kerosene stoves and other domestic fuels like coal etc – by way of Bank loan etc. Results are there for everyone to see.

The Asian Development Bank has created a special project named Regional Technical Assistance (RETA) for reducing vehicle emissions. It has Action Plans for China, India, Indonesia, Vietnam etc.

GSPC and implementing agency should strive to enlist the support of such multilateral agencies for the implementation of CNG projects in Gujarat.

COST ESTIMATES FOR THE PROJECT

10.1 Whereas precise cost estimates will require a detailed project report, based on the information available, it is estimated that a Mother Station requires an investment of the order of Rs. 6 Crores and a Daughter Station will require an investment of Rs. 80 Lacs. Instead of a Daughter Station, if a Daughter Booster Station is established, the investment may be of the order of Rs. 1.0 Crore.

10.2 If we assume 27 Mother stations and 40 Daughter stations, the estimated cost will be as follows :

1. Mother Station	Rs. In Crores
27 Mother Stations @ Rs. 6 Crores each.	= 162
2. Daughter Station / Daughter Booster Station	
40 Nos. Daughter stations @ Rs. 1.0 Crore each.	= 40
Total	= <u>202</u>

10.3 Thus, it may be seen that the order of magnitude cost for the project involving 27 Mother Stations and 40 Daughter Booster Stations will be of the order of Rs. 200 Crores, depending on the choice of compressors, cascades, other facilities like Dispensers, DG Sets, Fire and Safety equipments, price of land etc.

ECONOMIC ANALYSIS

11.1 For the purpose of this report, an attempt has been made to throw some light on the economic analysis under two categories :

1. Economic Analysis at User End i.e. for the Consumers.
2. Economic Analysis from the Investment Point of view.

11.2 Economic Analysis at User End i.e. for the Consumers.

The cost of conversion kit for Petrol vehicles is estimated at Rs. 30,000/- and that of Diesel vehicles is estimated at Rs. 50,000/-. This initial cost may seem to be high. But it is more than offset due to lower operating cost not only in fuel consumption, but also in maintenance costs of vehicles.

It is well known that the present cost of petrol is Rs. 33/- per ltr. As against this, CNG may be priced in the region of Rs. 18/- to 20/- per kg. Equivalent energy consumption-wise, this will throw up a figure of Rs. 22/- for every litre of petrol substituted by CNG. Therefore, it is clearly advantages in terms of fuel consumption for all petrol vehicles.

Similarly, for diesel which costs around Rs. 22/- per ltr., the equivalent energy consumption figure will be the same i.e. Rs. 22/- for every litre of diesel substituted by CNG. However, there are certain hidden advantages of CNG such as lower maintenance cost, doubling of engine life, saving on oil filters, oil changing etc. Further, the specifications for diesel are becoming more and more stringent e.g. the sulphur levels being stipulated in diesel for the refineries are much lower now than ever before. Therefore, diesel prices are bound to go up. Already, the petrol pumps are dispensing into "Super Diesel" costing more than the ordinary variety of diesel.

11.3 Random interviews of Auto Rikshaw and Taxi Drivers using CNG in Mumbai.

During various visits to Mumbai, we had enquired from Auto Rikshaw and Taxi Drivers about their experience with CNG. The same can be summarised below :

1. The days of standing in long queues are over.
2. They are able to get their vehicles filled with CNG in 2 to 3 minutes time.
3. There is a net saving of at least Rs. 150/- per day for Auto Rikshaw Drivers and saving of Rs. 250 to Rs. 350/- per day for Taxi Drivers, depending on k.m. travelled.

4. The repairs and maintenance cost have gone down – though it is difficult to quantify.
5. They are happy that their vehicles do not generate smoke i.e. less tail piece emissions.
6. As perceived by them, engine noise level is low when CNG is used.
7. They felt that in view of the above indications and their experiences, it can be safely said that the cost of the conversion kits can be recovered in 9 months to a year time.

With the above scenario, it is clear that CNG will be more attractive from the economic stand point for the consumers besides being more environment friendly.

11.4 Economic Analysis from the Investment Point of view.

As mentioned earlier at Chapter-8, the Ministry of Petroleum & Natural Gas, Govt. of India, has estimated that the consumption of petrofuels in Gujarat works out to a total spending of Rs. 5200 Crores per year.

Table-13 gives an estimate of the possible revenues at different levels of market penetration by CNG.

Table-13

Estimated Annual Sales Turnover at Different Market Penetration of CNG.		
Assumptions :	<ol style="list-style-type: none"> 1. Private Car runs 500 kms/month i.e. 6000 kms/year. 2. CNG consumption based on 22 km/kg = 272.7 kg/year/car. 3. An Auto Rikshaw runs 100 km/day and its CNG consumption is 4.5 kg/day based on 22 km/kg and runs for 340 days in a year i.e. 1530 kg of CNG/year/auto rikshaw. 4. A bus on an average runs 150 km/day and consumes CNG @ 4 km/kg and runs for 330 days in a year i.e. 37.5 kg/day and 12375 kg/year/Bus. 5. Only the cities of Ahmedabad, Vadodara and Surat are considered. 6. Only Cars, Autos and Buses are considered for conversion. 7. New vehicles being added every year are not considered. 	
Sr. No.	Market Penetration	Estimated Annual Sales Turn Over.
1.	10% Cars + 10% Autos + 10% Buses.	106.00 Crores
2.	25% Cars + 25% Autos + 25% Buses	265.18 Crores
3.	25% Cars + 50% Autos + 50% Buses	494.00 Crores
4.	50% Cars + 50% Autos + 50% Buses	530.00 Crores
5.	50% Cars + 75% Autos + 75% Buses	758.73 Crores
6.	100% Cars + 100% Autos + 100% Buses	1060.00 Crores

When viewed against the estimated investment of around Rs. 200 Crores in CNG facilities, the above figures of estimated annual sales turn over compare favourably indicating a comfortable position. In this connection, it may be mentioned that the company implementing first such project in the country, Indraprastha Gas Limited, despite facing difficulties of being the first company and infrastructure bottlenecks, has posted a modest profit for the last 3 years.

The above figures are just annual sales turnover figures for one year. If we multiply the above figures for 3 years and more, the investment becomes attractive.

As already mentioned earlier in Chapter-7, compression requirement in Gujarat is considerably less which can bring down the cost of CNG to that extent, a factor in favour of profitability.

Further, it may be of interest to note that our neighbouring country, Pakistan has estimated that the CNG market will attract an investment of the order of USD 600 – 700 million.

REVIEW OF SUPREME COURT JUDGEMENTS

12.1 As is well known, the Supreme Court of India has given landmark judgements and is quite concerned about the right of the citizens of the country to breathe clean air without any adverse consequences to the health of the human population.

12.2 Brief History

Based on the experience and awareness about the water and air pollution in early 1980s, an environmental group filed an appeal in the Supreme Court in 1985 asking it to issue a writ of mandamus to the various authorities to implement the laws enacted to prevent and control pollution of air and water in Delhi. The Government of India responded by appointing an Environment Pollution (Prevention and Control) Authority (EPA) for the National Capital Region whose advice would be mandatory on the governments. The Supreme Court based its orders in this case on the deliberations of the EPA.

The Supreme Court passed orders in July, 1998 that all buses run by the Delhi administration and private operators for public transport had to adopt CNG as fuel and diesel-run buses had to be phased out by 31st March, 2001.

Court directed the Union of India to evolve a scheme of compulsory switch over of all two-wheelers, three-wheelers and motor vehicles to CNG/LPG in cities which were equally or more polluted than Delhi.

12.3 Out of the many judgements given by the Supreme Court with regard to CNG, the following are particular importance to Gujarat.

1. The judgement dated 5-4-2002, and
2. The judgement dated 9-5-2002.

The operative part of the above judgements are reproduced below.

12.4 Some important features of the Supreme Court ruling dated 5-4-2002.

1. The first observation is with regard to availability of CNG. The Court has pointed out that far from it being in short supply, no CNG was currently being imported and indigenous supply was actually increasing, particularly from the South Bassein field.
2. The Ministry of Petroleum and Natural Gas was deliberately flouting its mandate to give priority to public health as specified in Articles 39(E), 47 and 48 A of our constitution. On the other hand, it seemed more concerned with shoring up the profits of private companies even though CNG for transport was priced at Rs. 13.11 a kg, a level nearly four times as much as the Rs. 3.55 a kg which industry paid !

3. The Court observed that the Union Government also seemed unwilling to accept the undoubted carcinogenic potential of automobile exhaust emissions particularly that of the particulates characteristic of diesel engines, in spite of numerous Indian and foreign studies to the contrary. The Central Pollution Control Board (CPCB) in the September 2001 issue of its journal 'Parivesh' described the cancer causing properties of diesel exhaust particularly that of polycyclic aromatic hydrocarbons (PAH) and nitro-PAH particulates. The mutagenicity of these compounds further increases when they undergo atmospheric transformation after they leave the engine. Amongst serious diseases in India that can be linked to atmospheric pollution are cases of acute respiratory infection (accounting for 13 per cent of deaths) and perinatal disease (accounting for 6 per cent of deaths). Both these fractions are the largest in the world. Others include chronic obstructive pulmonary disease, lung cancer, asthma, tuberculosis, cardio vascular disease and blindness.

12.5 Operative part of the Supreme Court judgement dated 9-5-2002 affecting Gujarat.

"DIRECTION WITH REGARD TO THE AFFIDAVIT FILED BY THE UNION OF INDIA.

Union of India will give a scheme with regard to compulsory switch over of all two wheelers, three wheelers and motor vehicles to LPG/CNG in cities other than Delhi which are equally or more polluted".

12.6 Subsequent to the above judgements, there was a meeting held by the Central Government and Chair Persons of Pollution Control Boards on 8th and 9th July, 2002 and it was decided that Ahmedabad, Kanpur, Kolkotta and Pune are the four cities which are equally or more polluted than Delhi.

Therefore, in compliance with the Supreme Court judgements, the concerned states were directed by the Central Government to prepare a scheme for compulsory switch over to LPG/CNG. Gujarat State in particular was required to submit a scheme for Ahmedabad city for such a compulsory switch over.

12.7 Steps taken by other States.

1. The State of Karnataka has introduced "Green Cess" from April, 2002 as given below :

Two-wheelers upto 15 years old.	Rs. 50/year	payable at a time for 5 years.
Four-wheelers upto 15 years old.	Rs. 100/year	-do-
Transport Vehicles more than 7 years old.	Rs. 200/year	Payable yearly.

The Transport Secretary and the Transport Commissioner of the State of Karnataka have stated that vehicles older than 15 years will not be allowed to enter Bangalore city after 1-1-2003.

2. As is well known in Delhi, transport vehicles and autorikshaws of older than 8 years have to compulsorily switch over to CNG.
3. In Mumbai, taxis older than 15 years and autoriskshaws older than 10 years have to be converted to CNG/LPG, as stated by the Transport Commissioner of Maharashtra.
4. The Tamilnadu Government is promoting electrical battery operated car, Reva, by offering 33% subsidy to Public Institutions and Trusts buying such cars.
5. In Kolkata, cars of more than 15 years will be given one year and cars of 8 to 15 years old will be given two years for conversion.
6. In Hyderabad, LPG is being promoted with the first LPG conversion kits for Autorikshwas having been launched in Hyderabad by the Chief Minister on 17th November, 2002.

12.8 Recommendations and views expressed by leading organizations.

Summarised below are the views and recommendations of the Mashelkar Committee, Society of Indian Automobile Manufacturers (SIAM) and Centre for Science and Environment (CSE).

Mashelkar Committee

1. The choice of autofuels and autofuel policy should be region specific.
2. Introduce higher emission norms and autofuel quality ahead of the rest of the country in cities that have very high vehicle pollution or ambient air pollutants concentration.

SIAM Recommendations

1. SIAM has stated that before any alternate fuel vehicle programme is initiated, several issues need to be addressed. These include ;
 - Development of appropriate vehicle technology.
 - Assured availability of alternate fuel.
 - Adequate supplies and infrastructure for extensive fuel dispensing.
 - Future availability position.
 - Safety parameters for fuel handling, dispensing and storage in the vehicle.
 - Proper incentive schemes for owners of alternate energy vehicles, who will have to pay higher initial cost.

12.9 Taking a wholistic view after the Supreme Court judgements and considering the immense impact of vehicle emissions on public health, particularly the vulnerable sections of the society, it appears urgent and imperative for the State of Gujarat to effect necessary legislation wherein the compulsory switch over to CNG or some equally or more environment friendly autofuel is emphasised.

Therefore, there is an urgent need for forming a small multi-disciplinary task force which can formulate the necessary legislation and Gujarat Autofuel Policy.

To begin with, it can be stated that, in Gujarat, we should consider :

1. All Public Transport Vehicles including Autorikshwas must compulsorily switchover to CNG in bi-fuel mode within a period of one year.
2. All Private Vehicles of older than 10 years must compulsorily switch over to CNG in bi-fuel mode within a period of one year.
3. All other Vehicles should switch over to CNG in bi-fuel mode within a period of two years.
4. A "Green Cess" to be introduced for older vehicles.
5. Liberal incentives for switching over to CNG.

RECOMMENDATIONS

A careful review of the foregoing, leads us to the following recommendations :

1. Gujarat should embark upon state-wide implementation of CNG projects and not only limited to Ahmedabad, Surat and Vadodara.
2. In the first phase, CNG projects should be launched simultaneously in the cities of Ahmedabad, Vadodara and Surat and in the cities along the highway from Mumbai to Ahmedabad. In the second phase, the rest of the cities like Mehsana, Rajkot, Jamnagar, Bhavnagar etc. may be taken up.
3. As mentioned at Chapter-7 and 9, the supply side should be properly ensured before embarking on the CNG projects.
4. Since distribution is the key to implementation of CNG projects, aggressive plan for laying the pipeline infrastructure for the CNG should be expedited.

5. The project may be implemented either as a Joint Venture with Private Sector Promoter carefully selected or by GSPC by way of a Franchisee Arrangement. Franchisee Arrangement will be quicker to implement and will generate more entrepreneurs.
6. Since LPG will be a serious competitor, appropriate strategy for speedy implementation of CNG project should be evolved. In business situations, the first to enter the market place always has an edge over subsequent entrants.
- 7.(a) The State Govt. should be approached for fiscal incentives to switch over to CNG as suggested at point no. 9.8 in Chapter-9. This effort should be done by enlisting active support of GPCB, Forest and Environment Dept., Transportation Dept., Public Health Dept. and the Energy & Petrochemicals Dept. as also from the Industries Dept.
- (b) The Central Govt. should be approached for incentives as suggested at point no. 9.9 in Chapter-9.
- (c) Support of multilateral agencies should also be enlisted as mentioned at point no. 9.10 in Chapter-9.
8. CNG Project should be declared as a project of state-wide importance.

9. All public transport vehicles must compulsorily switch over to CNG or some more environmental friendly alternative fuel as may be approved by the State Government. Necessary legislation in this regard may be enacted with clear road map.
10. A detailed awareness programme for the advantages of CNG should be immediately launched on a massive scale.
11. Similarly, a training programme for Autorikshaw Drivers, Technicians, Mechanics etc. should be launched forthwith.
12. GSPC or the implementing agency can consider soft finance for the consumers with strategic arrangements with conversion kit suppliers as a part of marketing strategy.
13. GSPC or the implementing agency should further explore the possibilities of vehicle filling at home as mentioned in Chapter 6 and as is being done elsewhere in the world.
14. Research to be encouraged for development of suitable four stroke engines/conversion kits for two-wheelers in the light of TVS-Suzuki's efforts in this regard.
15. Pilot plant trials of Fuel Cell operated transport vehicles/private cars and in a similar manner Decentralised Generation of power by Fuel Cell technology may be initiated. It is to be noted that Fuel Cells can use CNG/Natural Gas as fuel, with practically "zero emissions".

Effects of Vehicular Pollutants on Humans	
Substance	Health Effects
CO (from gasoline cars, 2-wheelers, 3-wheelers)	Fatal in large doses; aggravates heart disorders; effects central nervous system; impairs oxygen carrying capacity of blood.
Nox (from diesel vehicles)	Irritation of respiratory tract.
Ozone	Eye, nose and throat irritation; risk to asthmatics, children and those involved in heavy exercise.
Lead (from petrol vehicles)	Extremely toxic: affects nervous system and blood; can impair mental development of children; causes hypertension.
HC (mainly from 2-wheelers and 3-wheelers.	Drowsiness, eye irritation, coughing.
Benzene	Carcinogenic
Aldehydes	Irritation of eyes, nose and throat, sneezing, coughing, nausea, breathing difficulties; carcinogenic in animals.
PAH (from diesel vehicles)	Carcinogenic

Source : WHO

ANNEXURE-3

INDRAPRASTHA GAS LIMITED

The CNG program was started in Delhi in 1992. During the pilot program implemented by GAIL, 9 CNG stations were set up in Delhi. Since the incorporation of IGL, the number of CNG stations has increased from 9 to 121.

Indraprasth Gas Limited (IGL) is a joint venture between GAIL, BPCL, IL&FS, IDFC, UTI and Government of NCT of Delhi.

Equity Structure

The equity structure between the joint venture partners is as given below :

	<u>Rs. Crores</u>	<u>%</u>
GAIL	31.5	22.5
BPCL	31.5	22.5
Govt. of Delhi	7.0	5.0
IL & FS Trust Co.	28.0	20.0
IDFCL	28.0	20.0
UTI	<u>14.0</u>	<u>10.0</u>
	<u>140.0</u>	<u>100.0</u>

IGL has spent more than Rs. 208 Crores in creating the CNG infrastructure so far and is actively implementing a further investment of Rs. 63 Crores.

Annexure-4A gives the location-wise CNG stations in New Delhi.

Annexure-4B gives a list of the Board of Directors of IGL since inception :

Success Story of IGL

It is by now recognised by the concerned Experts, the Central Pollution Control Board and the Public in general that the use of CNG as autofuel in Delhi has resulted in better environment.

For infrastructure projects such as CNG, it is difficult to achieve financial success in the initial years, but is heartening to note that IGL has earned profit in the last 3 years. The profit before tax was Rs. 180 Lacs and the profit after tax carried to balance sheet was Rs. 160 Lacs for the year 2000-01.

ANNEXURE-4A

BOARD OF DIRECTORS OF IGL SINCE INCEPTION

1.	Shri S. Behuria	Chairman
2.	Shri A.K. De	Managing Director
3.	Shri P.S. Bhargava	Director (Commercial)
4.	Shri J.K. Jain	Director
5.	Shri S.S. Rao	Director
6.	Shri S.S. Dalal	Director
7.	Shri Gautam Saigal	Director
8.	Shri Satish Chandra	Director
9.	Shri Krishan Sehgal	Director

MAHANAGAR GAS

1. The CNG movement was started in Mumbai by GAIL in 1992 as a pilot project. On formation of Mahanagar Gas Limited, all CNG activities were handed over from GAIL on April 2, 1996.
2. Mahanagar Gas Limited (MGL) was incorporated on 8th May, 1995. MGL is engaged in the distribution of Piped Natural Gas in the city of Mumbai. It is a joint venture of Gas Authority of India Limited (GAIL) and B.G. (British Gas), a leading international gas distribution company.

The company has taken the onus to spearhead the MUMBAIKARS into the new millennium by providing them a new and alternative source of energy – Natural Gas.

The two main services that Mahanagar Gas provides are :

PNG (Piped Natural Gas)

CNG (Compressed Natural Gas)

3. Mahanagar Gas has recorded a high rate of success and popularity for Compressed Natural Gas (CNG).

4. Conversion to CNG :

CNG kits are presently being imported from Italy. These kits are to be type approved for road worthiness by testing agencies namely ARAI – Pune / VRDE / IIP. CNG conversion workshops are trained for retrofitting these kits.

A petrol vehicle can be converted to operate on CNG. However, technical suitability of a vehicle to use CNG can be ascertained only by CNG workshops.

At present, there are around 39,046 vehicles running on CNG which includes 29,000 taxis and private vehicles and 10,000 three-wheelers. Bus operators like B.E.S.T. have shown keen interest in operating fleet of buses dedicated to run on CNG and there are already 46 B.E.S.T. buses running on CNG. The average daily sale of CNG is approx. 1,47,000 kgs. There are 29 CNG retail outlets in Mumbai and 16 more will be added by 2003.

NOTE : Details as on 31st July, 2002.

5. CONTACT

Corporate Office

Pay & Accounts Buildings
Bandra – Kurla Complex
Bandra (East)
Mumbai -- 400 051

Phone Numbers

6591705 / 6591708

Registered Office

City Gate Filling Station
Opposite to Anik Bus Dept.
Sion, Mumbai.

4045785
4012400 (in case of
emergency).

Project Offices

"G" Block, Bandra Kurla Complex
Bandra (East),
Bandra Link Road
Mumbai – 400 051

EPABX :
6908075 / 6908072
6908073 / 6908074

L-29, Laxmi Industrial Estate
New Link Road, Andheri (West)
Mumbai – 400 053

EPABX : 6350281
FAX : 6350278

Row House No. 2, Shivalaya
Shivashanti Building, Poisar
Takur Complex, Kandivali (East)
Mumbai – 400 101

6541707 / 6542647

G-13, Nahar & Sheth Industrial Estate
Chakala, Andheri (East)
Mumbai – 400 099

EPABX : 8371749
8376490
FAX : 8371886

LIST OF ANNEXURES

Annexure-1	Effect of various vehicular pollutants on humans.
Annexure-2	Fuel Cell based Toyota & Nissan
Annexure-3	FAQs on CNG.
Annexure-4	Details of Indraprastha Gas.
Annexure-5	Details of Mahanagar Gas.
Annexure-6	List of useful contacts in CNG Industry.
Annexure-7	Contact details of type approved conversion kit suppliers.
Annexure-8	Some interesting press clippings related to CNG.

ANNEXURE-7

Contact List of Type Approved Conversion Kit Suppliers.