GSPC

GUJARAT STATE PETROLEUM CORPORATION LIMITED

FEASIBILITY STUDY FOR GAS GRID IN GUJARAT

FINAL REPORT

TCS

TATA CONSULTANCY SERVICECS

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Nirmal Bldg., Nariman Point

Mumbai 400 021

MAY 1999

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The total energy consumption in India, which has registered a higher growth of 6% p.a., from 1973 to 1993 (as compared to the world average of 1.5%) is expected to double by 2010. An increasing awareness over environmental concerns and higher efficiencies has resulted in the emergence of natural gas as a viable alternative to coal.

Currently, India accounts for only 1 % of the world's natural gas consumption (1755 MMTOE). As against global levels of 5%, nearly half of the total natural gas is consumed as feedstock for fertiliser units.

The Government of Gujarat has ambitious plans for accelerating the industrial growth of the state. Investments worth Rs. 1,000 billion have been earmarked for infrastructure projects (excluding Power, LNG terminals and Refineries) over the next 15 years. Majority of these investments (over 50%) are expected to be concentrated in the Central and South Gujarat corridors. The break up of the investments across industries is as under:

- Chemical and Petrochemical 60%
- Glass 10%
- Ceramics & Cement 10%
- Engineering 10%
- Textiles 10%

The demand for natural gas in Gujarat, is expected to reach 44 MMSCMD from the current level of 27 MMSCMD - by 2007. Power and Fertiliser units will continue to be the main drivers of demand for natural gas and are expected to account for nearly 75% of this demand.

The power sector itself will contribute to half the total demand. By 2007, installed capacity in the state is expected to more than double, from the current level of 6800 MW to 15500 MW. Of this increase, gas and naphtha based plants will account for nearly 2500 MW.

Though demand for urea is likely to outstrip indigenous supply, further domestic expansions of 1.5 MMTPA may not fructify as it may be economical to set up dedicated, gas-based plants in the Middle East where natural gas is available cheaply.

The cement industry has predominantly used coal as fuel. However, deterioration in the quality of coal, inadequate supply and transportation bottlenecks coupled with the advantages of using natural gas an economical, environmental-friendly and efficient fuel has resulted in natural gas being considered as a suitable substitute for coal. At one point 40 MMTPA of new cement manufacturing capacity was envisaged in the state. Due to the current recession in the domestic market and collapse of the export market, these projections have been scaled down to 10 MMTPA and the corresponding demand for natural gas will not exceed 2 MMSCMD by 2007.

Demand for natural gas from other industries is unlikely to exceed 20% of the demand from the above core drivers going by the consumption figures provided by GAIL and the expansion plans of the glass, ceramic and petrochemical industries.

Over a longer time-frame, (by 2017), issues relating to efficiency and environment will drive the demand for natural gas to 98 MMSCMD, the power sector accounting for nearly 75% of the demand.

In order to be considered for substitution of competing fuels - naphtha, domestic coal, imported coal and lignite - natural gas will have to be priced at US$ 5.3, 4.9, 4.6 and 2.7 per MMBTU, respectively, at current prices.

On the supply side, currently, Gujarat produces about 9 MMSCMD of natural gas (12 % of India's total natural gas production) from its Gandhar & Tapti basins and Hazira. This figure is expected to increase to about 28 MMSCMD (inclusive of Coal Bed Methane) by 2007 *(source: Ministry of Petroleum and Natural Gas, Annual Report 1997-98)*. The shortfall of around 16 MMSCMD in 2007 will have to be met though the import of LNG.

This potential for natural gas will attract large-scale private investments in the areas of gas transmission, distribution, and storage. Scattered demand centres, across the state, will necessitate the creation of a gas grid in Gujarat. In order to attract investment and create a level playing field for both public and private promoters, it is necessary to have an independent regulatory authority in place.

The following distinct areas exist in the natural gas industry:

- Gas exploration and production
- Gas transmission
- Gas distribution

Gas transmission is a natural monopoly because the minimum efficient scale of operation is very large in relation to the market and only one supplier can function if the cost of service is to be kept at minimum. The majority of pipeline costs are fixed costs and a very small proportion is the variable cost i.e. operation & maintenance costs. Hence any existing pipeline operator can effectively prevent competition from entering by reducing cost of service. A newcomer who has to cover total costs cannot compete with an existing entity.

Ever since the Government of the United Kingdom began selling off state-owned utilities in 1984, it has become a role model for privatisation and unbundling of services. Governments around the world have embraced not only the privatisation ideology but also its methods. The RPI-X formula, which is used to set the prices that UK privatised utilities charge their customers, has driven gains in efficiency so successfully that it is becoming the method of choice in countries from Argentina to Australia.

The regulatory authority should comprise the Chairman and two other members with a tenure of around 3-5 years, and an upper age limit of 65 years. The members should be appointed through a legislative process. Any member of the regulatory authority may be removed from office by order of the Governor of the State after the High Court has reported that the member ought to be removed.

The responsibilities of the State Regulatory Authority would include:

- Establishing procedures, promoting efficiency and economy through optimal utilization of pipelines.
- Laying down procedures for effective settlement of disputes
- Monitoring compliance of safety, regulations and standards.

In the long-term, gas and power regulators can be expected to be merged on account of the increasing convergence of the two markets.

1.1 Background and Terms of Reference

The Government of Gujarat has designated the Gujarat State Petroleum Corporation (GSPC) as the nodal agency for exploration and exploitation of oil and gas in the state. As part of its vision to pursue a multi-dimensional role to meet the state's energy needs, GSPC plans to set up a gas grid to supply natural gas in the state. In this context, TCS was given the following mandate:

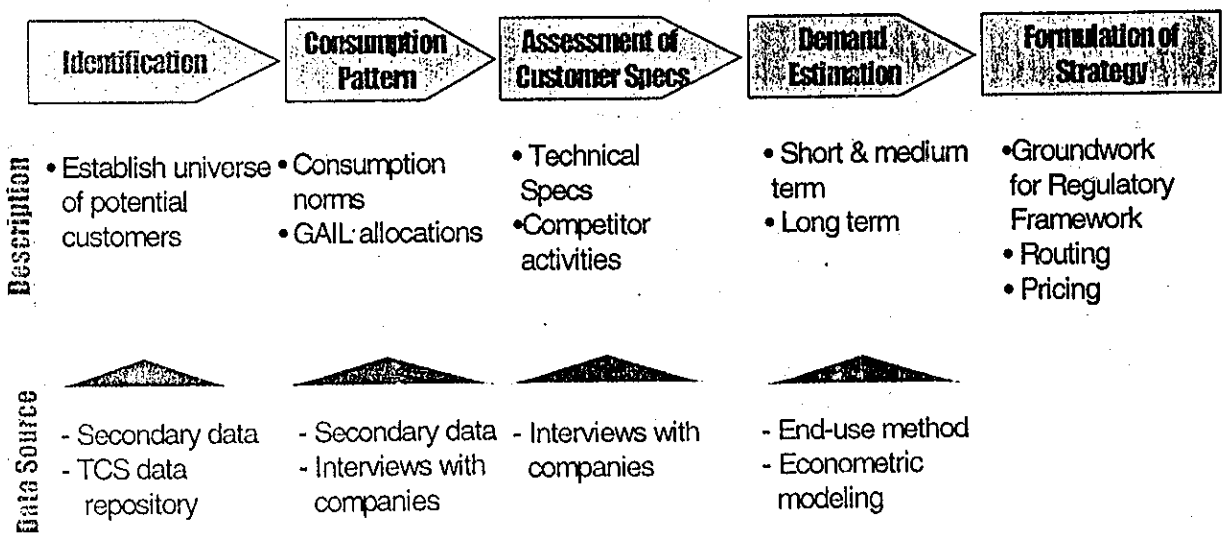
- Preparation of macro-level regulatory framework for gas distribution in Gujarat
- Assessing demand – supply for natural gas in Gujarat
- Advising on gas pricing

1.2 Scope of the engagement

The scope of the engagement for assessing demand of natural gas was restricted to units in the power, fertiliser, refinery, petrochemicals, steel, glass and cement industries, and the transportation and household sectors. The geographical scope was restricted to the state of Gujarat. Gas demand was projected over the short term (5-year), medium term (10-year) and long term (20-year) horizon.

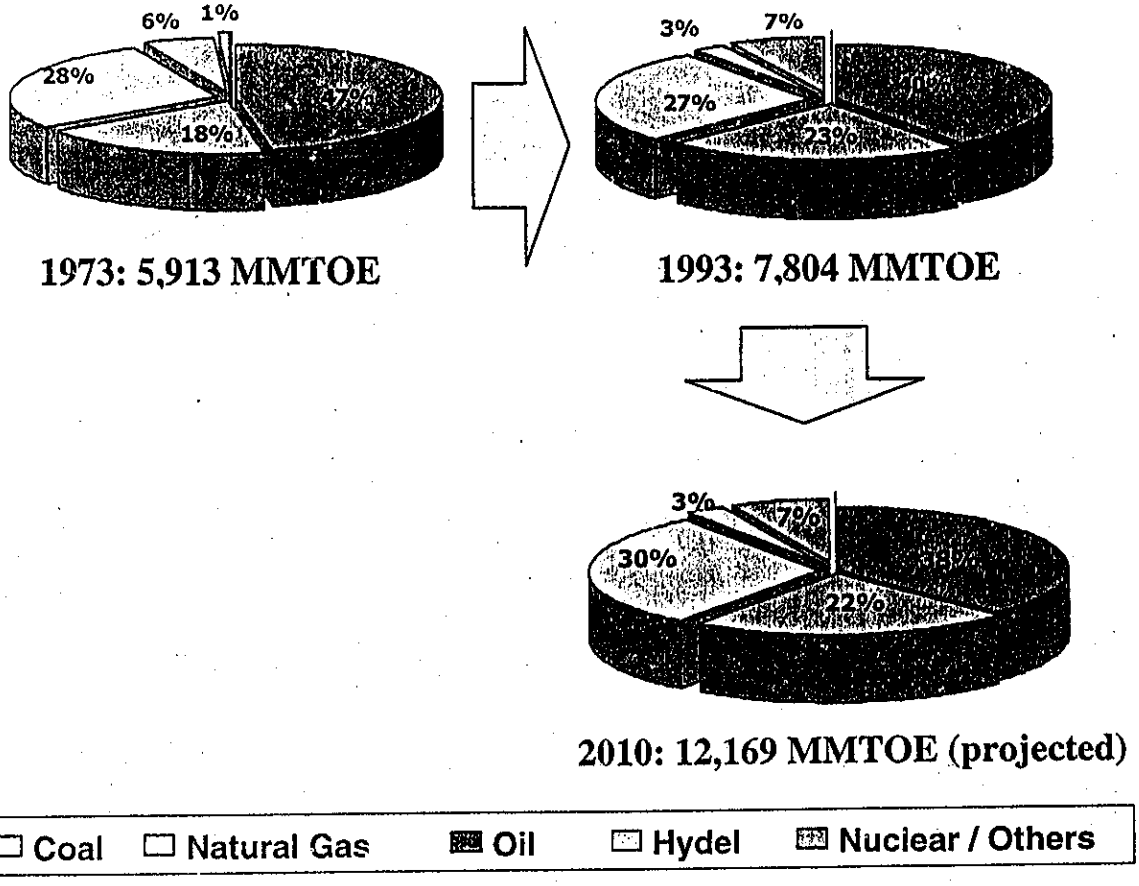
1.3 Approach & Methodology

TCS' approach and methodology, for execution of this assignment, has been pictorially represented below:



2.1 The Global Energy Scenario

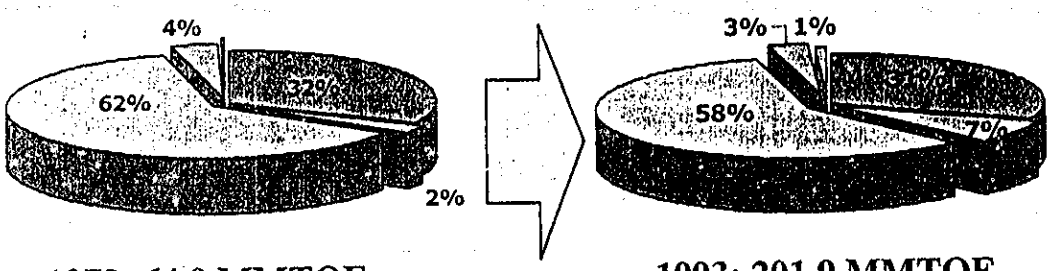
There has been a steady increase in global energy consumption: from 5,913 MMTOE in 1973 to 7,804 MMTOE in 1993. Energy consumption is expected to reach 12,169 MMTOE by 2010. Oil and gas account for around 60% of global energy consumption and this trend is expected to continue.



Source: IEA Estimates

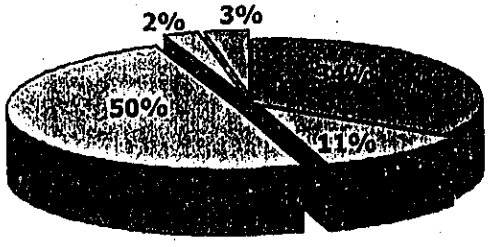
2.2 The Indian Energy Scenario

Indian energy consumption has registered a higher growth of 6% p.a., from 1973 to 1993, as compared to the world average of 1.5%. This high growth rate is on account of industrialisation and the shift from non-commercial to commercial energy sources. The total energy consumption, in India is likely to double by 2010. Natural gas is gradually emerging as a viable alternative to coal.



1973: 64.9 MMTOE

1993: 201.9 MMTOE

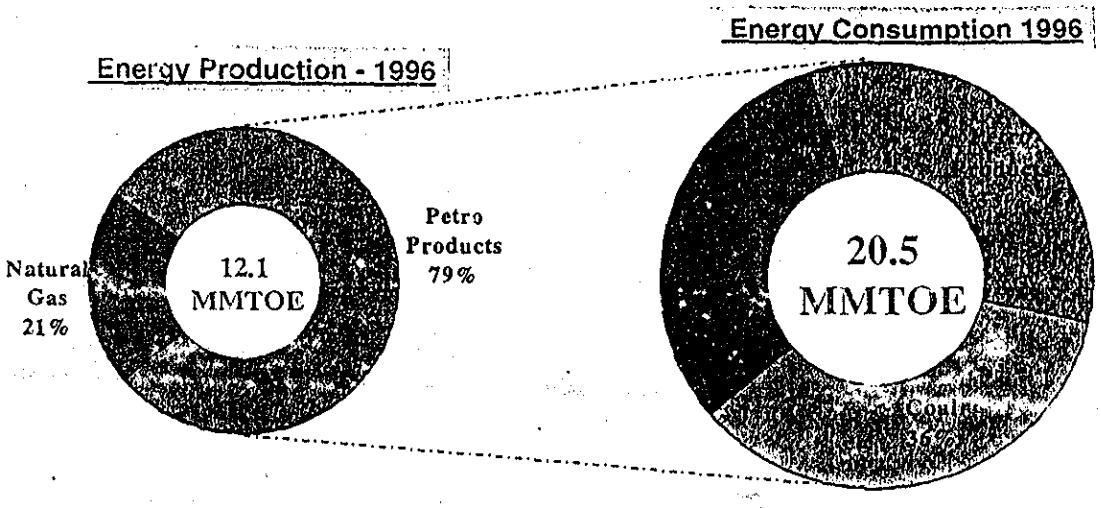


2010: 477 MMTOE (projected)

Coal | Natural Gas | Oil | Hydel | Nuclear / Others

Source: IEA Estimates

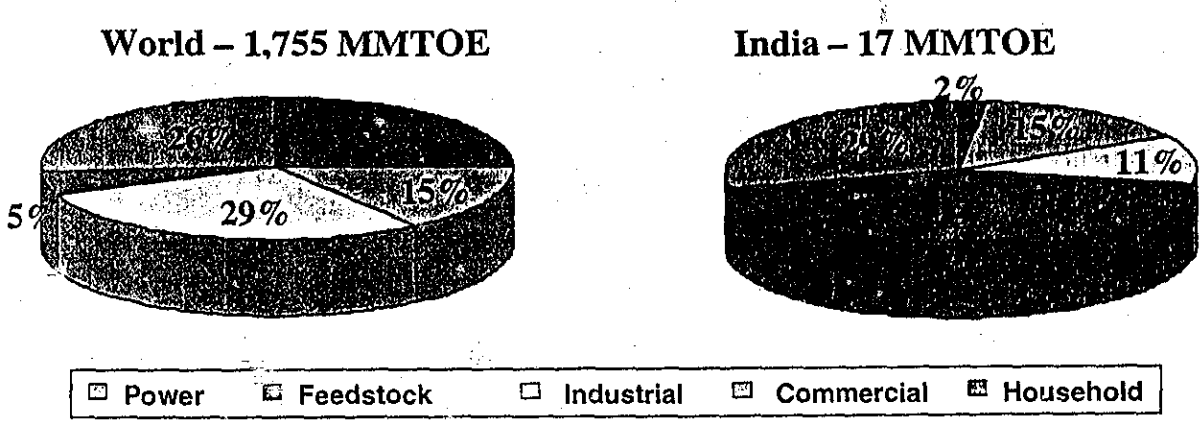
2.3 Energy Scenario in Gujarat



Source: GAIL, CIL, CMIE

Gujarat accounts for 9% of national energy consumption but has only 4% of the population of India. This is an indication of the relatively high level of industrial development of the state. The state has limited coal deposits and oil / gas is the major local sources of energy. The short fall in energy production of about 40 % is met by imports from neighbouring states.

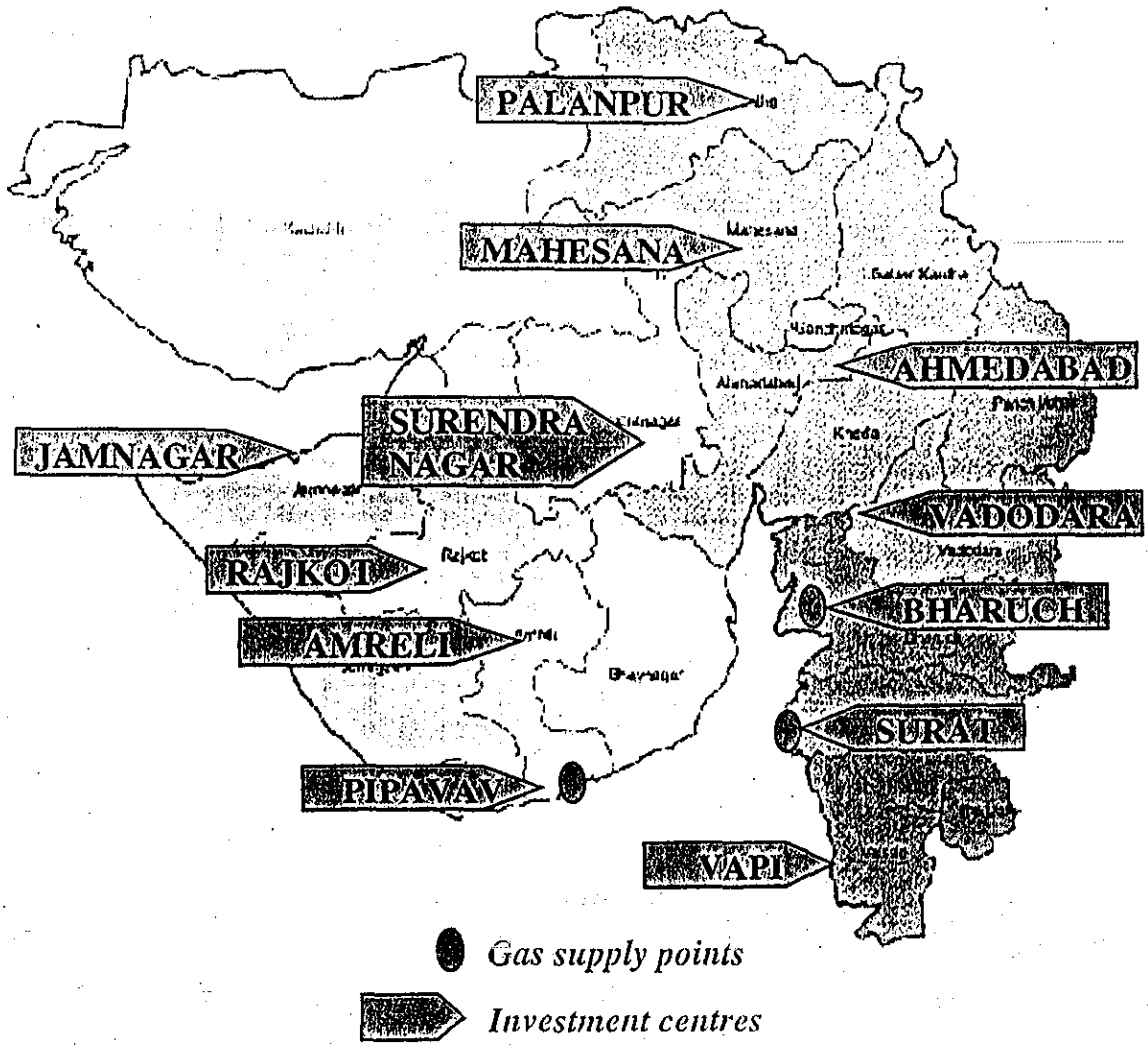
2.4 Natural Gas Consumption – India v/s the World



Source: 'R' Group Report, 1996

India accounts for only 1 % of the world's natural gas consumption. Nearly half of the total natural gas is consumed as feedstock, in India, as compared to 5 % globally. This is not surprising since the only major gas transmission system in India, the HBJ pipeline, was set up to provide feedstock to fertiliser plants.

3.1 The Investment Corridor



Source: Industries Commissionerate, Gandhinagar

Investments worth Rs. 1,000 billion are expected to be made in Gujarat over the next 15 years. This figure does not include investments in Power, Refineries, and LNG terminals. Majority of these investments (over 50%) are expected to be concentrated in Central and South Gujarat. Chemical and petrochemical industries would account for over 60% of total investment while glass, ceramics & cement, engineering and textiles, would account for 10% each.

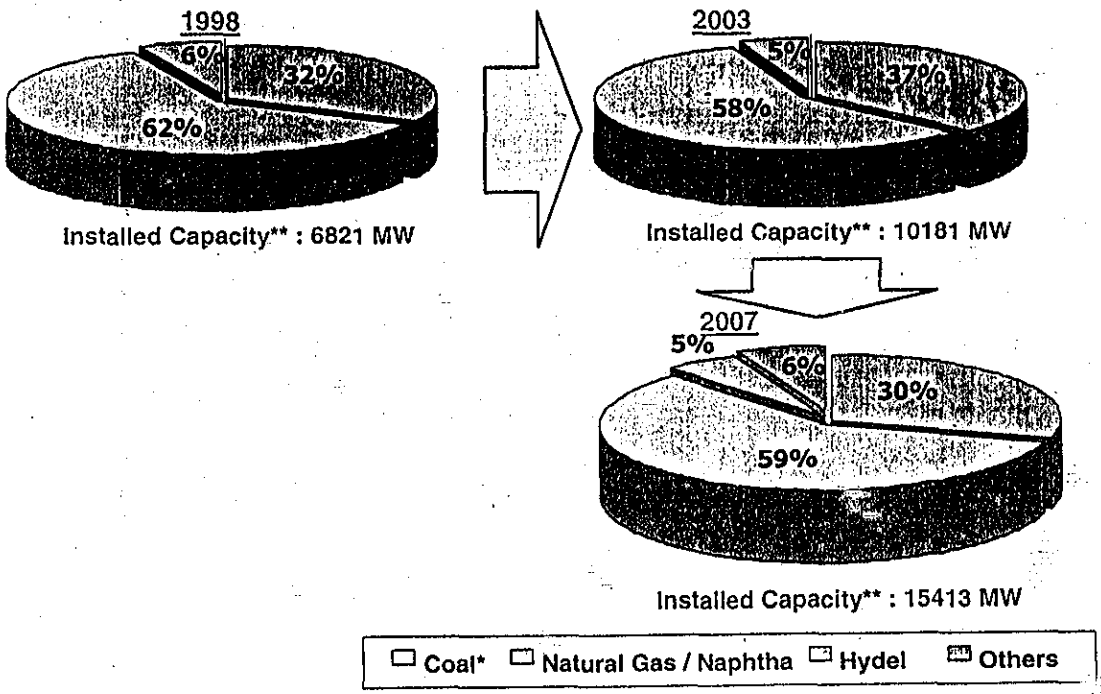
3.2 Gas Allocation for Gujarat

The gas allocation for consumers in Gujarat is as shown below:

Along HBJ Pipeline		Onshore Gas Consumers in Gujarat	
GSFC - Vadodara	0.45	IFFCO - Kalol	0.84
IPCL - Vadodara	0.90	GSFC - Vadodara	0.35
IOCL - Vadodara	0.40	GEB - Dhuvaran & Utran	0.75
NTPC - Kawas	0.75	GNFC - Bharuch	0.60
		Heavy Water Project	0.13
Gas Allocation at Hazira		Baroda City Gas	0.06
		AEC - Vatva	0.40
KRIBHCO	3.00	Gujarat Gas Co.	0.17
Essar Guajarat	1.40	Reliance Industries Ltd.	0.08
Reliance Industries	0.50	GIPCL - Vadodara	0.70
Gujarat Gas Co. Ltd.	0.30	NTPC - Gandhar	1.50
Heavy Water Project	0.10	Torrent - Gandhar	1.50
		Gujarat Guardian Ltd.	0.12
Total	7.80		7.20
	Grand Total	**15.00**	

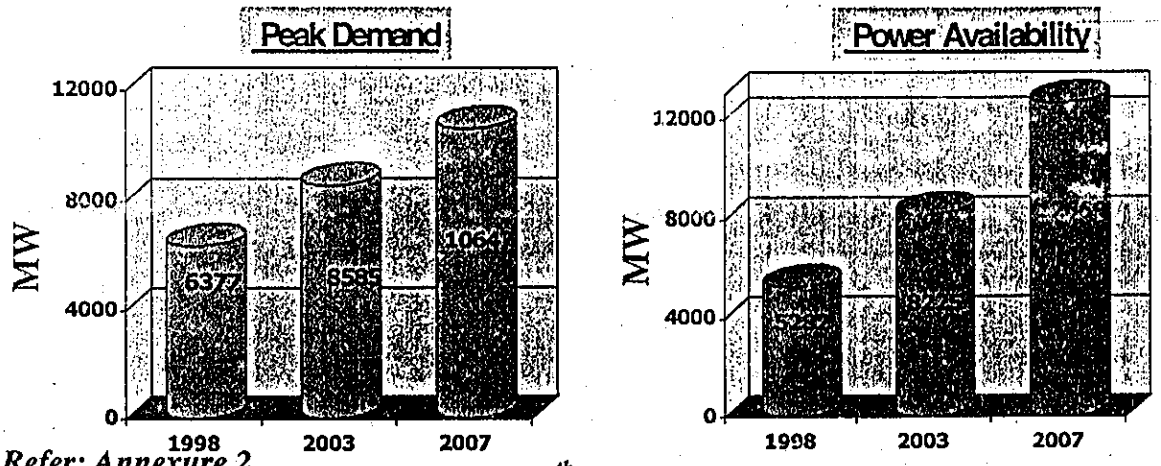
Source: GAIL

3.3 Power Scenario in Gujarat



*[Note: * indicates coal, lignite and petroleum coke and ** indicates installed capacity of all power plants in the state (including central plants but excluding captive power plants)]*

Over the next 10 years, 2000 MW of gas-based capacity is expected to be installed. This excludes naphtha-based projects, which may switch to natural gas, if it is available. Total gas and naphtha based capacity addition is estimated to be of the order of 2,400 MW. In addition, captive power capacity is expected to increase from 1,540 MW to 2,900 MW by 2007.

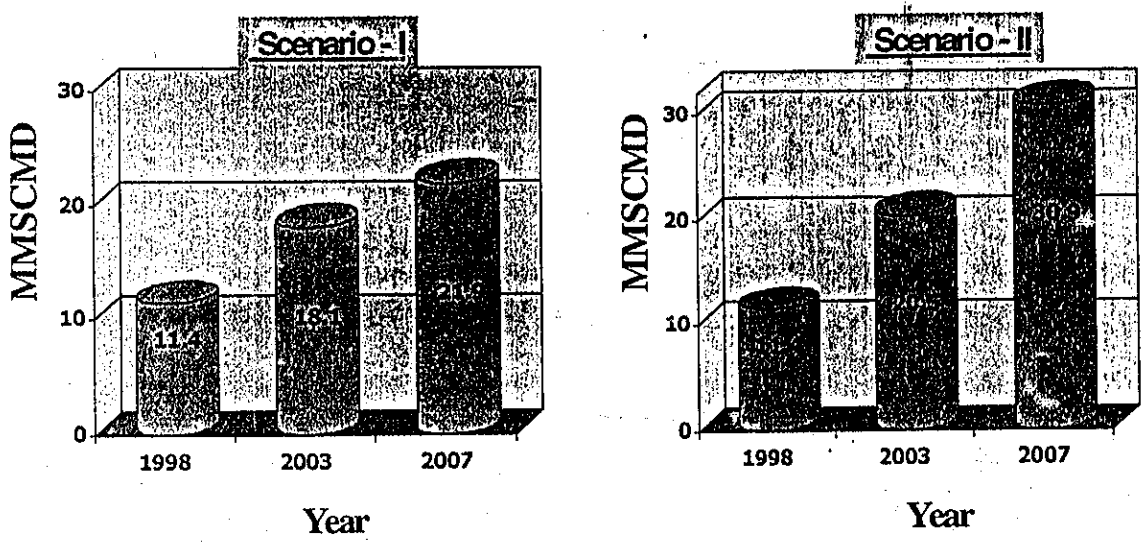


Refer: Annexure 2

Source: 15th EPS, TCS Estimates

With an estimated capacity addition of nearly 7,500 MW, Gujarat is likely to move from being a peak power deficit state (-1,100 MW) in 1998 to a power surplus one (+ 2,000 MW) by 2007 assuming that the growth in Net State Domestic Product (NSDP) remains below 7%.

3.3.1 Demand for Natural Gas from Power Sector



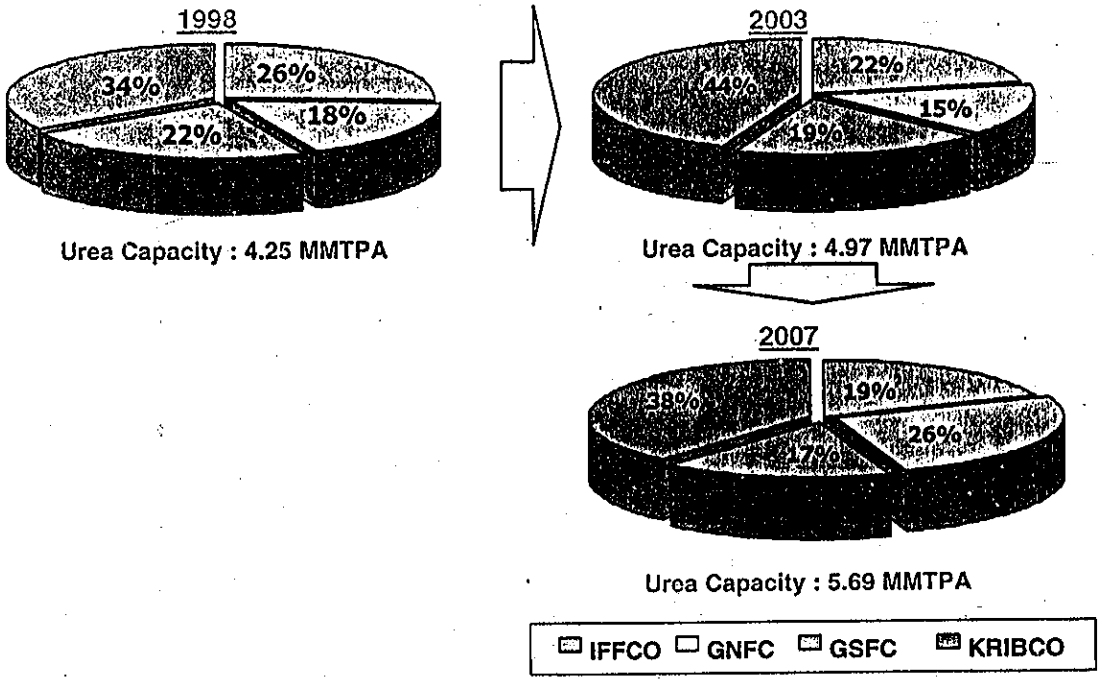
Refer: Annexure 2

(Note: Plant Availability assumed to be 85%)

Assuming that the proposed capacity additions come through (Scenario I), the demand for natural gas is expected to rise to 22 MMSCMD at the end of the ten-year period (1998-2007).

However, in the event the state government decides on a single 510 MW gas based plant in lieu of the scrapped 10 small power plants, and a single 2,000 MW gas based project in Pipavav instead of three separate plants (2 x 615 MW gas based plants & 1x 1,000 MW imported coal based plant), this demand will increase to nearly 31 MMSCMD (Scenario II).

3.4 Fertiliser Scenario in Gujarat

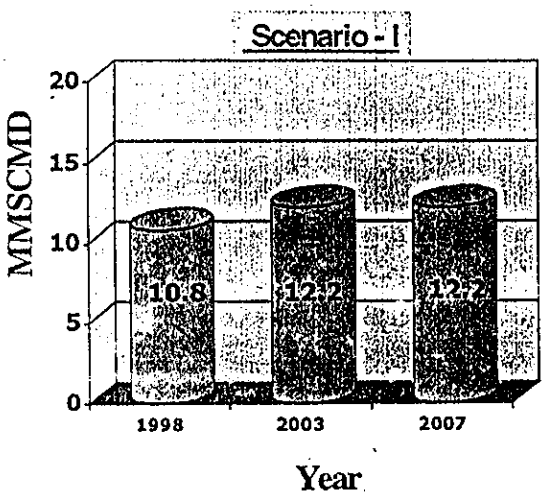


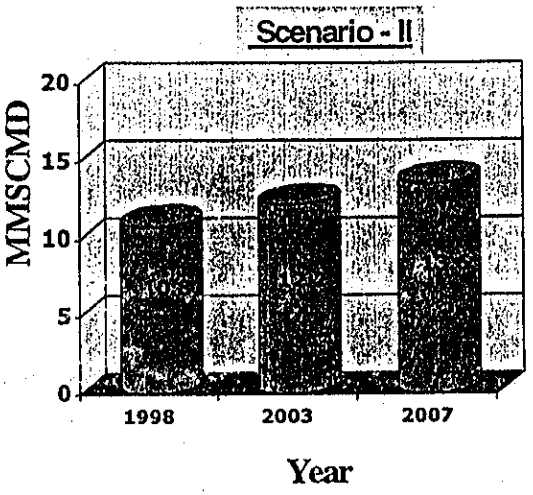
Refer: Annexure 3

Source: Company sources

On account of the expansion plans of existing fertiliser units, urea capacity in the state is expected to increase by nearly 33% - 4.25 MMTPA in 1998 to 5.69 MMTPA by 2007. There is, however, some thought by the Ministry of Fertiliser to locate new capacity in the Middle East where natural gas is cheaper. This may affect the fructification of the expansion plans of the units in Gujarat.

3.4.1 Demand for Natural Gas from Fertiliser Industry



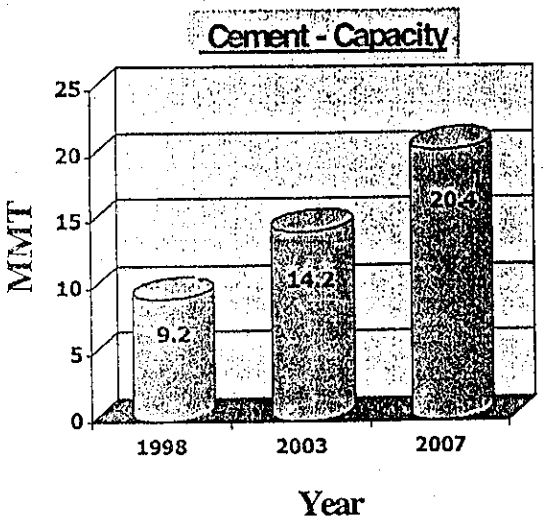


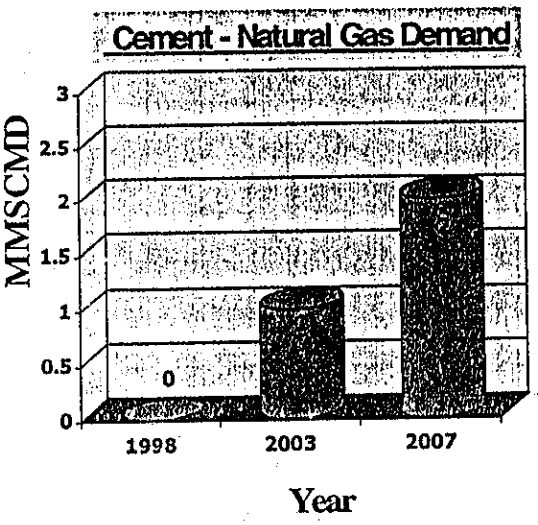
Refer: Annexure 3

Of the proposed capacity augmentations, the likelihood of the expansion plans of GNFC to fructify is quite low (Scenario I). Correspondingly, demand for gas from the fertiliser industry is likely to increase marginally to 12.2 MMSCMD by 2007.

In the event the GNFC plant does come up (Scenario II), this demand will increase to 13.6 MMSCMD by 2007.

3.5 Cement Scenario in Gujarat





Refer: Annexure 4

Source: Cement Manufacturers' Association

Despite being endowed with large limestone deposits, cement capacity in Gujarat is expected to only double from a current level of less than 10 MMT to just over 20 MMT in the next 10 years. The ongoing recession in the country and the collapse of the export market in South East Asia has put the brakes on the addition of new capacity. Currently all plants use coal / lignite. Use of natural gas improves the plant efficiency and new plants can be expected to use natural gas. Assuming that 50 % of the new capacities will be operated on natural gas, the demand for natural gas from this industry will be around 2 MMSCMD by 2007.

3.6 Demand for Natural Gas from Other Industries

Power, fertiliser and cement industries form the core demand drivers for natural gas. A preliminary survey of the glass and ceramic industries reveals that their gas requirements are 0.51 and 0.07 MMSCMD respectively. The survey included companies like Gujarat Guardian Ltd., Gujarat Borosil Ltd., Alembic, Gopal Glass Works, Bell Ceramics, Somani Pilkingtons, Madhusudan Ceramics and Swastik Ceramics. Other pointers to this demand are provided below:

- Current consumption of gas in the petrochemical industry is 0.5 MMSCMD
- Supply of gas by Gujarat Gas Company Limited, for domestic and commercial use, after 10 years of operation (1989-98) is 0.67 MMSCMD
- GAIL allocations for the glass industry are around 1.6 MMSCMD
- Potential demand for natural gas in the Vapi area, as detailed below, is unlikely to exceed 0.05 MMSCMD

Thus, the demand from these industries is unlikely to exceed 20% of the demand from the above core demand drivers.

3.6.1 Potential Demand for Natural Gas in Vapi

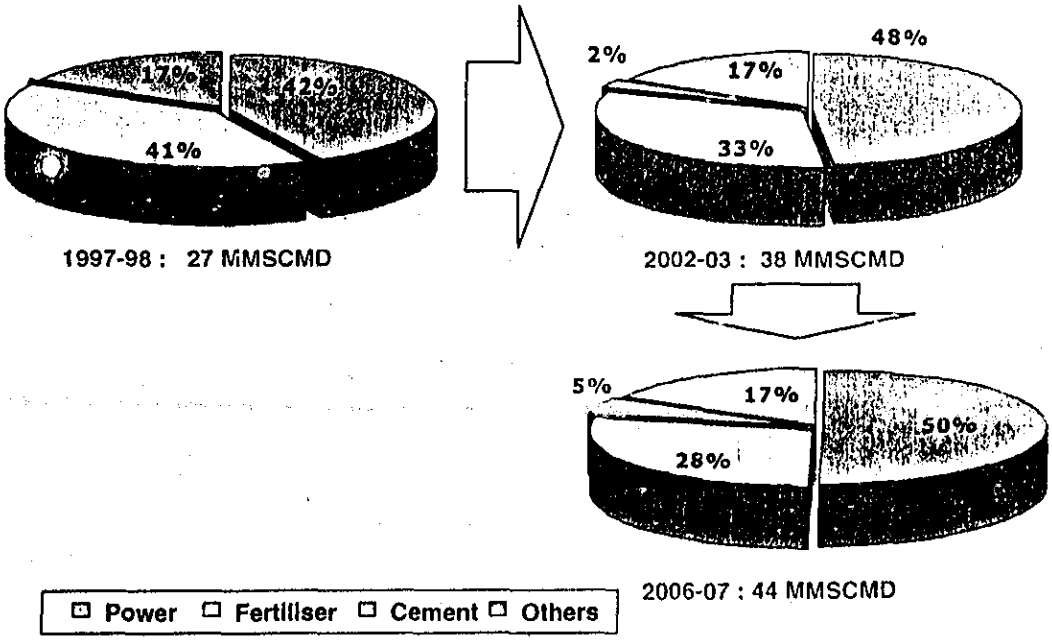
The industrial belt in Vapi, South Gujarat comprises textiles (dyeing), chemical, petrochemical and pharmaceutical units. Apart from a handful of medium to large manufacturing units, the Vapi belt is dotted with small scale industrial units.

The following extract outlines the details of the large-scale units (listed companies) in Vapi which were considered as potential natural gas consumers.

All the companies, except United Phosphorus, use multi-fuel boilers, which can support a gas fuel (The multi-fuel boiler at United Phosphorus can not be operated with gas). The boilers used in the small scale units are of the single fuel type operating either on FO or LDO. The small capacities, however, may render the switch to a gas based boiler financially unattractive.

Company	Products	Capacity (MT)	Fuel used	Potential Gas Demand (lit/day)	(MMCFD)
United Phosphorus Ltd.	Pesticides	14445	Fuel oil	15000	0.60
	Pesticide Intermediates	12240			
	Phosphorus compounds	29450			
	Mercury Salts	100			
Themis Chemicals Ltd.	Bulk Drugs	200	LDO	1000	0.04
	Tablets	200 mn. Noose			
	Syrups	0.37 mn ltrs.			
	Injections	0.05 mn. Ltrs			
	Drug Intermediates	220			
Beta Naphthol Ltd.	Dye intermediates	4860	Fuel Oil	2000	0.08
	Dye Stuff	600			
	Beta Mix	150 k. ltrs			
Pidilite Industries	Chemicals	47882	Fuel oil	15000	0.60
	Dyestuffs	2364			
Other Small units (boiler capacity : 1-2T)			Fuel Oil / LDO		0.25
			Total Potential Demand (Approx.)		1.57 MMCFD 0.04 MMSCMD

3.7 Summary of Natural Gas Demand in Gujarat

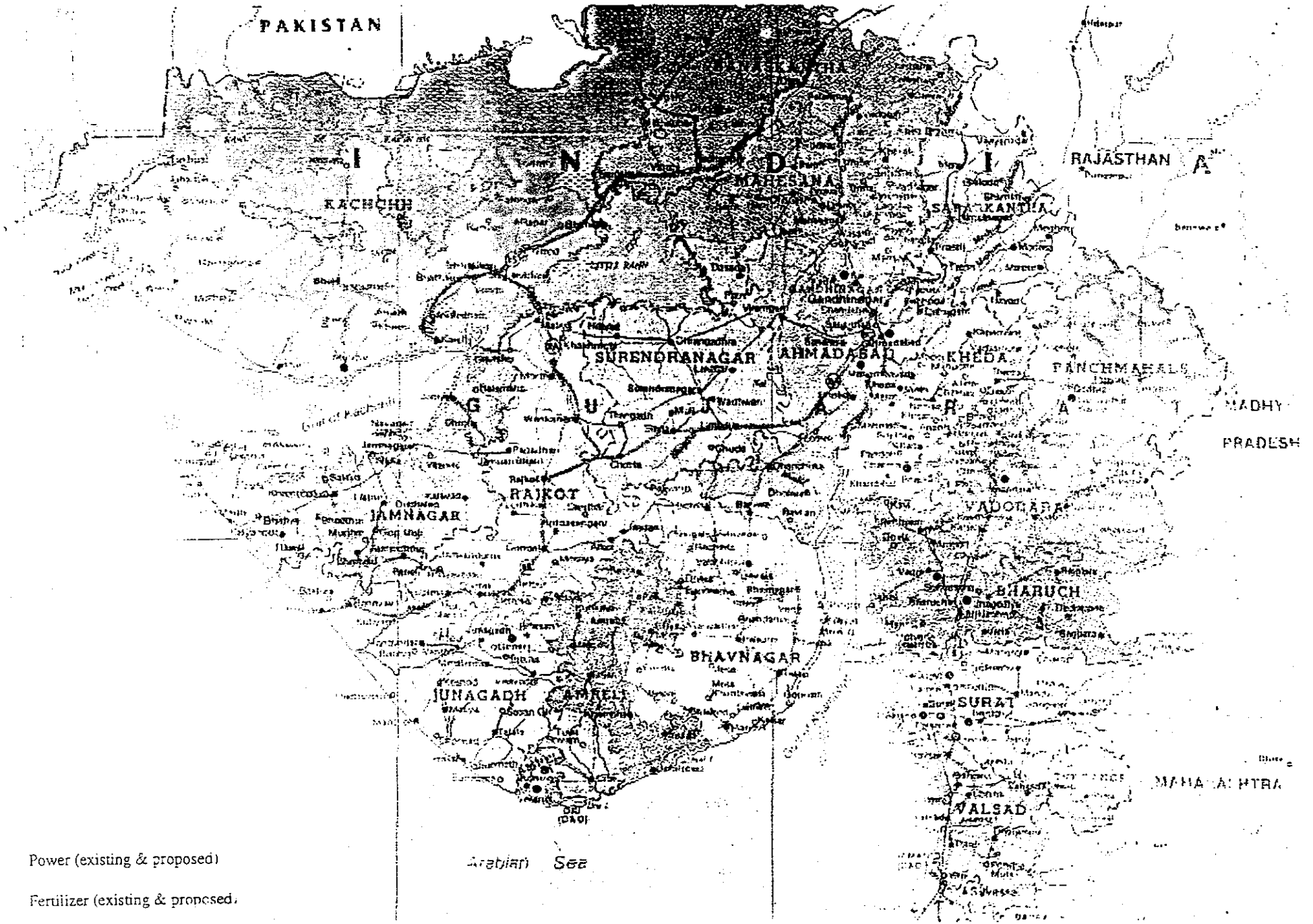


In the first scenario (Scenario I), demand for natural gas is expected to increase from the current estimates of 27 MMSCMD to 44 MMSCMD by 2006-07.

As per the alternative scenario (Scenario - II) described in previous sections - the demand for natural gas will shoot up to nearly 56 MMSCMD by 2006-07.

3.8 Cluster-wise distribution of Companies

The table on the following page depicts the distribution pattern of natural gas consumers in Gujarat. Most of the current demand is concentrated in the north-south axis running from Surat to Mehsana. Future demand points like Chaara- Pipavav lie along the Saurashtra coast. The proposed LNG terminal at Pipavav could meet the demand in this part of Gujarat.



Power (existing & proposed)

Fertilizer (existing & proposed)

CLUSTERS	INDUSTRY	POWER	FERTILISER	OTHERS
	HAZIRA - BHARUCH	• Essar Power • GEB - Utran Gas TPS • NTPC - Kawas • NTPC - Gandhar • GTEC - Gandhar • GSPCL - Hazira	• GNFC Bharuch • KRIBCO - Surat	• Reliance Petrochemicals Ltd. • IPCL - Gandhar
	VADODARA - GANDHINAGAR	• AEC - Vatva & Ahmedabad • GEB - Dhuaran	• GSFC - Vadodara • IFFCO - Mehsana	• ICC - Koyali • IPCL - Vadodara
	CHAARA - PIPAVAV	• GPCL - Pipavav • GPCL - Chaara • KRIBCO - Junagadh	• None	• Narmada Cement - Amreli • L&T Cement - Amreli • Gujarat Ambuja - Amreli
	OTHERS	• GIPCL - Godhra • GPCL - Mundra	•None	• Reliance Ind. - Jamnagar • Essar Refineries, Vadinar • Pittie Cements - Bhavnagar • Indian Rayon - Bhavnagar • DLF Guj. Ltd. - Kutchh • J K Corp - Kutchh • Sanghi Cement - Kutchh • Grasim Ind - Junagadh • Saurashtra Cement - Junagadh

3.9 Customer Responses / Technical Specifications

Some of the customer responses have been captured verbatim, as given below:

'They have given us concrete proposals ... but they do not assure us continuous supply... '

Mr. K. Das
Executive Director
KRIBHCO

'I want gas.. give me gas and I will use it instead of naphtha for our expansion program '

Mr. Manoj Saxena
Senior Supdt. - Maintenance & Planning
NTPC - Gandhar Power Plant

'Give me gas at a price lower than naphtha and we will change over...'

Mr. D. S. Sharma
General Manager - Operations,
NTPC Kawas

'If the price is less than naphtha and you give us an assured supply ... we would use gas instead of naphtha..'

Mr. U. Bhatt
Asst. General Manager (Finance)
GTEC

The following table provides the technical specifications as indicated by current and potential natural gas consumers:

Industry	Power	Fertiliser	Others
Calorific Value (kcal/SCM)	8,500 – 10,300	9,500	Petrochemicals – 8,500 Refineries – 11,000
Pressure (PSI)	280 – 350	644 – 650	Not available

GSPC must address the following issues in marketing the gas grid

- Reliability of supply
- Customer technical specifications
- Routing options
- Transportation price

3.10 Demand for Natural Gas from Neighbouring States

All figures in MMSCMD

State	1998	2003	2007
Rajasthan			
Power	1.95	9.11	9.11
Fertiliser	1.95	3.40	3.40
Madhya Pradesh			
Power	0.00	4.67	4.67
Fertilizer	2.70	2.70	2.70
Maharashtra			
Power	0.85	0.85	5.33
Fertiliser	4.00	4.00	4.00

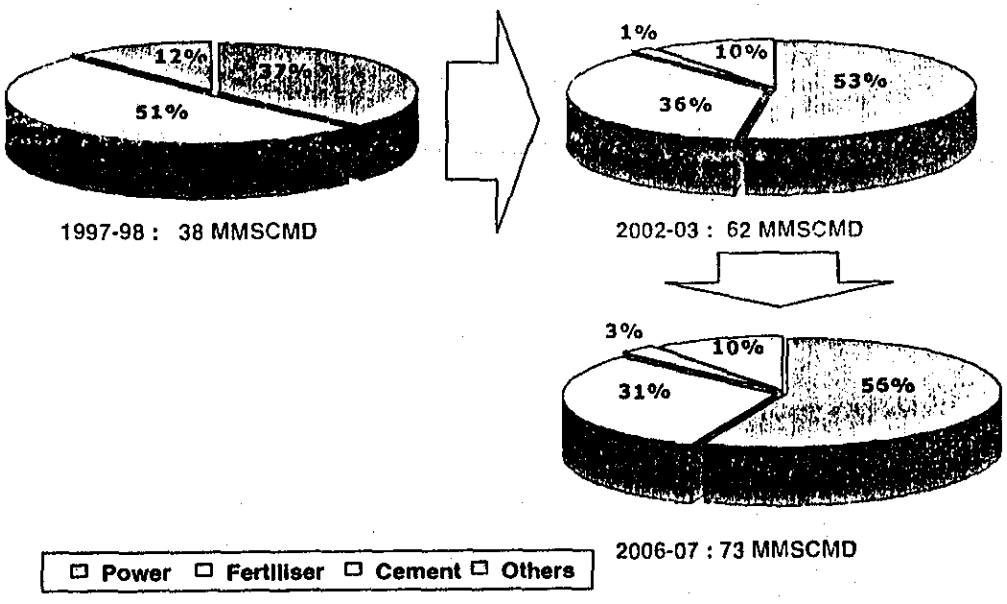
(NOTE: Only those units in close proximity to the HBJ pipeline have been considered)

Refer: Annexure 5 ***Source: TCS Estimates***

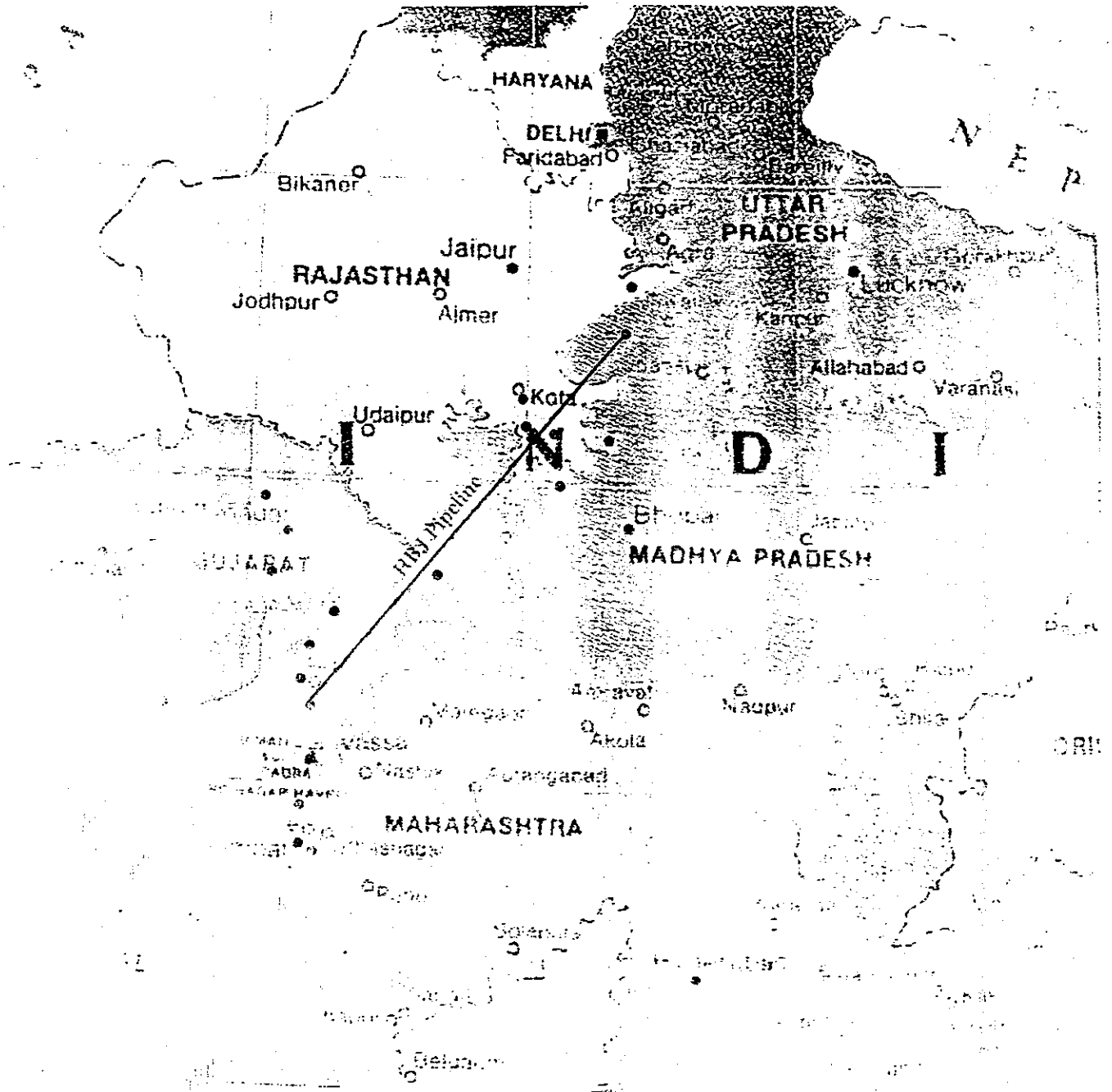
The total demand for natural gas from the adjoining areas of the neighbouring states of Rajasthan, Madhya Pradesh, and Maharashtra, is expected to increase from the current level of 12 MMSCMD to 29 MMSCMD by 2007. The ratio of demand of natural gas from the

power sector to that from fertiliser plants will change from 0.32 to 1.89 indicating a major increase in demand from the power sector as against a stagnant demand from the fertiliser sector.

3.11 Summary of Natural Gas Demand in Gujarat and Neighbouring States



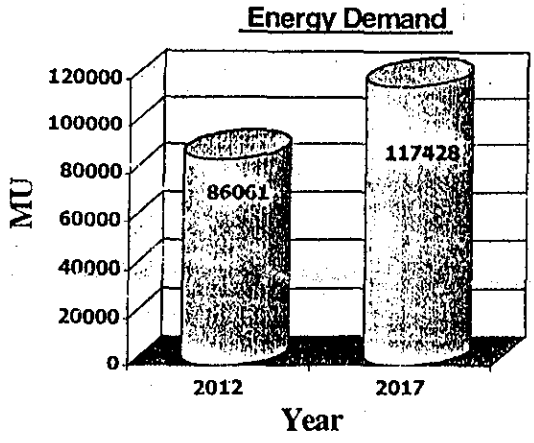
Demand for natural gas, in Gujarat and adjoining areas of neighbouring states, is expected to increase from the current level of 38 MMSCMD to 73 MMSCMD by 2006-07.

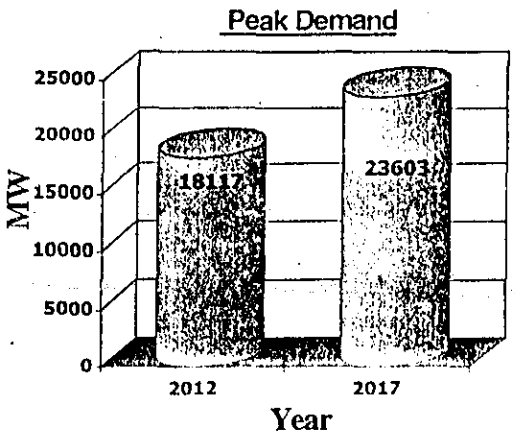


Power (existing & proposed)

Fertilizer (existing & proposed

4.1 Power Scenario in Gujarat



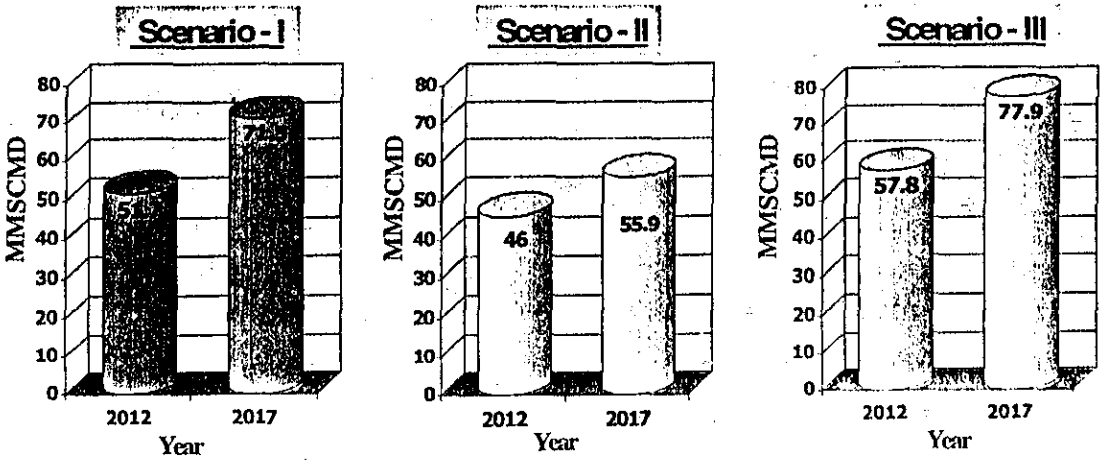


Refer: Annexures 6 & 7

Source: TCS Estimates

The Net State Domestic Product (NSDP) of Gujarat is expected to grow at 6% per annum in the long term; this translates into a power-demand growth rate of 7.1% p.a. Power-demand growth rate is, however, expected to decline from 7.1% p.a. in 2002 to 5% p.a. in 2017 due to development of energy-efficient technologies.

4.1.1 Demand for Natural Gas from Power Sector



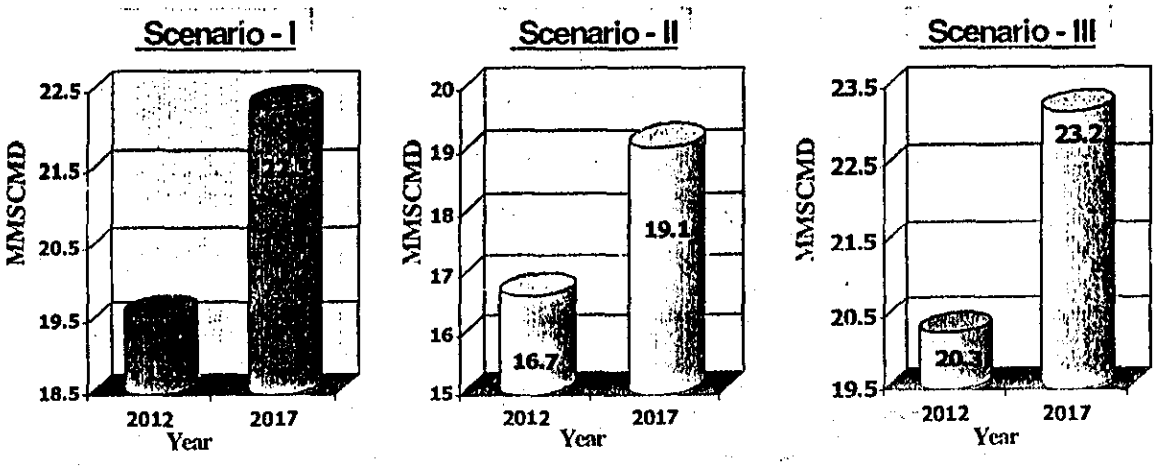
Refer: Annexures 6 & 7

With low availability of domestic fossil fuels in Gujarat, all additional plants (in line with a 6% growth in NSDP p.a.) are expected to be based on natural gas / coal bed methane (Scenario I). Consequently the demand for natural gas is estimated to be 71 MMSCMD by 2017.

Assuming only 50% of the additional plants are based on natural gas (Scenario II), the demand for the same is expected to be nearly 56 MMSCMD by 2017.

If the NSDP growth rate increases to 7% p.a. during IXth and Xth plan periods and stabilises at 6% p.a. thereafter, and if all additional plants are gas-based (Scenario III), the demand for natural gas is expected to reach 78 MMSCMD by 2017.

4.2 Demand for Natural Gas from the Industrial Sector



Refer: Annexures 6 & 8

Increasing substitution of liquid petroleum products in industry by natural gas – driven by environmental and price considerations – will fuel the demand for the latter. Assuming an annualised growth rate of 6% in NSDP (Scenario I), the demand for natural gas from industrial sector is expected to be 22.3 MMSCMD by 2017.

If only 50% of liquid petroleum products are substituted by natural gas (Scenario II), the demand for natural gas will be restricted to 19 MMSCMD. For an NSDP growth rate of 7% per annum during IXth and Xth plan periods and 6% per annum thereafter, and 100 %

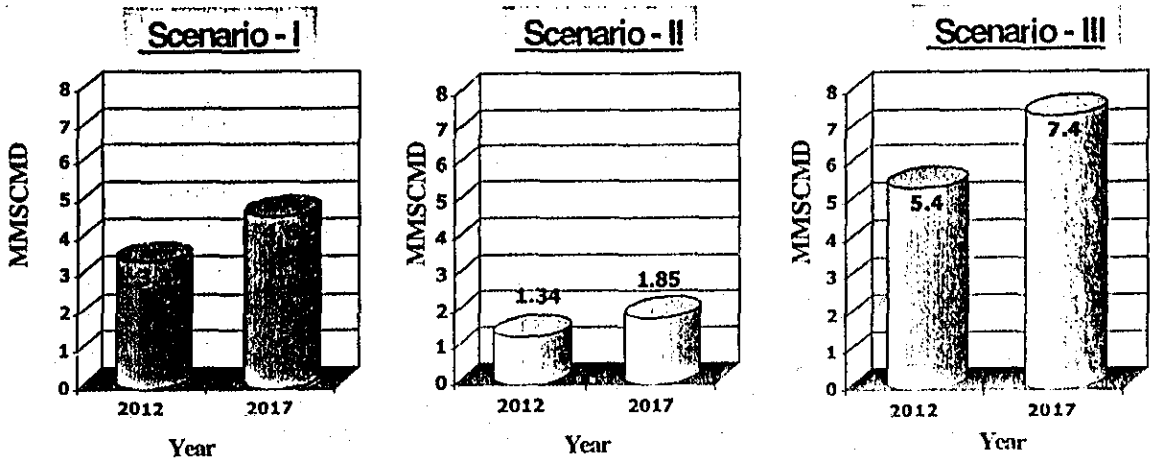
substitution (Scenario III), the demand is expected to be marginally higher at 23.2 MMSCMD.

4.3 Demand for Natural Gas from the Transport Sector

International experience shows that despite many virtues, infrastructural bottlenecks render Compressed Natural Gas (CNG) a poor substitute for liquid petroleum products. In the short-to-medium term CNG is unlikely to be popular mainly on account of:

- Limited availability of CNG across the state
- High cost of infrastructure build-up
- High cost of conversion kit, particularly for diesel vehicles

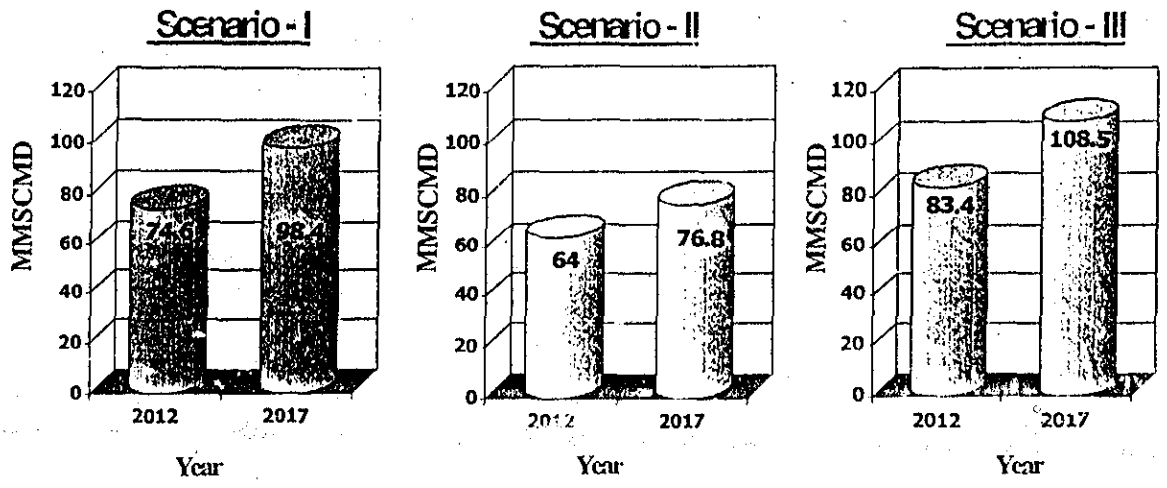
In the long term, CNG could substitute a small percentage of petrol in the passenger car segment. For diesel vehicles, due to high cost of conversion and lower cost of diesel, the usage of CNG is likely to be restricted to the public transport system only.



Refer: Annexure 6

At a 7% and 6% annualised growth in passenger cars and buses, respectively, the population of cars will increase from 3.3 lakhs in 1998 to 12 lakhs in 2017, while the number of buses will increase from nearly 32,000 in 1998 to over 81,000 in 2017. Assuming that 25% (Scenario I), 10% (Scenario II) and 40% (Scenario III) of these vehicles convert to CNG, the demand for natural gas will reach 4.6, 1.85 and 7.4 MMCMD respectively.

4.4 Summary of Demand for Natural Gas



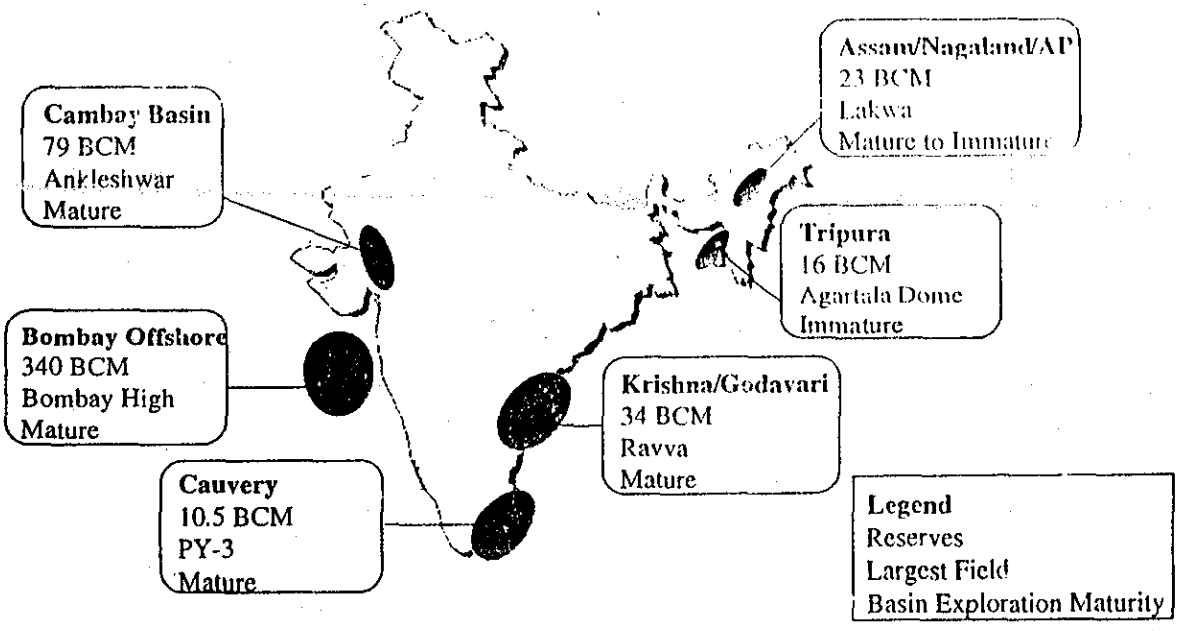
In line with the estimates pertaining to Scenario I (as stated in the previous sections), demand for natural gas is expected to quadruple from the current figure of 27 MMSCMD to 98 MMSCMD in 2017.

The pessimistic estimate (Scenario II) indicates the demand to reach 77 MMSCMD by 2017.

An NSDP growth rate of 7% pr annum during IXth and Xth plan periods and 6% per annum thereafter (Scenario III) will cause demand for natural gas to increase to 109 MMSCMD in 2017.

5.1 Productive Basins in India

The productive basins in India have been shown on the map below:



Source: Ministry of Petroleum & Natural Gas, Annual Report – 1995-96

5.2 Natural Gas Production in India

All figures in MMSCM

	1985-86	1990-91	1994-95	1995-96	1996-97	1997-98*
Onshore						
Gujarat	919	1696	2462	2878	2932	3115
Assam / Nagaland	2029	2011	1909	1880	1941	2018
Arunachal Pradesh	6	29	37	32	23	23
Tripura		70	97	131	154	196
Tamil Nadu		64	98	117	92	95
Andhra Pradesh		46	640	679	799	1022
Rajasthan				12	10	149
Offshore						
Bombay High	5180	14082	14138	16579	16794	18102
Total	8131	17998	19381	22308	22743	24720

provisional

Source: Ministry of Petroleum & Natural Gas, Annual Report – 1997-98

Bombay High is a major source of natural gas production in India and has been consistently contributing around 75% of the total gas produced.

All figures in MMSCMD

	1997-98	2002-03	2006-07
Domestic Production			
Gandhar - Onshore	8.0	6.3	3.4
Hazira	1.0	3.5	6.0
Tapti - Offshore		10.0	12.0
CBM		1.0	6.0
Total	9.0	20.8	27.4
Demand	27	38	44
Demand-Supply Gap	(18)	(17.2)	(16.6)

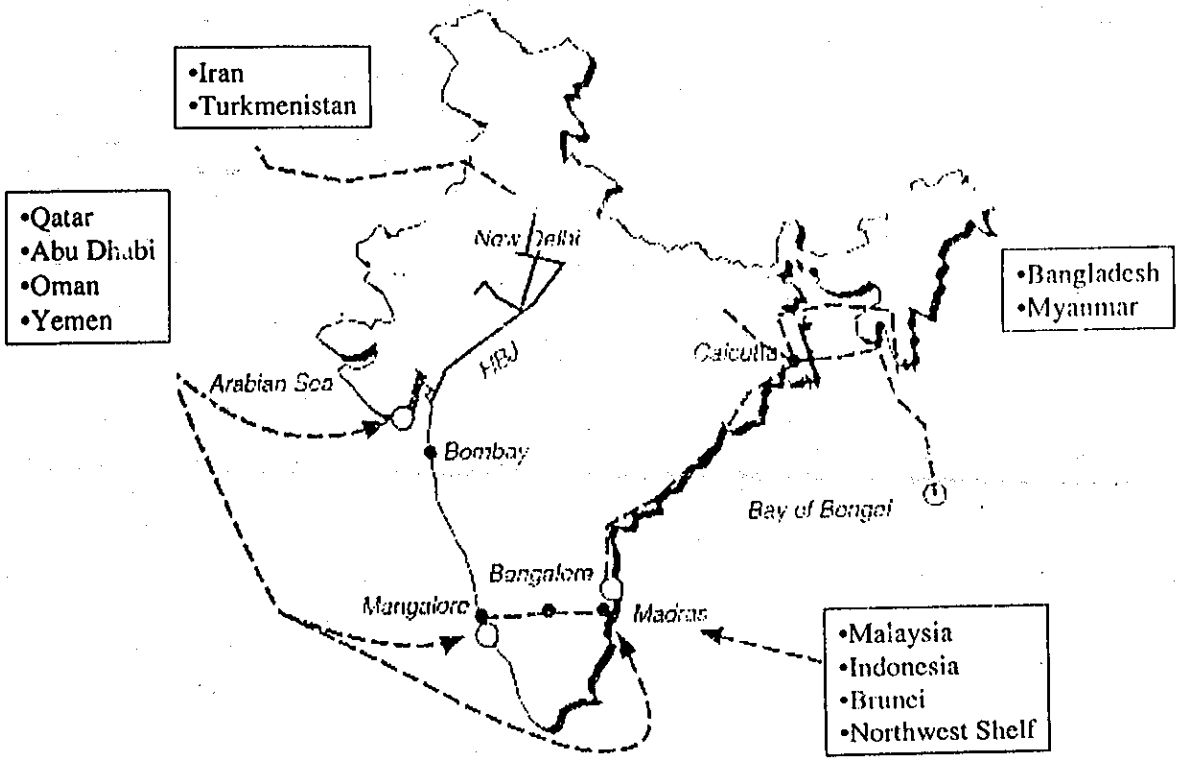
Source: Ministry of Petroleum & Natural Gas, Annual Report – 1997-98

5.3 Domestic Gas – Demand / Supply Scenario in Gujarat

The table indicates a drop in shortfall in supply of natural gas as a percentage of the total demand, but the absolute deficit is expected to be around 17 MMSCMD till 2007. The shortfall will have to be met by way of LNG imports or through cross-border pipelines.

5.4 Import Options for Supply of Natural Gas

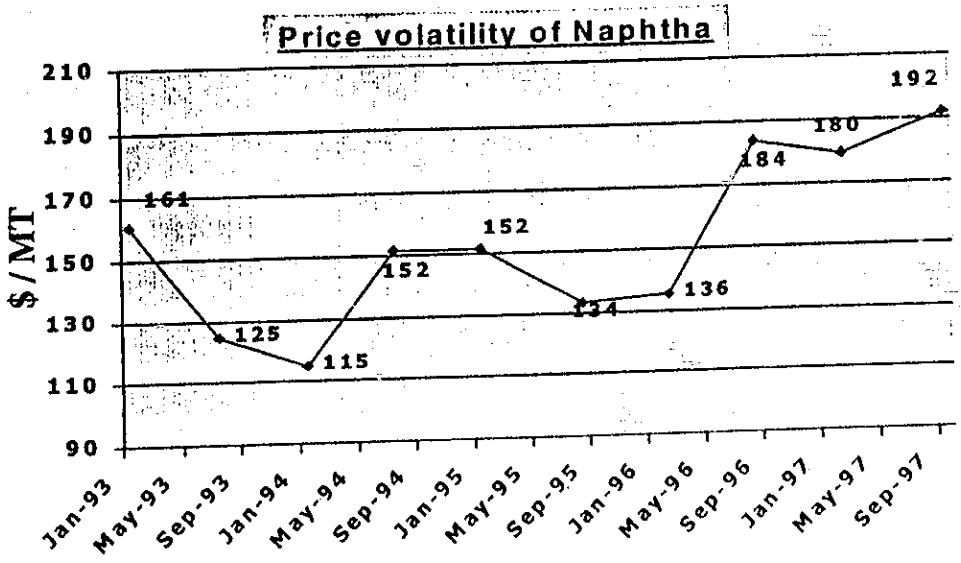
The schematic on the following page depicts the various import options for supply of natural gas to India from various gas fields. There large gas reserves surrounding the Indian sub-continent and gas could be brought to India either through cross-border pipelines or by ships as liquefied natural gas (LNG). For reserves lying up to 1500 KM away from India and accessible through a land route, piped gas would be cheaper than LNG. The corresponding figure for submarine pipelines is 1000 KM.



5.5 Pricing of Natural Gas

Natural gas prices are market-determined the world over and the same is expected in India. These prices would be pegged to a basket of petroleum products. Since natural gas will replace some of the existing fuels currently used in power, fertiliser, and other industries, demand for natural gas will essentially be driven by the price of the fuel it replaces.

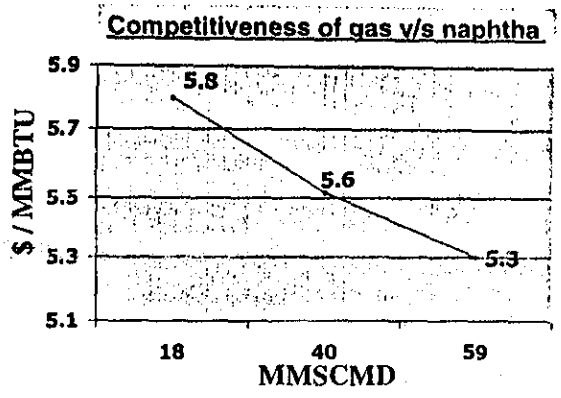
5.6 Indicative price of natural gas

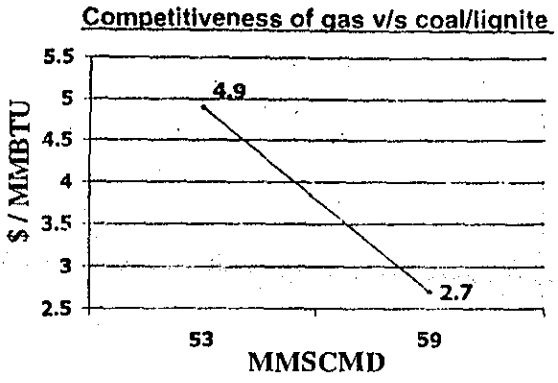


(Landed cost for Naphtha in Mumbai for mid April'99 = $ 143 / MT)

Source: Platts Arabian Gulf FOB Prices (via BP)

High volatility in international prices of naphtha renders it unfavourable as fuel for power generation / feedstock for fertiliser as compared to natural gas. It can at best be termed as a short-term / stopgap solution.





(NOTE: Demand figures provided for 2006-07 at current prices)

Refer: Annexure 9

The following prices have been assumed for naphtha, coal, and lignite:

- Naphtha base price = US $ 143 per MT (landed price in Mumbai for mid April '99).
- Coal base price = Rs 819 per MT (Sale price of 'C' grade Non Long Flame coal from Western Coalfields Ltd).
- Lignite base price = Rs. 510 per MT (Sale price of 'A' grade lignite at Panandharo mines).
- Imported coal price = Rs 2,500 per MT (Consumption point price of South African coal).

The above comparisons indicate that in order to be considered for substitution of competing fuels - naphtha, domestic coal, imported coal and lignite - natural gas will have to be priced at USD 5.3, 4.9, 4.6 and 2.7 per MMBTU, respectively.

5.7 Pipeline tariff

Pipeline tariffs also play an important role in determining the final cost of natural gas to the consumer. The two models normally used to ascertain pipeline tariffs are

- 'RoR' model, which is based on return on investments made
- 'RPI - X' model which is based on performance / efficiency level of operation

5.7.1 The 'RoR' Approach (the US practice)

RoR stands for 'Rate of Return' on assets and is fixed by the government / regulator. This approach is also known as the 'cost plus' regulation approach and it limits the maximum return that the operator can earn. At the same time, this method gives the operator an opportunity to earn a certain expected level of profit. The drawback of this model is that it could lead to 'gold plating' of assets.

However, it is a simple and effective way for the operator to calculate the basic price of service, at the time of bidding and is widely used by the privatised public utilities in the US.

5.7.2 The 'RPI-X' Approach (the UK practice)

RPI stands for Retail Price Index and X is a number (efficiency factor) prescribed by the government / regulator. This approach is also known as the price cap regulation approach and it limits the prices to be charged to consumers, irrespective of returns on capital. For example, if RPI is 10% and X has been fixed as 15, prices to consumers would fall by 5% in real terms. For the same RPI, if X were fixed at 5, prices to consumers would rise by 5% in real terms.

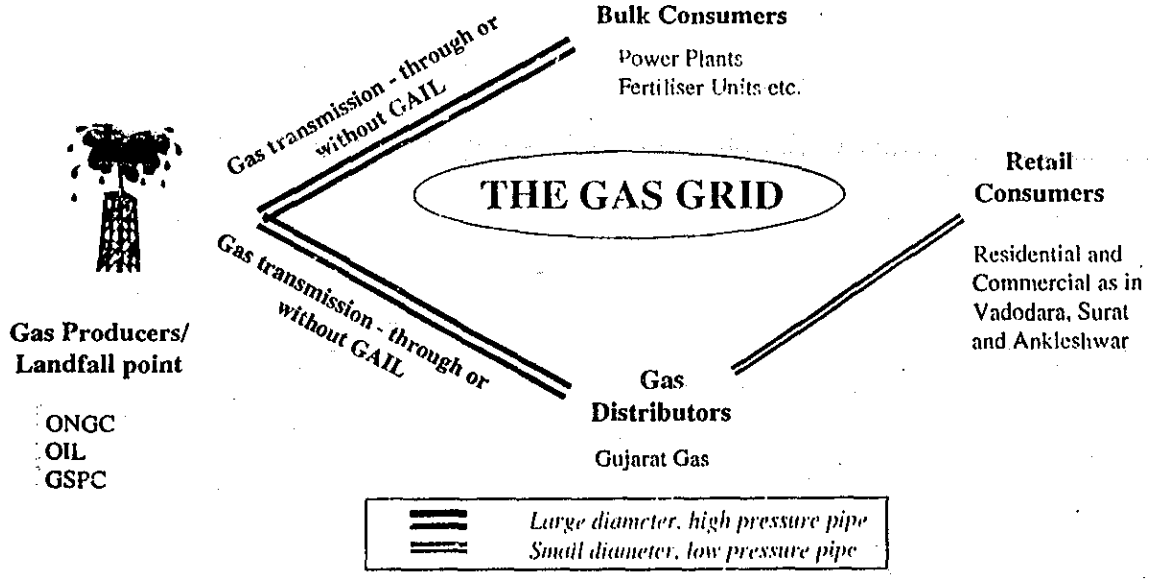
In fixing X factor the regulator has to balance the interests of the investors and the consumers.

X factors are subject to changes every 3-4 years. This model has the following advantages:

- protects consumers against monopoly by focusing precisely on the services of monopoly concern
- gives enough incentives to firms to achieve productive efficiency and promote innovation as cost reductions would be retained by the firm
- burden on regulator is low as compared to RoR Method.

6.1 Entities and Activities

The following is a pictorial representation of the different players in the natural gas chain – from producers through intermediaries to end-users.



a. Gas Exploration and Production

In the early stages in most countries the government is often involved in the development of upstream industry such as Exploration & Production (E & P) due to large capital requirements and concomitant high risk. India also followed the same approach whereby only the state owned company ONGC was involved in the E & P activities. Subsequently, there has been a shift in the policy and private investment is now being promoted. Regarding the import of liquefied natural gas (LNG), as of now; anybody can import it as it can be obtained by obtaining an open general license (OGL).

b. Gas transmission network / pipeline:

This is a critical infrastructure for the development of the industry and needs substantial investment. If it is not regulated at this stage, it can lead to wastage of capital due to duplication of pipelines. The government is likely to invite the private sector to participate in this venture and more than one private company could be involved. In order to optimise the

use of resources, gas sellers would be allowed **Open Access** to the gas grid. The current thinking of the Government of Gujarat on the operation of the gas grid is as follows:

- The Government of Gujarat will decide the route and the capacity of the Gas Grid.
- The Government of Gujarat will endeavor to insure optimum use of resources.
- Regulate the Gas Grid for Open Access / on common carrier principle.
- The Gas Grid has to be regulated by the state, if needed by a legislation to ensure that there is a free market for gas.
- Gujarat State Petrochemicals Corporation Limited (GSPCL) would be the nodal agency for the development of the Gas Grid.
- Promote investment in development of the Gas Grid on a public-private partnership basis through various mechanism like build operate transfer (BOT).
- Fix a Rate of Return for the developer of the pipeline. This return should be linked to the Real Rate of Interest

c. End-users:

- Large users to draw gas directly from the gas grid by laying spur lines.
- Retail consumers to be supplied through distribution utilities.

d. Gas distribution network:

In the retail distribution network, involvement of government is generally low and ***exclusivity*** for distribution could be given to the distribution agencies for a specified zone.

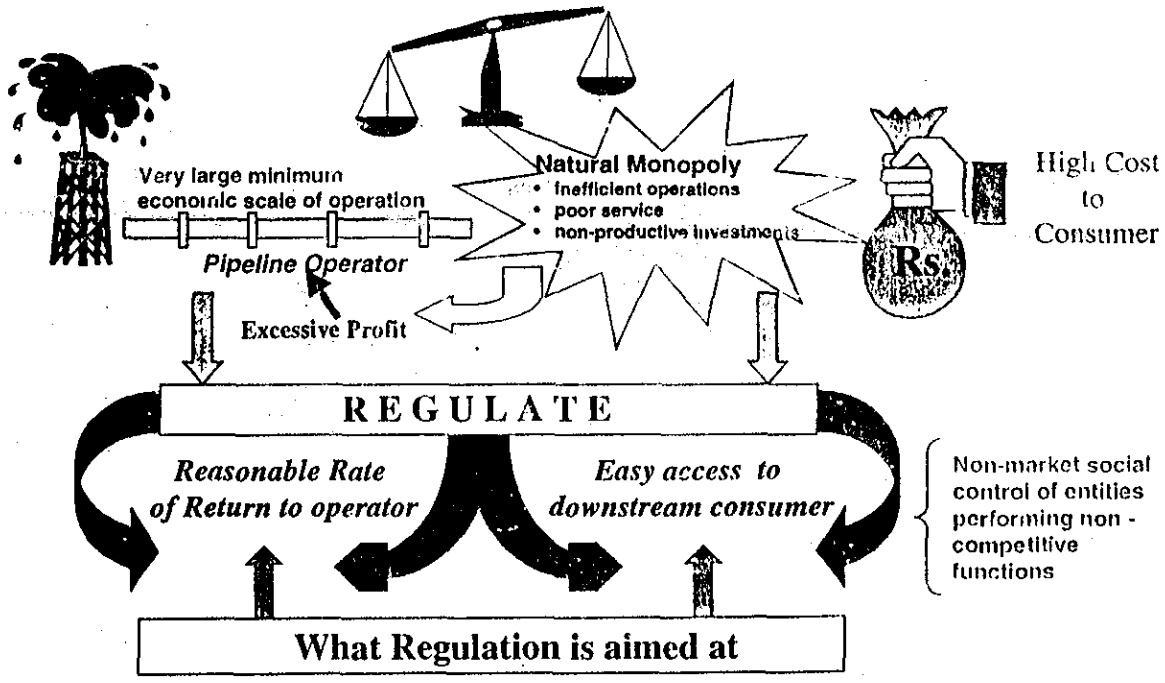
- The Government of Gujarat would decide on the boundaries of the geographic zone
- The Government of Gujarat would decide on the exclusivity period
- Attract investment in retail distribution by giving exclusive rights for a zone to a company
- Identify a suitable company through competitive bidding for operating the distribution circle The income of the distribution company would be controlled by using either the "Rate of Return" or "RPI-X" method.

6.2 Need for regulation

As evident from the above analysis, gas transportation is a natural monopoly; inefficient operations of and non-productive investments by operators would result in high costs to consumers. At the same time, huge investments are required even for a minimum economic

scale operation thereby creating the need to ensure reasonable rate of return to the operator. Thus regulation is aimed at addressing these two basic issues.

The following is a pictorial representation of the need for regulation:



6.3 Transmission, Distribution and Storage

The role of the regulator would encompass both gas grid system development activities and operating practices as given below:

Development issues include the following:

- Land identification and acquisition
- Environmental clearance - preservation of local flora / fauna, natural beauty
- Development of storage areas
- Scrutiny of applications from prospective service providers
- Authorisation / awarding licences
- Transportation / storage charges
- Specification of operating standards
- Specification of grounds for revoking licences
- Inspection

- Penalties for non-compliance
- Redressal of consumer grievances
- Capacity augmentation
- Renewal of licences

Operating practices include the following:

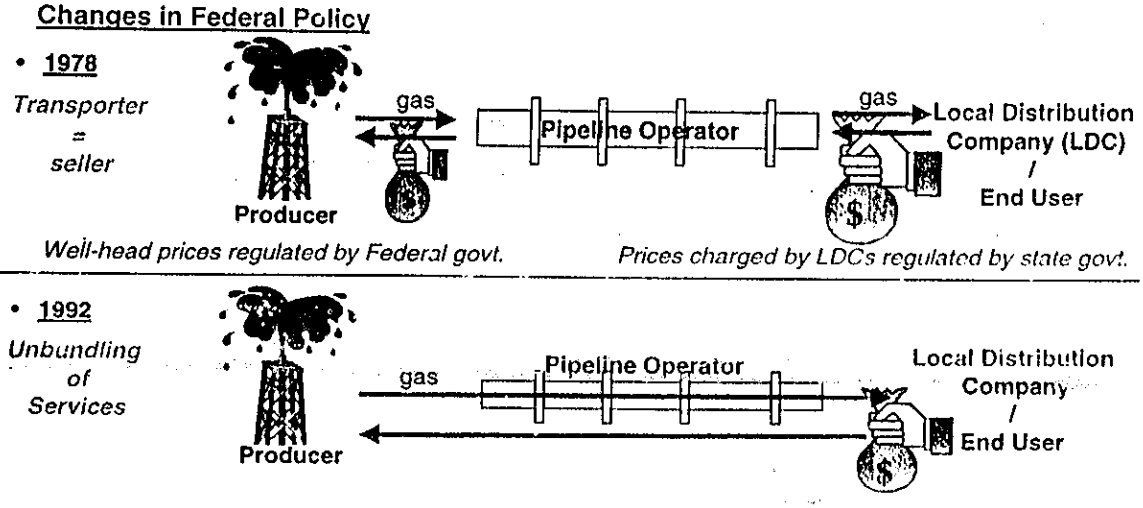
- Exclusive transportation and storage of gas
- Open access: consumers' right to transport / store gas - subject to available capacity
- Access to bonafide users (authorised transporters / end-user of gas) only
- Safety and public health issues
  - gas leakage
  - interference in public water supply
  - laying down maximum rates of injection / withdrawal of gas
  - specifying maximum injection pressure for storage, and compression for transportation of gas
  - provision for inspection bore-holes
  - addition / removal of ingredients to / from gas in storage
- Accidents
  - early public notification
  - arrangements / co-ordination with police, fire, public health, water supply authorities, etc.

6.4 Pipeline tariffs

The following table provides an analysis of certain issues pertaining to pricing of natural gas:

Issues	Implications for Gas Pricing
Gas demand more than gas availability	Gas price should be comparable to the fuel it potentially displaces
Protection of buyers' interests	Ceiling price Price discrimination only at regulator's discretion
Protection of sellers' interests	Floor price Provision for review of prices by regulator
Protection of transporter's interests	Reasonable rate of return on investment Transport price according to cost reflective methodology Compensation plan in case of less than reasonable prices being set

6.5 International regulatory practices – USA



The United States natural gas industry was first regulated in 1938 under the Natural Gas Act (NGA) which created the Federal Power Commission (FPC). The Industry was very simple. Producers sold gas under long-term contracts to pipelines. The pipelines owned all the gas and sold it to end-users. The government controlled the pipeline's purchase and sales price.

The first major change came in 1978 with the Natural Gas Policy Act (NGPA) which created the Federal Energy Regulatory Commission (FERC). The FERC consists of a five-member panel, appointed by the President; each serving staggered five-year terms. The main purpose of the NGPA was to reduce government controls and increase competition. At the time interstate demand had surpassed supply. Diminished gas discoveries attributed to wellhead price controls, led to gas shortages and curtailment. The NGPA attempted to resolve the price-supply issue with a complex law that generated a range of gas prices from $0.30 to $10.00 per mcf. In fear of being short of supply and in an effort to stimulate development, pipelines were quick to enter long-term "take-or-pay" contracts (TOP) for this expensive gas. Unfortunately, in 1983 demand decreased, primarily as a result of the US recession, strapping pipelines with expense gas and TOP penalties.

To comply with a court directive to end discriminatory sales of TOP gas by pipelines, the FERC issued order 436 in 1986, which proposed an "open access" transportation plan. However, Orders 436 and 380, which allowed end users to exit high cost shipper contracts with the pipelines, further exacerbated the TOP problem. End users bypassed pipelines and

purchased lower cost "new" gas from producers and shipped as third parties on pipelines under the tenants of Order 436. The "spot market" for gas supply evolved in this environment allowing customers to contract with producers of their choice for short-term supply usually ranging from one day to one year. In 1987 the D.C. Court of Appeals struck Order 436 on the grounds that pipelines were bearing too much of the TOP burden. The FERC then issued Order 500, which allowed for a complicated formula for sharing the burden between producers, pipelines and consumers. In an effort to further increase competition, Orders 436/500 allowed third party transporters to bypass pipelines that possessed inadequate facilities or excessive prices by constructing new pipelines under an expedited or "fast-track" certificate process.

In 1992 FERC brought far-reaching pipeline restructuring with the issue of Order 636. In short, this order facilitated the transportation of gas by pipelines on behalf of other parties. Pipelines were required to "unbundle" rates for the services it provided (i.e. transportation, storage) allowing consumers to choose from a menu only the services they required.

Currently, almost all gas transported by pipelines is by contract for third parties, thus, eliminating the merchant function of pipelines. Furthermore, pipeline shippers have the option of transporting gas under firm or interruptible contracts. With the use of electronic bulletin boards, created by pipeline companies, consumers are given access to available firm and interruptible capacity to better manage their fuel supply requirements.

Order 636 proved very efficient and advantageous to many consumers that possessed the sophistication to manage their fuel supply needs. However, many smaller consumers felt lost in this New World of gas contracting and fuel supply management. Hence, the niche was created for marketing companies to assist consumers with the need.

6.6 Other international regulatory examples

The UK experience and the lessons to be learnt

In the UK the duties and powers under the Gas Act 1995 are shared between the relevant Minister and the Director General of Ofgas. However one decides to allocate functions and powers between the State and the regulator it is crucial that their respective roles are well

defined. In determining such roles one must decide on the level of State involvement in the regulatory process - for instance, whether to limit the State's role to developing government policy in this area and simply leave it to the regulator to implement that policy. Generally speaking, the more one leaves to the discretion of the State the more wary potential industry participants become. There is not normally an issue over who supervises and enforces the regulatory regime, as this will always tend to be the regulator, but rather debate focuses on which body makes the rules and regulations governing the regulated industry. This is particularly evident in the development of licence conditions.

In the UK the Secretary of State for Trade and Industry cannot issue licences - this is the sole domain of the Director General for electricity and gas supply (the UK Regulator). Some control is imposed on the UK Regulator in that he or she must follow set standard conditions for that particular type of licence. [1] These standard conditions were developed by the UK Regulator along with the Department of Trade and Industry as a series of standard conditions applicable to Public Gas Transporters, suppliers and shippers. The UK Regulator can impose additional conditions but is only able to modify the standard conditions after consultation with, and the agreement of, a specified proportion of licence holders. If this threshold is not reached, the UK regulator then refers the matter to the Monopolies and Mergers Commission for a ruling.

Victoria, Australia

The Office of the Regulator-General Act 1994 appoints a single regulated authority to regulate "Regulated Industries" in Victoria such as gas, electricity and water. The Victorian regulator is clearly independent of the State and has been expressly made "not subject to the direction or control of the Minister in respect of any determination, report or enquiry". Specific powers which have been vested in the hands of the regulator include price control. It should be noted that safeguards and guidelines have been included in the legislation which are an effective control by the State legislature on the regulator's discretion in respect of these matters.

[1] There are currently three types of licences under the Gas Act 1986: A Public Gas Transporter (PGT) Licence, a Shipper Licence and Supply Licence)

New South Wales ("NSW"), Australia

The regulatory regime here is governed by the Gas Supply Act 1996 ("the NSW Act"). The bodies responsible for regulation under the Act include the relevant State Minister, the Tribunal and a Review Panel.

Their general duties under the Act include, inter alia:-

- ensuring all reasonable demands for gas are satisfied as far as it is economical to do so;
- taking proper account of the business interests of transporters and suppliers; and
- considering the development of efficient and safe gas distribution pipelines and gas distribution systems.

While a licence as such is not required for gas supply in NSW, an authorisation from the State Government is required for any person wishing to supply gas to consumers. The authorisation application and award process is transparent with clear guidelines provided for in the NSW Act. The decision rests with the NSW Government as to whether or not an authorisation is given although the government's discretion is fettered as any refusal must be based on specific grounds provided for in the Act. As in the UK the NSW State government imposes conditions on any authorisation given but controls are placed on the type and scope of these conditions. Control is also placed on the NSW government's ability to unilaterally change these conditions once authorisation has been granted. The NSW Government is not, however, permitted to regulate supply prices nor to determine the terms on which a local distribution network operator grants access to its system. Price controls for supply are administered by a Tribunal rather than the State.

A Review Panel, consisting of three members appointed by the State, resolves any disputes arising from decisions made, for example, by the Tribunal over pricing control orders.

Australian Capital Territory ("ACT"), Australia

The regulatory regime is governed by the Gas Supply Act 1998 ("the ACT Act"). As with New South Wales, the legislation provides for authorisations rather than licences but, in practice, there is little difference between the two.

As in the UK, the downstream gas related functions of transmission, distribution and supply are unbundled under the ACT Act with separate authorisations required for each. Applications for these authorisations are made to, and granted by, the State Government. The State has a fairly wide discretion over both the conditions which it can attach to any authorisation and any changes to those conditions. This discretion is slightly fettered, however, as the State cannot make authorisation variations which affect the authorised companies ability to meet either their contractual obligations or the supply of gas to their customers.

Unlike in NSW, the ACT Act does provide for the appointment of a regulator. The "Gas Technical Regulator" is limited to a supervisory/enforcement role and its functions include:-

- securing compliance with the ACT Act;
- assisting and advising the State in relation to the matters arising under the ACT Act;
- developing gas technical policy in consultation with other States;
- monitoring and promoting safety and technical standards in relation to gas installations and gas appliances; and
- enforcing authorisation conditions.

South Australia ("SA")

The regulatory regime is governed by the Gas Act 1997 ('the SA 'Act'). As with the ACT legislation the SA Act does provide for the appointment of a technical regulator whose functions are to:-

- administer the licensing regime;
- monitor and regulate safety standards; and
- monitor service standards.

Unlike the other Australian State legislation which we have examined, the technical regulator, rather than the State, is responsible for awarding licences and imposing licence conditions. The guidelines for awarding licences are more comprehensive than in other Australian States as the regulator may consider the applicants' previous commercial dealings, financial and technical resources etc.

The SA Act also provides for the appointment of the relevant State minister as a Pricing Regulator. The Minister's function here is to fix a maximum price for the sale of gas to certain groups of customers.

New Zealand

Downstream gas regulation in New Zealand is currently very light handed with little government involvement. This is in contrast with the early days of the New Zealand gas industry where wellhead prices were originally negotiated by the New Zealand government, on behalf of the then government owned gas company, NGC, with oil and gas production companies. As was the case in the UK and the USA these supply arrangements were in the form of long term take-or-pay contracts.

Competition in gas supply has now been established in New Zealand. Unusually, the impetus for this change has come from individual applications to the courts using competition law to ban restricted trade practices rather than through a pro-active regulator as in the UK, USA and to a lesser extent, Australia. Unlike the other examples we have included there is no gas or general energy regulator in New Zealand to regulate the industry or promote competition.

Gas transmission, by definition a natural monopoly, is controlled by one company, NGC, which, unusually, is not prohibited from competing with other gas suppliers in the supply of gas. The 1990's have seen the New Zealand Government embark on a policy of deregulation through the development of an "open access regime". NGC, the transmission system owner/operators, must provide access to third parties at set tariffs. These tariffs are controlled by the New Zealand Government.

The regulatory framework governing the downstream gas industry derives from two separate areas: competition law in the form of the Commerce Act 1986 and specific gas legislation in the form of the Gas Act 1992. There is no licensing regime as such nor, we understand, are there any authorisations required for the transportation or supply of gas.

The Gas Act 1992 removed local gas supply franchises and did away with price control. The Act provided the relevant ministerial chief executive with the following functions:-

- ensuring the safe supply and use of gas;

- determining whether or not the provisions of the Act are being complied with;
- inspecting distribution systems.

More recently the New Zealand Government has enacted the Gas Information Disclosure Regulations. These regulations require gas pipeline companies such as NGC to disclose:-

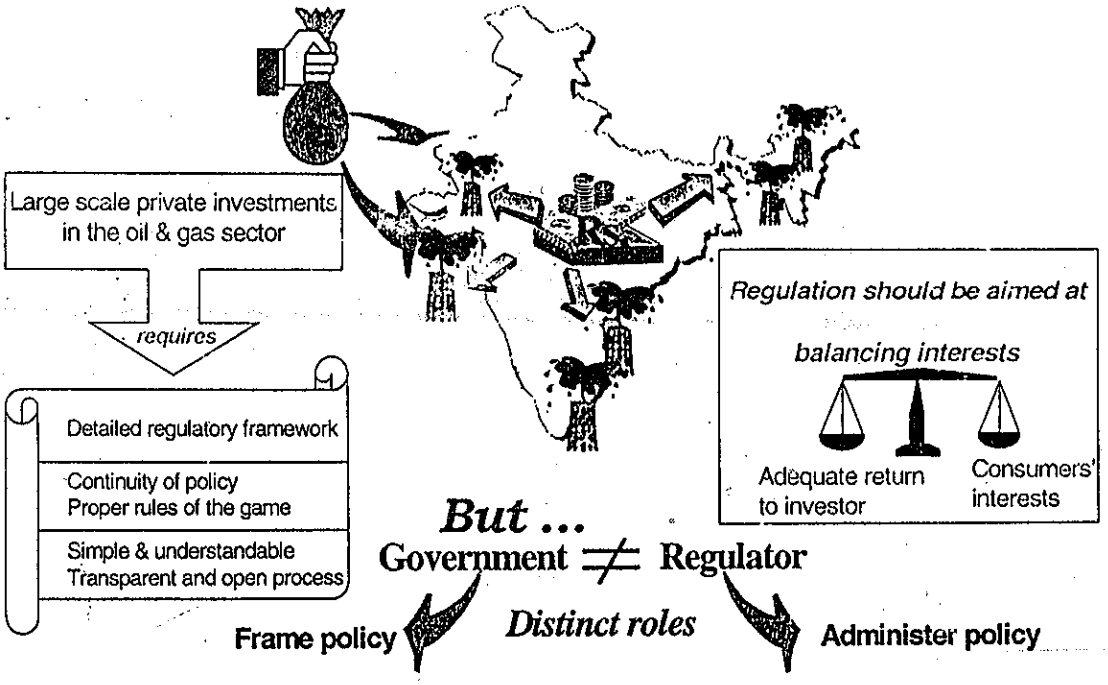
- separate financial statements for transmission, wholesale, distribution and retail businesses;
- contract prices, terms and conditions;
- financial, efficiency and reliability performances measures;
- methodologies used;
- pipeline capacity information; and
- line charges.

Israel

There is currently no real natural gas industry in Israel. Recent draft Israeli legislation attempts to provide a legal framework for the industry's development. To provide a certain amount of flexibility the licensing route is preferred but with a slight difference, as the draft Act provides an exclusive transportation and supply licence for around 20 years to one company (the winner of a tender) which will be a joint venture between the successful tenderer and the Israeli Government. Interestingly no industry regulator is planned although there is a post referred to as the "superintendent of safety". Licence conditions will be prepared before the tender (and hence available to all prospective tenderers) with any subsequent modifications which financially disadvantage the licensees being compensated by the Government.

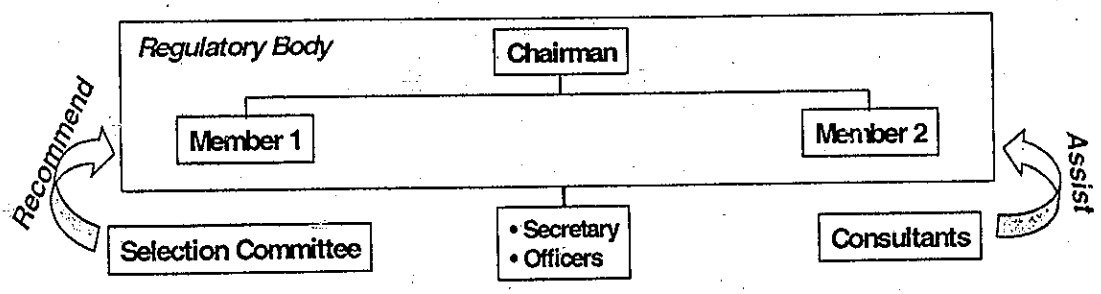
In developing any regulatory regime much debate will focus on how much authority the State should cede to its regulator. While the State will naturally wish to retain all real control over the regulated industry, experience has shown that investors are more willing to enter markets which are stable and which have, to a certain degree, removed themselves from the vagaries of political control. Those countries or states which have not opted for a truly independent regulator akin to the UK/US model have still placed sufficient legislative control on the relevant government's discretion to regulate the industry.

6.7 Reinforcing the need for regulation in India



In sum, there has to be a clear demarcation of the Government and the Regulator's role – the former should frame policies and give the regulator a free hand in administering the same.

6.7.1 Structure



The Government of Gujarat may, if it deems fit, establish the State Regulatory Authority consisting of the Chairman and two other members. Members should be appointed through a legislative process, by the State Government, on recommendation of Selection Committee constituted by the State Government. The tenure of members should be around 3-5 years, with an upper age limit of 65 years. Members should have adequate knowledge of and

experience in dealing with problems relating to engineering, law, economics, commerce, finance, and management. They should have an impeccable personal record with regard to integrity and honesty. Salaries of members would be as prescribed by the State government. Any member of the regulatory authority may be removed from office by order of the Governor of the State after the High Court has reported that the member ought to be removed. There should be limited grounds for removal of members, such as insolvency, conviction, abuse of position, conflict of interest. Appointment of officers and other employees, required to assist the State Authority in discharge of its functions, would be subject to the approval of the state government. The regulatory authority may levy appropriate charges for its services.

6.7.2 Roles

- To maintain standards of performance on Health, Safety and Environment issues
- Arbitrator
- Consumer Protection

6.7.3 Responsibilities

- Safeguarding property, environment and public safety in the construction and operation of systems of transport and distribution
- Monitoring compliance of safety, regulations and standards.
- Regulate the market i.e. liberalised or closed markets
- Safeguarding the interests of the consumers.
- Establishing procedures, promoting efficiency and economy through optimal utilization of pipelines.
- Regulating the rent for the use of pipelines to a fair and reasonable level.
- Lay down procedures for effective settlement of disputes

6.7.4 Legislation:

It is proposed to have a State Legislation to set broad framework comprising of:

- Power and Duties of the Regulator
- Rules and Procedures

6.7.5 Advisory Committee:

- The Regulatory body should be assisted and advised by an Advisory Council comprising eminent persons from various disciplines including representatives of the gas industry and gas consumers.

6.7.6 Appeals Committee:

- All appeals on the decision of the Regulatory Body should lie with appeals Committee to be headed by a retired Chief Justice of the High Court and will be consisting of Secretary, E&P Department and eminent persons from the gas industry as members. Further appeals on the decision of Appeals Committee to lie with the concerned High Court.

6.7.7 Functioning of the regulator

In order to discharge its duties effectively, the regulatory authority should function in a systematic manner:

- It may appoint a Secretary and Consultants to assist the authority in the discharge of its duties
- It shall meet at its head office (or any of its offices) at such time as the Chairperson may direct
- It shall observe such rules of procedure, with regard to transaction of business at its meetings, as determined by regulations
- The Chairperson shall preside at the meeting
- Every member shall have one vote
- Majority of votes would be used to decide on all questions, which come up
- The Secretary shall authenticate all orders and decisions of the regulatory authority.

Annexure 1

LIST OF ABBREVIATIONS

MMSCMD	-	Million Metric Standard Cubic Metre per Day
BCM	-	Billion Cubic Metres
NSDP	-	Net State Domestic Product
CNG	-	Compressed Natural Gas
MW	-	Mega Watt
MU	-	Million Units
FO	-	Fuel Oil

Annexure 2

NATURAL GAS DEMAND – POWER (SHORT & MEDIUM TERM)

POWER SCENARIO IN GUJARAT

POWER - INSTALLED CAPACITY IN GUJARAT (MW)

GEB Plants	Fuel/Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
Existing												
1 Dhuvaran TPS	Gas	54	54	54	54	54	54	54	54	54	54	54
2 Dhuvaran TPS	Coal	534	534	534	534	534	534	534	534	534	534	534
3 Gandhinagar TPS	Coal	660	660	660	660	660	660	660	660	660	660	660
4 Kadna HEP	Hydel	120	120	120	120	120	120	120	120	120	120	120
5 Kutch Lignite TPS	Lignite	215	215	215	215	215	215	215	215	215	215	215
6 Panam Hydro Project	Hydel	2	2	2	2	2	2	2	2	2	2	2
7 Sikka TPS	Coal	240	240	240	240	240	240	240	240	240	240	240
8 Ukai HEP	Hydel	300	300	300	300	300	300	300	300	300	300	300
9 Ukai LBC hydro	Hydel	5	5	5	5	5	5	5	5	5	5	5
10 Ukai TPS	Coal	850	850	850	850	850	850	850	850	850	850	850
11 Utran TPS	Coal	39	39	39	39	39	39	39	39	39	39	39
12 Utran TPS (New) CCPP	Gas	135	135	135	135	135	135	135	135	135	135	135
13 Wanakbori TPS	Coal	1260	1260	1260	1260	1260	1260	1260	1260	1260	1260	1260
Expansion/New												
14 Dhuvaran Gas Based project	Gas				110	110	110	110	110	110	110	110
15 Kadana Hydro Power Project	Hydel			60	60	120	120	120	120	120	120	120
16 GSEC-GEB, Sikka Extn. Stage II	Imp. Coal						250	500	500	500	500	500
17 Utran Gas based PS stage 3	Gas				160	160	160	160	160	160	160	160
Sub Total		**4414**	**4414**	**4474**	**4744**	**4804**	**5054**	**5304**	**5304**	**5304**	**5304**	**5304**

Non - GEB Plants	Fuel/Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
Existing												
18 AEC - Sabarmati & Ahmedabad	Coal	400	400	400	400	400	400	400	400	400	400	400
19 AEC - Vatva	Gas	110	110	110	110	110	110	110	110	110	110	110
20 Essar Power - Hazira	Gas	300	300	300	300	300	300	300	300	300	300	300
21 GIPCL - Godhra	Gas	145	145	145	145	145	145	145	145	145	145	145
22 GTEC - Gandhar, CCPP	Gas	160	655	655	655	655	656	656	656	656	655	1310
Expansion/New												
23 AEC - Ahmedabad CCGT	Gas			155	155	155	155	155	155	155	155	155
24 AEC - Ahmedabad TPS	Coal					125	125	125	125	125	125	125
25 Essar Power WHRU - Hazira	Waste heat					150	150	150	150	150	150	150
26 GIPCL - Godhra, Vadodara CCPP	Naphtha		160	160	160	160	160	160	160	160	160	160
27 GIPCL - Mangrol TPS	Lignite			250	250	250	250	250	250	250	250	250
28 GMDC - Akrimota TPS	Lignite				250	250	250	250	250	250	250	250
29 GPCL - Chhara, Amreli	Gas											615
30 GPCL - Ghogha TPS	Lignite						375	375	375	375	375	375
31 GPCL - Pipavav	Gas							615	615	615	615	615
32 GPCL - Pipavav	Imp. Coal										1000	1000
33 GPCL - Kutch, Mundra	Imp. Coal										500	500
34 GSEC-GEB, Gandhinagar TPS Ext 5	Coal					210	210	420	420	420	420	420
35 GSECL Wanakbori TPS Ext 5	Coal		210	210	210	210	210	210	210	210	210	210
36 GSEC-GEB, Panandhro, Kutch	Lignite							75	150	225	225	225
37 GSEC-GEB, Sarakhadi	Imp. Coal										1000	1000
38 GSPCL - Hazira	Gas				160	160	340	340	340	340	340	340
39 IOC - Savli	Petroleum Coke							500	500	500	500	500
40 Jamnagar TPS (Reliance Power)	Petroleum Coke							500	500	500	500	500
41 KRIBCHO - Junagadh	Naphtha							200	200	200	200	200
Sub Total		**1115**	**1980**	**2385**	**2795**	**3280**	**3835**	**5935**	**6010**	**6085**	**8585**	**9855**

Central Plants		1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
Tarapur (Nuclear)	Nuclear	160	160	160	160	160	160	160	160	160	160	160
Kakarpur(Nuclear)	Nuclear	125	125	125	125	125	125	125	125	125	125	125
NTPC Korba	Coal	360	360	360	360	360	360	360	360	360	360	360
NTPC Vindhyachal	Coal	230	230	230	230	230	230	230	230	230	230	230
NTPC Kawas	Gas	184	184	184	184	184	184	184	184	184	184	184
NTPC Gandhar	Gas	185	185	185	185	185	185	185	185	185	185	185
Expansion/New												
Narmada Hydro Project	Hydel										232	232
Vindhayachal Extn. II (NTPC)	Coal						183	183	183	183	183	183
NTPC Kawas II	Gas											195
Auriya CCGT (UP)	Gas											195
NTPC Gandhar II	Gas											195
Anta CCGT (Rajasthan)	Gas											195
Sub Total		**1244**	**1244**	**1244**	**1244**	**1244**	**1427**	**1427**	**1427**	**1427**	**1659**	**2439**

SUMMARY OF GUJARAT POWER SCENARIO

Peaking Capacity	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
GEB	4414	4414	4474	4744	4804	5054	5304	5304	5304	5304	5304
NON-GEB	1115	1980	2365	2795	3280	3835	5935	6010	6085	8585	9855
CENTRAL*	1244	1244	1244	1244	1244	1427	1427	1427	1427	1659	2439
Total Peaking Capacity (MW)	6773	7638	8103	8783	9328	10316	12666	12741	12816	15548	17598

Peak Available Capacity	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
GEB	3090	3090	3132	3321	3363	3538	3713	3713	3713	3713	3713
NON-GEB	948	1683	2027	2376	2788	3260	5045	5109	5172	7297	8377
CENTRAL*	1244	1244	1244	1244	1244	1427	1427	1427	1427	1659	2439
Total Peak Available Capacity	5282	6017	6403	6941	7395	8225	10185	10248	10312	12669	14529

* Only the power allotted to the state from the central plants have been considered & not the entire plant capacity

DEMAND SUPPLY SCENARIO

Description		1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
Peak Demand (MW)	as per 15th EPS	6377	6774	7191	7618	8070	8565	9101	9616	10132	10647	13918
Peak Power Availability (MW)		5282	6017	6403	6941	7395	8225	10185	10248	10312	12669	14529
Peak Power Surplus / Deficit (MW)		-1095	-757	-788	-677	-675	-340	1084	632	180	2022	611

Electricity SUPPLY SCENARIO

Description		1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
Electricity Requirement (mkwh)	as per 15th EPS	38543	40946	43467	46049	48777	51693	55009	58124	61240	64358	84111
Electricity Requirement (mkwh)	as per energy - NSDP correlation	36577	39138	41877	44809	47945	51301	54893	58735	62846	67248	94316
Electricity Available (mkwh)		46266	52707	56091	60798	64778	72047	89217	89775	90334	110981	127270
Surplus / Deficit Capacity (MW)*		1301	1822	1909	2149	2261	2786	4610	4169	3622	5674	4428

*Surplus Capacity = (Electricity Available - Electricity Requirement) / (8.76*0.85)
1 MW = 8.76 mkwh
PAF = 0.85

SCENARIO I

PROJECTS CONSIDERED FOR DEMAND ASSESSMENT :

A	GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	1 Dhuvaran TPS	Gas	54	54	54	54	54	54	54	54	54	54	54
	2 Utran TPS (New) CCPP	Gas	135	135	135	135	135	135	135	135	135	135	135
	3 Dhuvaran Gas Based project*	Gas	0	0	0	110	110	110	110	110	110	110	110
	4 Utran Gas based PS stage II	Gas	0	0	0	160	160	160	160	160	160	160	160
	Sub Total		189	189	189	459	459	459	459	459	459	459	459
B	Non - GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	5 AEC - Vatva	Gas	110	110	110	110	110	110	110	110	110	110	110
	6 Essar Power - Hazira	Gas	515	515	515	515	515	515	515	515	515	515	515
	7 GIPCL - Godhra	Gas	145	145	145	145	145	145	145	145	145	145	145
	8 GTEC - Gandhar, CCPP	Gas	160	655	655	655	655	655	655	655	655	655	1310
	9 AEC - Ahmedabad CCGT	Gas	0	0	155	155	155	155	155	155	155	155	155
	10 GIPCL - Godhra, Vadodara CCPP	Naphtha	0	160	160	160	160	160	160	160	160	160	160
	11 GPCL - Chhara, Amreli	Gas	0	0	0	0	0	0	0	0	0	0	615
	12 GPCL - Pipavav	Gas	0	0	0	0	0	0	615	615	615	615	615
	13 GSPCL - Hazira	Gas	0	0	0	160	160	340	340	340	340	340	340
	14 KRIBCHO - Junagadh	Naphtha	0	0	0	0	0	0	200	200	200	200	200
	Sub Total		930	1585	1740	1905	1900	2080	2895	2895	2895	2895	4165
C	Central Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	15 NTPC Kawas	Gas	644	644	644	644	644	644	644	644	644	644	644
	16 NTPC Gandhar	Gas	648	648	648	648	648	648	648	648	648	648	648
	17 NTPC Kawas II	Gas	0	0	0	0	0	0	0	0	0	0	650
	18 NTPC Gandhar II	Gas	0	0	0	0	0	0	0	0	0	0	650
	Sub Total		1292	1292	1292	1292	1292	1292	1292	1292	1292	1292	2592
	Total (MW)		2411	3066	3221	3651	3651	3831	4646	4646	4646	4646	7216
	Gas (MW)		2411	2906	3061	3491	3491	3671	4286	4286	4286	4286	6856
	Naphtha (MW)		0	160	160	160	160	160	360	360	360	360	360

Gas Demand (Note>1 MW requires 1/6 MMCFD of gas (at 85% availability))

A	GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	1 Dhuvaran TPS	Gas	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
	2 Utran TPS (New) CCPP	Gas	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
	3 Dhuvaran Gas Based project	Gas	0.00	0.00	0.00	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33
	4 Utran Gas based PS stage II	Gas	0.00	0.00	0.00	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67
	Sub Total		31.50	31.50	31.50	76.50	76.50	76.50	76.50	76.50	76.50	76.50	76.50
B	Non - GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	5 AEC - Vatva	Gas	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33
	6 Essar Power - Hazira	Gas	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83
	7 GIPCL - Godhra	Gas	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17
	8 GTEC - Gandhar, CCPP	Gas	26.67	109.17	109.17	109.17	109.17	109.17	109.17	109.17	109.17	109.17	218.33
	9 AEC - Ahmedabad CCGT	Gas	0.00	0.00	25.83	25.83	25.83	25.83	25.83	25.83	25.83	25.83	25.83
	10 GIPCL - Godhra, Vadodara CCPP	Naphtha	0.00	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67
	11 GPCL - Chhara, Amreli	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	102.50
	12 GPCL - Pipavav	Gas	0.00	0.00	0.00	0.00	0.00	0.00	102.50	102.50	102.50	102.50	102.50
	13 GSPCL - Hazira	Gas	0.00	0.00	0.00	26.67	26.67	56.67	56.67	56.67	56.67	56.67	56.67
	14 KRIBCHO - Junagadh	Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	33.33	33.33	33.33	33.33	33.33
	Sub Total		155.00	264.17	290.00	316.67	316.67	346.67	482.50	482.50	482.50	482.50	694.17
C	Central Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	15 NTPC Kawas	Gas	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33
	16 NTPC Gandhar	Gas	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00
	17 NTPC Kawas II	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	108.33
	18 NTPC Gandhar II	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	108.33
	Sub Total		215.33	215.33	215.33	215.33	215.33	215.33	215.33	215.33	215.33	215.33	432.00
At P. 85%	Grand total - scenario I (MMCFD)		402	511	537	609	609	639	774	774	774	774	1203
	In MMSCMD		11.38	14.47	15.20	17.23	17.23	18.08	21.93	21.93	21.93	21.93	34.06

SCENARIO II the state govt. puts up a single 510 MW gas based plant in lieu of the scrapped 10 small power plants and a single 2000 MW gas based project in Pipavav instead of three separate plants (2 x 615 MW gas based & 1 x 1000 MW imported coal based).

A	GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	1 Dhuvaran TPS	Gas	54	54	54	54	54	54	54	54	54	54	54
	2 Utran TPS (New) CCPP	Gas	135	135	135	135	135	135	135	135	135	135	135
	3 Dhuvaran Gas Based project	Gas	0	0	0	110	110	110	110	110	110	110	110
	4 Utran Gas based PS stage II	Gas	0	0	0	160	160	160	160	160	160	160	160
	Sub Total		189	189	189	459	459	459	459	459	459	459	459
B	Non - GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	5 AEC - Vatva	Gas	110	110	110	110	110	110	110	110	110	110	110
	6 Essar Power - Hazira	Gas	515	515	515	515	515	515	515	515	515	515	515
	7 GIPCL - Godhra	Gas	145	145	145	145	145	145	145	145	145	145	145
	8 GTEC - Gandhar, CCPP	Gas	160	655	655	655	655	655	655	655	655	655	1310
	9 AEC - Ahmedabad CCGT	Gas	0	0	155	155	155	155	155	155	155	155	155
	10 GIPCL - Godhra, Vadodara CCPP	Naphtha	0	160	160	160	160	160	160	160	160	160	160
	11 GPCL - Pipavav	Gas	0	0	0	0	0	0	2000	2000	2000	2000	2000
	12 Gas based plant	Gas	0	0	0	510	510	510	510	510	510	510	510
	13 GSPCL - Hazira	Gas	0	0	0	160	160	340	340	340	340	340	340
	14 KRIBCHO - Junagadh	Naphtha	0	0	0	0	0	0	200	200	200	200	200
	Sub Total		930	1585	1740	2410	2410	2590	4790	4790	4790	4790	5445
C	Central Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	15 NTPC Kawas	Gas	644	644	644	644	644	644	644	644	644	644	644
	16 NTPC Gandhar	Gas	648	648	648	648	648	648	648	648	648	648	648
	17 NTPC Kawas II	Gas	0	0	0	0	0	0	0	0	0	0	650
	18 NTPC Gandhar II	Gas	0	0	0	0	0	0	0	0	0	0	650
	Sub Total		1292	1292	1292	1292	1292	1292	1292	1292	1292	1292	2892
	Total (MW)		2411	3066	3221	4161	4161	4341	6541	6541	6541	6541	8496
	Gas (MW)		2411	2906	3061	3401	3491	3671	4288	4288	4288	4288	6856
	Naphtha (MW)		0	160	160	160	160	160	360	360	360	360	360

Gas Demand (Note: 1 MW requires 1/6 MMCFD of gas (at 85% availability))

A	GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	1 Dhuvaran TPS	Gas	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
	2 Utran TPS (New) CCPP	Gas	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
	3 Dhuvaran Gas Based project	Gas	0.00	0.00	0.00	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33
	4 Utran Gas based PS stage II	Gas	0.00	0.00	0.00	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67
	Sub Total		31.50	31.50	31.50	76.50	76.50	76.50	76.50	76.50	76.50	76.50	76.50
B	Non - GEB Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	5 AEC - Vatva	Gas	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33	18.33
	6 Essar Power - Hazira	Gas	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83	85.83
	7 GIPCL - Godhra	Gas	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17	24.17
	8 GTEC - Gandhar, CCPP	Gas	26.67	109.17	109.17	109.17	109.17	109.17	109.17	109.17	109.17	109.17	218.33
	9 AEC - Ahmedabad CCGT	Gas	0.00	0.00	25.83	25.83	25.83	25.83	25.83	25.83	25.83	25.83	25.83
	10 GIPCL - Godhra, Vadodara CCPP	Naphtha	0.00	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67	26.67
	11 GPCL - Pipavav	Gas	0.00	0.00	0.00	0.00	0.00	0.00	333.33	333.33	333.33	333.33	333.33
	12 Gas based plant	Gas	0.00	0.00	0.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00
	13 GSPCL - Hazira	Gas	0.00	0.00	0.00	26.67	26.67	56.67	56.67	56.67	56.67	56.67	56.67
	14 KRIBCHO - Junagadh	Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	33.33	33.33	33.33	33.33	33.33
	Sub Total		155.00	264.17	290.00	401.67	401.67	431.67	798.33	798.33	798.33	798.33	907.50
C	Central Plants	Fuel Type	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2011-12
	15 NTPC Kawas	Gas	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33	107.33
	16 NTPC Gandhar	Gas	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00	108.00
	17 NTPC Kawas II	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	108.33
	18 NTPC Gandhar II	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	108.33
	Sub Total		215	215	215	215	215	215	215	215	215	215	432
At P	85% Grand total - scenario II (MMCFD)		402	511	537	694	694	724	1090	1090	1090	1090	1416
	In MMSCMD		11.38	14.47	15.20	19.64	19.64	20.49	30.87	30.87	30.87	30.87	40.10

Annexure 3

NATURAL GAS DEMAND – FERTILISERS (SHORT & MEDIUM TERM)

FERTILISER INDUSTRY IN GUJARAT

Company	Location	District	Urea Capacity (MMTPA)	Urea Production (MMTPA)	Status of Project	Feed	Current Cons.of NG (mmcfd)	Potential Cons.of NG for NH3 Prodn. (mmcfd)	Potential Cons.of NG for Urea from NH3 (mmcfd)	Gas for power plat (mmcfd)	Total Potential for Cons. Of NG (mmcfd)	Year of Comm.
GSFC	Baroda	Baroda	0.364	0.287	Existing	Naph/Gas	23.48	33.28	3.68	15.00	51.96	-------
GSFC Exp.	Baroda	Baroda	0.726		Existing	Naph/Gas	-------	36.70	9.29		46.08	-------
GNFC	Bharuch	Bharuch	0.742	0.726	Existing	FO/Gas	24.71	52.07	9.29		86.67	-------
IFFCO	Kalol	Mehsana	0.396	0.455	Existing	Gas	26.46	30.09	5.02		35.90	-------
KRIBHCO	Hazira	Surat	1.452	1.722	Existing	Gas	105.67	99.63	22.04		121.66	-------
IFFCO	Kalol	Mehsana	0.545		UI	Gas	-------	31.59	6.97		38.56	1999
KRIBHCO	Hazira	Surat	0.726		Approved in	Gas	-------	36.81	9.29		46.10	2003
GNFC	Bharuch	Bharuch	0.742		Proposed	Naph	-------	36.81	9.49		46.30	2007

	1998	2003	2007
Gas demand - Scenario I	382.91	430.91	430.91
Gas demand - Scenario II	382.91	430.91	479.21

In MMCFD

1998	2003	2007
10.64	12.20	12.20
10.64	12.20	13.57

In MMSCMD

Notes

Specific heat required per tonne of ammonia for existing plants	9.00	million Kcal
1kcal equals	4.20	BTU
1 Ton equals	1,000	kg
1 Million equals	1,000,000	
1 cubic metre equals	35.31	cubic feet
Heat Requirement for production of 1ton of ammonia - old / ext.	37.80	MMBTU
Gas required for production of 1 ton of ammonia - old	35,310	scf
Heat Requirement for production of 1ton of ammonia - new pla	34.00	MMBTU
Gas required for production of 1 ton of ammonia -new plant	31,760.32	mmscf
Heat Requirement for production of 1 ton urea from ammonia	5.00	MMBTU
Additional gas required for conversion to 1 ton of urea from amr	4,670.63	scf
Calorific Value of Natural Gas	9,000	Kcal/scm
Calorific Value of Naphtha	10,500	Kcal/Kg
Calorific Value of LSHS/FO	9,500	Kcal/Kg
No.of days in a year for gas supply	365	
GSFC's captive power plant capacity	90	MW
1 MW plant requires	0.1666667	mmcfd of gas

Annexure 4

NATURAL GAS DEMAND – CEMENT (SHORT & MEDIUM TERM)

CEMENT INDUSTRY IN GUJARAT

Company	Location	District	Capacity (MMTPA)	Potential Demand for Natural Gas (mmcfd) (Scenario I)	Potential Demand for Natural Gas (mmcfd) (Scenario II)	Year of Comm.
Existing Cement Plants						
Narmada Cement	Magdalla	Surat	0.667			
Ambuja Cement	Kodinar	Amreli	1			
Gujarat Ambuja Cement	Kodinar	Amreli	1			
Gujarat Sidhee Cement	Viraval	Junagadh	1.2			
Narmada Cement	Jafrabad	Amreli	1			
L&T	Pipavav	Pipavav	1.5			
Sevalia Cement	Sevalia		0.215			
HMP Cements	Porbundar	Junagadh	0.198			
Saurashtra Cements	Ranavav	Junagadh	1.164			
Chettinad Cement	Dwarka		0.277			
Sri Digvijay Cement	Sikka		1			
Sub-total			**9.22**			
Proposed Cement Plants						
L&T	Kovaya	Amreli	1.5	9.807	19.614	1999
Gujarat Ambuja	Vadnagar	Amreli	1	6.538	13.076	1999
Sanghi Cement	Jadhwa	Kutchch	2.5	16.345	32.69	2001
Sub-total			**5.00**	**33**	**65**	
Total (upto 2003)			**14.22**	**33**	**65**	
Grasim Inds.	Madhapur	Junagadh	5	32.69	65.38	
Saurashtra Cement	Ranavav	Junagadh	1.2	7.8456	15.6912	
Sub-total			**6.20**	**41**	**81**	
Total (upto 2007)			**20.42**	**73**	**146**	

Assumptions

Plant with a capacity of 1 MT consumes	13.076 mmcfd of Natural Gas
Capacity Utilisation	100%
Scenario I - shift from col to gas	50%
Scenario II - shift from col to gas	100%
1 MMSCMD =	35.31 MMCFD

	1998	2003	2007
Gas Demand (MMSCMD)	**0.00**	**0.93**	**2.07**

Annexure 5

GAS DEMAND FROM NEIGHBOURING STATES

POWER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN MAHARASHTRA

	Fuel Type	1998	1999	2000	2001	2002	2003	2004	2005	2007
1 Trombay GT(TEC)	Gas	180	180	180	180	180	180	180	180	180
2 Palghar CC Power Project (BSES)	Gas							500	500	500
3 Bhivpuri Power Project (TEC)	Gas							450	450	450
TOTAL (MW)		180	180	180	180	180	180	1130	1130	1130
Gas demand (MMSCMD)		0.85	0.85	0.85	0.85	0.85	0.85	5.33	5.33	5.33

POWER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN RAJASTHAN

	Fuel Type	1998	1999	2000	2001	2002	2003	2004	2005	2007
1 NTPC, Anta	Gas	413	413	413	413	1063	1063	1063	1063	1063
2 Chambal Power Ltd.	Naphtha				166	166	166	166	166	166
3 RPG Dholpur	Naphtha				702	702	702	702	702	702
TOTAL (MW)		413	413	413	1281	1931	1931	1931	1931	1931
Gas demand (MMSCMD)		1.95	1.95	1.95	6.05	9.11	9.11	9.11	9.11	9.11

POWER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN MP

	Fuel Type	1998	1999	2000	2001	2002	2003	2004	2005	2007
1 Bhander Power project	Gas				330	330	330	330	330	330
2 Ratgarh Power project	Gas						330	330	330	330
3 Guna Power project	Naphtha						330	330	330	330
TOTAL (MW)		0	0	0	330	330	990	990	990	990
Gas demand (MMSCMD)		0.00	0.00	0.00	1.56	1.56	4.67	4.67	4.67	4.67

FERTILISER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN MAHARASHTRA

Company	Location	Urea Capacity (MMTPA)	Ammonia Capacity (MMTPA)	Feedstock	Natural Gas Demand (MMSCMD)	
1 RCF	Chembur	0.33	0.396	Gas	1.2	
2 RCF	Thal	1.782	1.188	Gas	2.8	Total = 4.0 MMSCMD

FERTILISER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN RAJASTHAN

Company	Location	Urea Capacity (MMTPA)	Ammonia Capacity (MMTPA)	Year of commision	Natural Gas Demand (MMSCMD)	
1 Chambal Fertilisers Ltd.	Gadepan	0.74	0.22		1.40	
2 Shriram Fertiliser & Chemicals Ltd.	Kota	0.33	0.15		0.55	
3 Chambal Fertilisers Ltd.	Gadepan	0.74	0.22	2002	1.40	Total = 3.4 MMSCMD

FERTILISER PROJECTS CONSIDERED FOR DEMAND ASSESSMENT IN MP

Company	Location	Urea Capacity (MMTPA)	Ammonia Capacity (MMTPA)	Feedstock	Natural Gas Demand (MMSCMD)	
1 National Fertiliser Ltd.	Bilapur	1.42	0.446	Gas	2.7	Total = 2.7 MMSCMD

ASSUMPTIONS FOR ESTIMATING LONG TERM DEMAND

A6.1 Power

Regression of power consumption with NSDP indicates the following linear relation between the two:

Power = - 6680.68 + 2.284 x (NSDP)

$R^2 = 0.90$

With increasing efficiency in electricity usage, the consumption of electricity is likely to flatten in future. The elasticity of power demand with NSDP is expected to go down gradually from the current level of 1.4 to 0.92 in 2017.

Currently, Transmission & Distribution loss in Gujarat is 22.5%. This is expected to go down by 0.75% per annum in the long term.

Annual load factor is taken to be 65.0%.

Scope for additional hydel capacity is limited as the potential for the state itself is about 450 MW (Source – CEA), which has already been surpassed.

Scope for additional nuclear capacity would be limited by environmental hazards.

Gujarat's current lignite reserves of 780 million MT can support a generation capacity of around 4,600 MW over 30 years. In the long term, a major part of this potential is expected to be realised. Thus, additional 2,000 MW (over and above 1,500 MW of proposed lignite-based projects) of lignite-based capacity has been taken into consideration.

A6.2 Industry

The demand for natural gas consists of two parts - actual and latent. Latent demand arises out of substitution of liquid petroleum products viz., FO, LSHS, naphtha, and LDO. The higher the availability of natural gas, the greater will be the level of substitution.

For FO, LSHS, and naphtha, only the part of consumption having substitution compatibility has been considered.

Naphtha is primarily consumed in fertiliser and petrochemical sectors, where almost total compatibility for substitution exists. Thus, for projecting the demand for naphtha, the current consumption has been converted into natural gas.

A6.3 Passenger cars

	Average Mileage	Prevailing Price
CNG:	10 km / Kg	12.0 Rs / lt or kg
Petrol:	12 km / Lt	27.0 Rs / lt or kg

- Net benefit per km on substituting petrol with CNG - Rs 1.05
- Approximate cost of conversion kit - Rs 40,000
- Average distance travelled in a day - 100 km
- CNG required per day - 10 kg
- Natural gas required per day - 12.5 SCM
- Current population of passenger cars (including taxis) in Gujarat - 3,34,354
- Average annual growth rate of passenger cars in Gujarat - 7.0%
- Expected population of Passenger Cars –

2007	2012	2017
6,14,700	8,62,150	12,09,200

A6.4 Buses

	Average Mileage	Prevailing Price
CNG	4.5 km / kg	12.0 Rs / lt or kg
Diesel	4 km / lt	12.0 Rs / lt or kg

- Net benefit per km on substituting diesel with CNG - Rs 0.35
- Approximate cost of conversion kit - Rs 1,20,000
- Average distance travelled in a day - 150 km
- CNG required per day - 33.5 kg

- Natural gas required per day - 41.5 SCM
- Current population of buses in Gujarat - 31,513
- Average annual growth rate of buses in Gujarat - 6.0%
- Expected population of buses –

2007	2012	2017
49,800	63,600	81,150

Annexure 7

NATURAL GAS DEMAND – POWER (LONG TERM)

LONG TERM GAS DEMAND - POWER

		2007-08P	2008-09P	2010-11P	2011-12P	20113-14P	2014-15P	2015-16P	2016-17P
Annualized Growth of NSDP	6.0%								
NSDP (Rs cr) —		32,163	34,093	36,306	40,605	45,624	48,361	51,263	54,338
Equation Energy (MU)= -6680.68 + 2.264 x (NSDP) R-square = 0.9									
Consumption of Electricity (MUs) -		66,779	71,167	80,811	86,061	97,624	103,776	110,403	117,428
Long Term T & D Losses *(Annual Reduction by 0.15%)*	22.50%	20.65%	20.70%	20.40%	20.25%	19.95%	19.80%	19.65%	19.50%
Energy Requirement at the Bus Bar		84,371	89,760	101,522	107,913	121,829	129,397	137,403	145,874
Peak Power Demand (MW) (Based on an Annual Load Factor of 65.0%)		14,817	15,766	17,830	18,952	21,396	22,725	24,131	25,619
Peak Power Demand (MW) (adjusted for decreasing elasticity)		14,514	15,354	17,164	18,117	20,173	21,269	22,412	23,603
Energy Supply from Utility *(based on short-medium term estmates)*		125,467	124,241	124,241	123,983	123,468	122,824	122,567	122,567
Energy Supply from Captive Units		3,798	3,798	3,798	3,798	3,798	3,798	3,798	3,798
Total Energy Supply		129,265	128,039	128,039	127,781	127,266	126,622	126,365	126,365
Energy surplus/shortage(-)		44,895	38,279	26,517	19,868	5,438	-2,774	-11,038	-19,509
Peak Supply from Utilities(MW) *(based on short-medium term estmates)*		14,323	14,183	14,183	14,153	14,095	14,021	13,992	13,992
Peak Supply from Captive Units (MW)		1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Total Peak Supply (MW)		15,373	15,233	15,233	15,203	15,145	15,071	15,042	15,042
Peak Surplus / Shortage (-) -MW		859	-121	-1,922	-2,914	-5,029	-6,198	-7,370	-8,561
Additional lignite/Coal based capacity (MW)		0	0	0	500	1,500	2,000	2,000	2,000
Balance capacity to be based on liquid fuel		-859	121	1,922	2,414	3,529	4,198	5,370	6,561
Scenario I: If all the capcities are based on natural gas ,									
Additional Gas Demand (MMCMD)		-4.1	0.6	9.2	11.5	18.6	20.0	25.6	31.2
Total Gas Demand (MMCMD)		26.0	35.6	49.4	51.7	57.0	60.2	65.8	71.5
Scenario II: If 50% of New capcities are based on natural gas ,									
Additional Gas Demand (MMCMD)		-2.0	0.3	4.6	5.7	8.4	10.0	12.8	15.6
Total Gas Demand (MMCMD)		30.0	35.3	44.8	46.0	48.6	50.2	53.0	55.9
Scenario III: NSDP growing @ 7 during 9th & 10th pland sunsequently @6% p.a., all additional power plant to be gas based									
Total Gas Demand (MMCMD)		43.2	47.1	55.2	57.6	63.5	66.7	72.3	77.9

Annexure 8

NATURAL GAS DEMAND – INDUSTRY (LONG TERM)

LONG TERM GAS DEMAND - INDUSTRY: (Scenario I)

	2007-08P	2008-09P	2010-11P	2011-12P	20113-14P	2014-15P	2015-16P	2016-17P
NSDP	32163	34093	38305	40605	45624	48361	51263	54336
Product : FO								
	23	24	26	27	29	30	31	32
Equation: Ln (FO) =5.440265+0.12165xLn(t)xLn(t)	6.63526243	6.667923178	6.730541715	6.760606816	6.818481701	6.846372858	6.87361519	6.900241596
Estimated Consumption (000 MT)	761.5	786.8	837.6	863.2	914.6	940.5	966.4	992.6
Non-Convertible Consumption								
Transport	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Power Generation	78.1	78.7	83.8	86.3	91.5	94.0	96.6	99.3
Cement/Mining/Engg./Fert	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9
Convertible Consumption	536.1	560.2	602.4	624.0	676.0	699.6	719.2	742.0
Equivalent Gas Demand (MMCMD)	1.6	1.6	1.8	1.8	1.9	2.0	2.1	2.1
Product : LSHS								
Equation: Ln (LSHS) =4.612619+0.347851xLn(NSDP)								
Estimated Consumption (000 MT)	2046.4	2088.3	2174.8	2219.3	2311.1	2358.5	2406.6	2456.1
Non-Convertible Consumption								
Transport	5	5	5	5	5	5	5	5
Power Generation	739.7	739.7	869.9	887.7	924.5	943.4	962.7	982.4
Cement/Mining/Engg./Fert	71.6	73.1	76.1	77.7	80.9	82.5	84.2	86.0
Miscellaneous	34.8	35.5	37.0	37.7	39.3	40.1	40.9	41.8
Convertible Consumption	*1195.4*	*1235.1*	*1186.8*	*1211.2*	*1261.5*	*1287.5*	*1313.8*	*1340.9*
Equivalent Gas Demand (MMCMD)	3.5	3.6	3.5	3.5	3.7	3.8	3.8	3.9
Product : LDO								
Equation: Ln (LDO) =6.612487-0.123072xLn(NSDP)								
Estimated Consumption (000 MT)	207.5	206.0	203.1	201.6	198.8	197.3	195.9	194.5
Non Convertible Consumption								
Transport	12.5	12.4	12.2	12.1	11.9	11.8	11.8	11.7
Food/Plantation								
Power Generation	24.9	24.7	24.4	24.2	23.9	23.7	23.5	23.3
Cement/Mining/Engg./Fert	20.8	20.6	20.3	20.2	19.9	19.7	19.6	19.5
Miscellaneous								
Convertible Consumption	149.4	148.3	146.2	145.2	143.1	142.1	141.1	140.1
Equivalent Gas Demand (MMCMD)	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Total latent demand for natural gas (MMCMD)	5.5	5.7	5.7	5.8	6.1	6.2	6.3	6.5
Natural Gas								
Demand for Natural Gas (MMCMD)	12.5	12.8	13.4	13.8	14.5	14.9	15.4	15.8
Equation: NG =6.612487+ 0.000195x(NSDP)								
Total natural gas demand in Industry	18.0	18.5	19.1	19.6	20.6	21.1	21.7	22.3

LONG TERM GAS DEMAND - INDUSTRY: (Scenario II)

	2007-08P	2008-09P	2010-11P	2011-12P	20113-14P	2014-15P	2015-16P	2016-17P
Product : FO								
	23	24	26	27	29	30	31	32
Equation: Ln (FO) =5.440265+0.12155xLn(I)xLn(I)	6.63526243	6.667923178	6.730541715	6.760606816	6.818461701	6.846372858	6.873361519	6.900241596
Estimated Consumption (000 MT)	761.5	786.8	837.6	863.2	914.6	940.5	966.4	992.5
Non-Convertible Consumption								
Transport	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Power Generation	76.1	78.7	83.8	86.3	91.5	94.0	96.6	99.3
Cement/Mining/Engg./Fert	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9
Convertible Consumption	269.6	280.1	301.3	312.9	333.6	344.3	355.1	366.0
Equivalent Gas Demand (MMCMD)	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1
Product : LSHS								
Equation: Ln (LSHS) =4.012618+0.347951xLn(NSDP)								
Estimated Consumption (000 MT)	2046.4	2088.3	2174.8	2219.3	2311.1	2358.5	2406.8	2456.1
Non-Convertible Consumption								
Transport	5	5	5	5	5	5	5	5
Power Generation	739.7	739.7	869.9	867.7	924.5	943.4	962.7	982.4
Cement/Mining/Engg./Fert	71.6	73.1	76.1	77.7	80.9	82.5	84.2	86.0
Miscellaneous	34.6	35.6	37.0	37.7	39.3	40.1	40.9	41.8
Convertible Consumption	*597.7*	*617.5*	*593.4*	*606.6*	*630.8*	*649.7*	*657.0*	*670.5*
Equivalent Gas Demand (MMCMD)	1.7	1.8	1.7	1.8	1.8	1.9	1.9	2.0
Product : LDO								
Equation: Ln (LDO) =6.612487-0.123072xLn(NSDP)								
Estimated Consumption (000 MT)	207.5	206.0	203.1	201.6	198.8	197.3	195.9	194.5
Non-Convertible Consumption								
Transport	12.5	12.4	12.2	12.1	11.9	11.8	11.8	11.7
Food/Plantation								
Power Generation	24.9	24.7	24.4	24.2	23.9	23.7	23.5	23.3
Cement/Mining/Engg./Fert	20.8	20.6	20.3	20.2	19.9	19.7	19.6	19.5
Miscellaneous								
Convertible Consumption	74.7	74.2	75.1	72.6	71.6	71.0	70.5	70.0
Equivalent Gas Demand (MMCMD)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total latent demand for natural gas (MMCMD)	2.8	2.8	2.8	2.9	3.0	3.1	3.2	3.2
Natural Gas								
Demand for Natural Gas (MMCMD)	12.5	12.8	13.4	13.8	14.5	14.9	15.4	15.8
Equation: NG =6.612487+ 0.000195x(NSDP)								
Total natural gas demand in industry	15.2	15.6	16.2	16.7	17.5	18.0	18.5	19.1

LONG TERM GAS DEMAND - INDUSTRY: (Scenario III)

	2007-08P	2008-09P	2010-11P	2011-12P	20113-14P	2014-15P	2015-16P	2016-17P
Product : FO								
	23	24	26	27	29	30	31	32
Equation: Ln (FO) =5.440265+0.12165xLn(t)xLn(t)	6.63523243	6.667923178	6.730541715	6.760606816	6.818481701	6.846372858	6.87361519	6.900241596
Estimated Consumption (000 MT)	761.5	786.8	837.6	863.2	914.6	940.5	966.4	992.5
Non-Convertible Consumption								
Transport	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Power Generation	76.1	78.7	83.8	86.3	91.5	94.0	96.6	99.3
Cement/Mining/Engg./Fert	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9
Convertible Consumption	539.1	560.2	602.6	624.0	668.9	688.5	710.2	732.0
Equivalent Gas Demand (MMCMD)	1.6	1.6	1.8	1.8	1.9	2.0	2.1	2.1
Product : LSHS								
Equation: Ln (LSHS) =4.612619+0.347961xLn(NSDP)								
Estimated Consumption (000 MT)	2114.4	2157.7	2247.0	2293.0	2387.9	2436.8	2486.7	2537.7
Non-Convertible Consumption								
Transport	5	5	5	5	5	5	5	5
Power Generation	754.3	754.3	898.8	917.2	955.2	974.7	994.7	1015.1
Cement/Mining/Engg./Fert	74.0	75.5	78.6	80.3	83.6	85.3	87.0	88.9
Miscellaneous	35.9	36.7	38.2	39.0	40.6	41.4	42.3	43.1
Convertible Consumption	*1245.1*	*1286.2*	*1226.4*	*1251.6*	*1303.6*	*1330.4*	*1357.7*	*1385.6*
Equivalent Gas Demand (MMCMD)	3.6	3.8	3.6	3.7	3.8	3.9	4.0	4.0
Product : LDO								
Equation: Ln (LDO) =6.612487-0.123072xLn(NSDP)								
Estimated Consumption (000 MT)	205.1	203.7	200.8	199.3	196.5	195.1	193.7	192.3
Non-Convertible Consumption								
Transport	12.3	12.2	12.0	12.0	11.8	11.7	11.6	11.5
Food/Plantation								
Power Generation	24.6	24.4	24.1	23.9	23.6	23.4	23.2	23.1
Cement/Mining/Engg./Fert	20.5	20.4	20.1	19.9	19.6	19.5	19.4	19.2
Miscellaneous								
Convertible Consumption	147.7	146.6	144.5	143.5	141.5	140.5	139.5	138.5
Equivalent Gas Demand (MMCMD)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total latent demand for natural gas (MMCMD)	5.7	5.8	5.8	5.9	6.2	6.3	6.5	6.6
Natural Gas								
Demand for Natural Gas (MMCMD)	13.0	13.3	14.0	14.4	15.2	15.6	16.1	16.6
Equation: NG =6.612487+ 0.000195x(NSDP)								
Total natural gas demand in industry	18.6	19.1	19.6	20.3	21.4	22.0	22.6	23.2

Annexure 9

GAS PRICING

Power [illegible] Gas v/s Naphtha

Assumptions : *Naphtha supplied from Koyali Refinery*

All figures in Rs / MT unless specified otherwise

Basic cost of Naphtha = US$ 143

Exchange rate Rs/$ = 43

all figures in Rs / MT unles specified otherwise

		Basic Cost	Central Excise	Sales Tax	Surcharge	Transportation	Total Cost	Equivalent [illegible]	Gas Demand [illegible]
			16%	20%					
1 *Dhuvaran TPS*	*Gas*	6149	922.35	1414.27	106	198.24	8789.86	5.5	9.00
2 *Dhuvaran TPS*	*Coal*	6149	922.35	1414.27	106	198.24	8789.86	5.5	89.00
3 *Gandhinagar TPS*	*Coal*	6149	922.35	1414.27	106	348.32	8939.94	5.6	110.00
4 *Kutch Lignite TPS*	*Lignite*	6149	922.35	1414.27	106	1635.2	10226.82	6.3	35.83
5 *Sikka TPS*	*Coal*	6149	922.35	1414.27	106	813.12	9404.74	5.8	40.00
6 *Ukai TPS*	*Coal*	6149	922.35	1414.27	106	348.32	8939.94	5.6	141.67
7 *Utran TPS*	*Coal*	6149	922.35	1414.27	106	348.32	8939.94	5.6	6.50
8 *Utran TPS (New) CCPP*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	22.50
9 *Wanakbori TPS*	*Coal*	6149	922.35	1414.27	106	198.24	8789.86	5.5	210.00
10 *Dhuvaran Gas Based project*	*Gas*	6149	922.35	1414.27	106	198.24	8789.86	5.5	18.33
11 *GSEC-GEB, Sikka Extn. Stage II*	*Coal*	6149	922.35	1414.27	106	813.12	9404.74	5.8	70.00
12 *Utran Gas based PS stage II*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	22.50
13 *AEC - Sabarmati & Ahmedabad*	*Coal*	6149	922.35	1414.27	1:0	198.24	8789.86	5.5	66.67
14 *AEC - Vatva*	*Gas*	6149	922.35	1414.27	106	198.24	8789.86	5.5	18.33
15 *Essar Power - Hazira*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	50.00
16 *GIPCL - Godhra*	*Gas*	6149	922.35	1414.27	106	198.24	8789.86	5.5	24.17
17 *GTEC - Gandhar, CCPP*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	109.17
18 *AEC - Ahmedabad CCGT*	*Gas*	6149	922.35	1414.27	106	198.24	8789.86	5.5	25.00
19 *GIPCL - Godhra, Vadodara CCPP*	*Naphtha*	6149	922.35	1414.27	106	198.24	8789.86	5.5	53.33
20 *GIPCL - Mangrol TPS*	*Lignite*	6149	922.35	1414.27	106	198.24	8789.86	5.5	41.67
21 *GIPCL - Mangrol TPS Ext.*	*Lignite*	6149	922.35	1414.27	106	198.24	8789.86	5.5	0.00
22 *GMDC - Akrimota TPS*	*Lignite*	6149	922.35	1414.27	106	1635.2	10226.82	6.3	41.67
23 *GPCL - Chhara, Amreli*	*Gas*	6149	922.35	1414.27	106	813.12	9404.74	5.8	0.00
24 *GPCL - Ghogha TPS*	*Lignite*	6149	922.35	1414.27	106	813.12	9404.74	5.8	62.50
25 *GPCL - Mundra, Kutch*	*Naphtha*	6149	922.35	1414.27	106	1635.2	10226.82	6.3	0.00
26 *GPCL - Pipavav*	*Gas*	6149	922.35	1414.27	106	813.12	9404.74	5.8	102.50
27 *GPCL - Pipavav*	*Coal*	6149	922.35	1414.27	106	813.12	9404.74	5.8	166.67
28 *GPCL - Valia, Baruch*	*Lignite*	6149	922.35	1414.27	106	348.32	8939.94	5.6	0.00
29 *GSECL - Gandhinagar TPS Ext 5*	*Coal*	6149	922.35	1414.27	106	348.32	8939.94	5.6	35.00
30 *GSECL Wanakbori TPS Ext 5*	*Coal*	6149	922.35	1414.27	106	198.24	8789.86	5.5	35.00
31 *GSPCL - Hazira*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	53.33
32 *IOC - Savli*	*Petroleum*	6149	922.35	1414.27	106	0	8591.62	5.4	83.33
33 *Jamnagar TPS (Reliance Power)*	*Petroleum*	6149	922.35	1414.27	106	813.12	9404.74	5.8	83.33
34 *KRIBCHO - Junagadh*	*Naphtha*	6149	922.35	1414.27	106	813.12	9404.74	5.8	33.33
35 *NTPC Kawas*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	107.33
36 *NTPC Gandhar*	*Gas*	6149	922.35	1414.27	106	348.32	8939.94	5.6	108.00

Total MMCFD 2075.67

MMSCMD 58.78

Power [illegible] Gas v/s coal

Assumptions : *Coal supplied from Chandrapur, lignite from Panandhara*

All figures in Rs / MT unless specified otherwise

all figures in Rs / MT unles specified otherwise

		Basic Cost	Royalty	Stowing Excise	Sales Tax	Transportation	Total Cost	Equivalent [illegible]	[illegible]
Coal			18%	3.50	0%				
Lignite			2.50	0.00	25%				
1 Dhuvaran TPS	Gas	819	147.42	3.50	0.00	746.90	1716.82	4.90	9.00
2 Dhuvaran TPS	Coal	819	147.42	3.50	0.00	746.90	1716.82	4.90	89.00
3 Gandhinagar TPS	Coal	819	147.42	3.50	0.00	746.90	1716.82	4.90	110.00
4 Kutch Lignite TPS	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	35.83
5 Sikka TPS	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	40.00
6 Ukai TPS	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	141.67
7 Utran TPS	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	6.50
8 Utran TPS (New) CCPP	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	22.50
9 Wanakbori TPS	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	210.00
10 Dhuvaran Gas Based project	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	18.33
11 GSEC-GEB, Sikka Extn. Stage II	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	70.00
12 Utran Gas based PS stage II	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	22.50
13 AEC - Sabarmati & Ahmedabad	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	66.67
14 AEC - Vatva	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	18.33
15 Essar Power - Hazira	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	50.00
16 GIPCL - Godhra	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	24.17
17 GTEC - Gandhar, CCPP	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	109.17
18 AEC - Ahmedabad CCGT	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	25.00
19 GIPCL - Godhra, Vadodara CCPP	Naphtha	819	147.42	0.00	0.00	746.90	1713.32	4.90	53.33
20 GIPCL - Mangrol TPS	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	41.67
21 GIPCL - Mangrol TPS Ext.	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	0.00
22 GMDC - Akrimota TPS	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	41.67
23 GPCL - Chhara, Amreli	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	0.00
24 GPCL - Ghogha TPS	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	62.50
25 GPCL - Mundra, Kutch	Naphtha	819	147.42	0.00	0.00	746.90	1713.32	4.90	0.00
26 GPCL - Pipavav	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	102.50
27 GPCL - Pipavav	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	166.67
28 GPCL - Valia, Baruch	Lignite	510	2.50	0.00	127.50	0.00	640.00	2.70	0.00
29 GSECL - Gandhinagar TPS Ext 5	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	35.00
30 GSECL Wanakbori TPS Ext 5	Coal	819	147.42	0.00	0.00	746.90	1713.32	4.90	35.00
31 GSPCL - Hazira	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	53.33
32 IOC - Savli	Petroleum	819	147.42	0.00	0.00	746.90	1713.32	4.90	83.33
33 Jamnagar TPS (Reliance Power)	Petroleum	819	147.42	0.00	0.00	746.90	1713.32	4.90	83.33
34 KRIBCHO - Junagadh	Naphtha	819	147.42	0.00	0.00	746.90	1713.32	4.90	33.33
35 NTPC Kawas	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	107.33
36 NTPC Gandhar	Gas	819	147.42	0.00	0.00	746.90	1713.32	4.90	108.00

Total MMCFD 2075.67

MMSCMD 58.78

COMPETITIVENESS OF FUELS IN INDIA FOR POWER SECTOR

Cost of imported gas per MMBTU							$5.30	$5.60	$6.30	$6.50	$7.10
Type of fuel	Dom Coal	Imp Coal	FO	D. Naphtha	I. Naphtha	D. Gas	I. Gas	I. Gas	I. Gas	I. Gas	I. Gas
Efficiency	33%	33%	38%	45%	45%	45%	45%	45%	45%	45%	45%
Heat Rate (KCal/KWh)	2606	2606	2263	1911	1911	1911	1911	1911	1911	1911	1911
CV (Kcal/Unit) (Kg or M^3)	4200	6400	9600	10500	10500	10000	10000	10000	10000	10000	10000
Consum. Unit/Kwh (Kg or M^3)	0.620	0.407	0.236	0.182	0.182	0.191	0.191	0.191	0.191	0.191	0.191
Fuel cost/unit (paise)	157	210	450	659	750	360	905	990	1075	1110	1212
Fuel cost/KWh (paise)	97	85	106	156	137	69	173	189	206	212	232
Auxi Power Consumption	9%	6%	5%	3%	3%	2%	2%	2%	2%	2%	2%
Fuel cost/Net KWh (paise)	107	91	112	161	141	70	176	193	210	216	236

Load Factor	85%	85%	85%	85%
KWh in 1 year	7446	7446	7446	7446
Life of the plant (years)	30	25	25	25
Total KWh in life	223380	186150	186150	186150
Capita cost/KW (Rs.)	45000	40000	35000	30000
Debt (Rs./KW)	31500	28000	24500	21000
Equity (Rs./KW)	13500	12000	10500	9000
Annual cost of debt (Rs.)	5403.65	4655.86	4248.87	3641.89
Annual cost of equity (Rs.)	2860.00	2560.00	2240.00	1920.00
Total Annual cost of capital (Rs.)	8263.65	7415.86	6488.87	5561.89
Capital cost/KWh (paise)	111	100	87	75

Depreciation (as % of capital exp.)	3.33%	4.00%	4.00%	4.00%
O&M Expenses (as % of capital exp.)	2.50%	2.50%	2.50%	2.50%
O&M and Dep Exp. (as % of capital exp)	5.83%	6.50%	6.50%	6.50%
O&M Expenses (Rs./annum/KW)	2624	2600	2275	1950
Total O&M Exp./KWh (paise)	35	35	31	26

Cost of imported gas per MMBTU							$5.30	$5.60	$6.30	$6.50	$7.10
	Dom Coal	Imp Coal	FO	D. Naphtha	I. Naphtha	D. Gas	I. Gas	I. Gas	I. Gas	I. Gas	I. Gas
Fuel cost (paise/KWh)	107	91	112	161	141	70	176	193	210	216	236
Capital cost (paise/KWh)	111	111	100	87	87	75	75	75	75	75	75
O&M cost (paise/KWh)	35	35	35	31	31	26	26	26	26	26	26
Total cost (paise/KWh)	254	237	246	278	258	171	277	294	311	317	337

Cost of imported gas per MMBTU							$5.30	$5.60	$6.30	$6.50	$7.10
Assumptions: Fuel Cost	Dom Coal	Imp Coal	FO	D. Naphtha	I. Naphtha	D. Gas	I. Gas	I. Gas	I. Gas	I. Gas	I. Gas
Thermal Efficiency (%)	33%	33%	38%	45%	45%	45%	45%	45%	45%	45%	45%
CV (KCal/Kg) (for gas in KCal/M^3)	4200	6400	9600	10500	10500	10000	10000	10000	10000	10000	10000
Fuel cost (paise/Kg) (for gas in paise/M^3) - at factory gate	157	210	450	659	750	360	905	990	1075	1110	1212
Aux. power consumption											
Re/$ conversion											
BTU / KCAL											

	Coal	FO	Naphtha	Gas
Load Factor				
Life of the plant (years)				
Capita cost/KW (Rs.)				
Effective tax rate				
debt propotion in total capital				
Rate of interest (pre tax)				
Return on equity (post tax)				
Return on equity (pre tax)				

	Coal	FO	Naphtha	Gas