"COMPARATIVE STUDY OF NATURAL GAS WITH OTHER COMPETING FUELS"

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Kriti

DECLARATION BY THE GUIDE

This is to certify that the dissertation report on "Comparative Analysis of Natural Gas with other competing fuels" submitted to the University of Petroleum & Energy Studies, Dehradun, by Kriti Sreedhar, in partial fulfillment of the requirement for the award of the degree of Master of Science (Oil Trading) is a bonafide work carried out by him under my supervision and guidance.

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ABSTRACT

At a global level natural gas has greater potentiality than crude oil. At a national level natural gas has a definite cost advantage over naphtha in all locations and coal in certain locations for power and fertilizer sector as also for industrial sector. The future national policy needs to be based on the following plans:-

(i) We must try to get into long term import of LNG contracts in the most optimum manner.

(ii) Economic choices need to be made on a location specific basis for power, fertilizer and industrial sectors- Natural Gas has obvious advantages over others in a number of cases.

This paper addresses the above mentioned issues.

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LIST OF ABBREVIATIONS

OECD	Organisation for Economic Cooperation and Development
EIA	Energy Information Administration
EU	European Union
GDF	Gaz de France
IEA	International Energy Agency
LNG	Liquefied natural gas
MoPNG	Ministry of Petroleum and Natural Gas
NELP	New Exploration and Licensing Policy
ONGC	Oil and Natural Gas Corporation Limited
RIL	Reliance Industries Limited
OIL	Oil India Limited
OVL	ONGC Videsh Limited
MCM	Million Cubic Metres
MMT	Million Metric Tonnes
MMSCMD	Million Metric Standard Cubic Metre per Day
MCM	Million Cubic Metres
MMT	Million Metric Tonnes
BCF	Billion Cubic Feet
BTU	British thermal unit
MMBTU	Million British thermal unit
MMTOE	Million Tonnes of Oil Equivalent
MU	Million Units
BnkWh	Billion Kilowatt Hour
Kg	Kilogram
PLF	Plant Load Factor
KW	Kilowatt

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INTRODUCTION

Natural gas in the energy basket has a share of 9%, whereas in the world energy basket its share is 23%.This is an indication that as GDP increases there is bound to be an increase in consumption of energy .This trend is indicative of how developed countries while moving towards higher level of energy consumption have favoured higher level of natural gas consumption in their growing energy basket. Thus, if India has to keep up to the expectations of sustaining a compounded economic growth rate between 8% and 10%, energy growth (particularly, natural gas growth) too will have to play an active part. The main reasons why Natural gas is bound to be the fuel supporting India's growth are:-

(1) World Oil reserves are expected to last for 40 years, whereas; natural gas reserves are estimated to last for another 60 years.

(2) Stranded natural gas reserves are more than the proved reserves in the case of natural gas, which implies that there is still huge amount of untapped potential in the case of this fossil fuel.

(3) In terms of pricing natural gas historically has been cheaper than oil and in the future also it will continue to be cheaper than oil but will have to linked to oil as a % or as a formula.

(4) Natural gas has minimal carbon di oxide emissions and therefore it is more environment friendly than the other fossil fuels. With the Kyoto Pact (February 16, 2005) and the recent predictions of catastrophic changes in climatic conditions like heatwaves, melting icecaps etc. environmental concerns would increase ,implying a greater use of natural gas and this would create a scenario where more and more new natural gas fields will get monetized.

The only drawback for natural gas is that when compared to oil its transportation can only be either through pipelines or LNG tankers. In view of this LNG is not traded the way oil is traded several times before it reaches the final consumers. Inspite of its drawbacks the advantages for LNG are far greater and with the changes in technology, the cost for development, production, transportation of natural gas will gradually come down.

The major producers of natural gas in the world are located in Gulf and Central Asia. Qatar, Iran and Russia alone hold more than 58% of world gas reserves. The other countries which have significant quantity of gas are Saudi Arabia, UAE, United States, Nigeria, Algeria, Venezuela and Iraq. While

Europe and United States may have some reserves their consumption is so high that they are deficient in gas and in the future will be major guzzlers of natural gas.

The western countries can afford to pay higher prices, whereas; developing countries and emerging economies like India and China, though have a great demand but affordability is a big factor .Therefore, demand in developing countries will be price sensitive and the projections being made in India and Chin are most ambitious and do not reflect in a great measure the price sensitivity .The Hydrocarbon Vision demand of India projected many years back when natural gas prices were very low needs to be reviewed in the light of the current pricing regime and the future outlook of natural gas pricing.

Indications are that India and China will have to resort to greater use of coal and nuclear energy, besides optimizing on non-conventional sources of energy like wind, solar, bio-mass, bio-diesel etc. In addition to that India will have to focus on increased production of domestic natural gas onshore as well as offshore and also develop faster and a greater measure of Coal Bed Methane and Gas Hydrates to feed the growing demand from its power, fertilizer and petrochemical sector. Taking the case of one of these sectors, the petrochemical industry in India had witnessed rapid growth in the past, growing at 1.5-2.5 times the GDP growth rate with soaring demand in the individual segments of the petrochemical industry. The phenomenon of the petrochemical sector growing at multiples of GDP growth rate continued till the onset of the global economic slowdown in 2000 when the US, EU and Japan economies simultaneously experienced recessionary trends causing a broad based slowdown in the global economy which adversely affected demand for petrochemicals.2003 marked the beginning of the recovery process in the global economy and soon signs of recovery could be seen in the petrochemical sector. However, as the recovery gathered momentum, prices of crude oil increased significantly, breaching the $ 50/barrel mark and pushed up the costs of production in the petrochemical industry. Despite firm prices and revival of demand, the cost-push effect of the hike in crude oil prices prevented margins from improving to their full potential.

India currently produces about 80 mmscmd of gas out which after internal use about 70 mmscmd is made available .About 20 mmscmd of gas is made available through LNG against this the current demand projected is 120 mmscmd, implying a deficit of 40 mmscmd .Therefore, the challenge before the country is how to meet the gap. The answer lies in:-

1. Increase in production
2. Continuing to explore possibilities of transnational pipelines from Iran, Kazakhstan, Bangladesh or Myanmar (chances of getting natural gas through pipelines are remote because of techno political factors, nevertheless, efforts must continue)
3. Import of natural gas in liquid form (LNG) and encouraging domestic companies to participate in the LNG supply chain.

While LNG availability will increase but at the same time pricing will be an issue, but whatever the price it will still be cheaper than crude oil, so one has to exercise his judgment and optimize on the most competitive energy basket.

India us fortunately placed logistically around the countries which produce or are likely to produce LNG .For the west coast the suppliers are Qatar, Yemen, Oman, UAE, Iran ,the east coast suppliers are Malaysia, Brunei, Australia .The other suppliers could be Nigeria , Algeria, Egypt, Libya, but on account of distance the transportation costs would be higher. In spite of this logistical advantage sourcing LNG for India is one of the biggest challenges. If we look at the last five years India has lost major opportunities to firm up reasonable contracts in a rising market just because people in the government and in the industry are affected more by the issue of subsidy pricing rather than looking at the dynamics of international market and the realization, some feel, has come too late for sourcing LNG at reasonable prices.

India will have to, given the scenario, be very clear in its mind about the energy security ,various components of the energy basket and its share together with the cost of procurement. Unfortunately, the integrated energy policy and its implementation has been delayed beyond reason, leading to the current situation where the power and the fertilizer sector (major consumers of crude oil and gas) are struggling and in the absence of clear directions the future of infrastructural development in these sectors is badly hampered.

In order to promote greater use of natural gas government needs to think very seriously on various fiscal measures-reduction of import duty on LNG, declaring gas sector as an industry and giving it infrastructural status, reduction in custom duty, decrease in sales tax etc. These issues have been discussed and debated in various quarters but for the last five to seven years no solution or resolution has come about. Until and unless infrastructure in the form of pipeline grid within the country connecting various producers and consumers is established, you cannot attain growth and share of natural gas in the energy basket from 9% to 20% in 2025 as per the India hydrocarbon vision.

Foreign investors and multi national companies are not coming in a big way to invest in an absence of a regulator .Here also the issue of regulator and regulatory mechanism has been over delayed and thus some urgent steps need to be taken in this direction to resolve this matter.

CHAPTER 1

ENERGY SUPPLY SCENARIO

1.1 CRUDE OIL SUPPLY SCENARIO

Most studies estimate that oil production will peak sometime between now and 2040. This range of estimates is wide because the timing of the peak depends on multiple, uncertain factors that will help determine how quickly the oil remaining in the ground is used, including the amount of oil still in the ground; how much of that oil can ultimately be produced given technological, cost, and environmental challenges as well as potentially unfavorable political and investment conditions in some countries where oil is located; and future global demand for oil. Demand for oil will, in turn, be influenced by global economic growth.

1.1.1 INTERNATIONAL SCENARIO

The Middle East and North Africa are exceptionally well-endowed with energy resources, holding 61% of the world's proven oil reserves. Current oil production is relatively low in comparison to these reserves and further development of them will be critical to meeting global energy needs in the coming decades.

World crude oil production increased by 58% over the 34-year period from 1971 to 2005. In 2005, the production reached 3 923 million tonnes or about 82 million barrels per day. Growth was not constant over the period as production declined in the aftermath of two oil shocks.

In 2005, the Middle East region's share of supply was 31% of the world total. However, both production and share varied significantly over the period, with the Middle East representing 32% in 1971 falling to less than 19% in 1985. Increased production in the 1980s and 1990s put the OECD on par with the Middle East during that period, but in 2004, the share of oil production by the OECD had fallen to 24%.

Russia, which vies with OPEC's Saudi Arabia as the world's No. 1 crude exporter, increased its exports by 20 percent during the first 10 months of this year compared with the same period of 2002, according to the official OPEC news agency. However, the IEA argued that Russian output was "critically dependent" on political issues raised in the current dispute between the senior management of Yukos, Russia's largest oil company, and the Russian government. Russia's crude output could suffer if the dispute slows the expansion of its oil majors, the report said.

The data for the last six years as far as key players in the world oil market are concerned is shown in the following table:-

TABLE1-

COUNTRY WISE CRUDE OIL SUPPLY

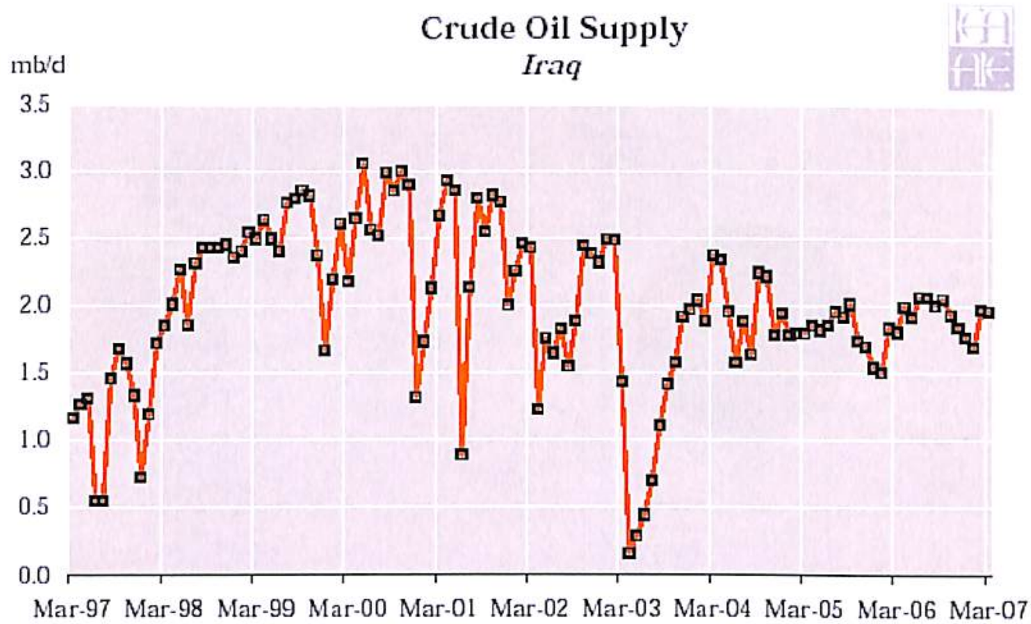
Australia	Mexico	Norway	United Kingdom	United States	EU 25 total	OECD total	China	India	Russian Federation	World
32.1	169.3	161	126.4	353	162.3	1008	163.2	36.4	321.7	3,605.3
33.1	175.5	162.5	116.8	349.9	151	1,003.60	164.2	36.2	345.8	3,611.1
31.3	178.3	157.7	116.1	348.1	154.2	1,007.10	167.2	37.4	377.2	3,591.5
29.1	189.3	153.6	106.2	338.4	144.3	999.6	169.8	37.7	418.6	3,707.8
29.1	191.4	151.8	95.5	325.9	134.7	982.7	176.2	38.3	456.3	3,870.8
26	187.6	138.8	84.6	306.6	122.3	928.9	183.3	36.9	469.9	3,923.3

Source: EIA

As far as Iraq is concerned the oil supply has shown a volatile trend (as depicted in the following figure).It has gained a prominent position in the geopolitics of the world post the September 11 attack and the consequent invasion of Iraq by the US army. Being regarded as the source of the new wave of Islamic terrorism and its habitual non compliance of the long term agreements (countries have to allow for stock cuts in months when there are terror strikes) and accounting for 5.6% share of the world oil reserves, it's important to study the trend in Iraq's oil supply to the world.

Iraqi output continued to increase, despite sabotage that has forced the closure of one of Iraq's two main export pipelines for crude. Iraq boosted its daily oil production by 320,000 barrels last month for a daily total of 1.9 million barrels. Yet if production trends continue, Iraq will soon reach the limits of its capacity to export oil from its lone operable terminal in the Gulf. Unless it finds alternative export routes, Iraq may fail to achieve its goal of producing 3 million barrels a day in 2004.

FIGURE 1

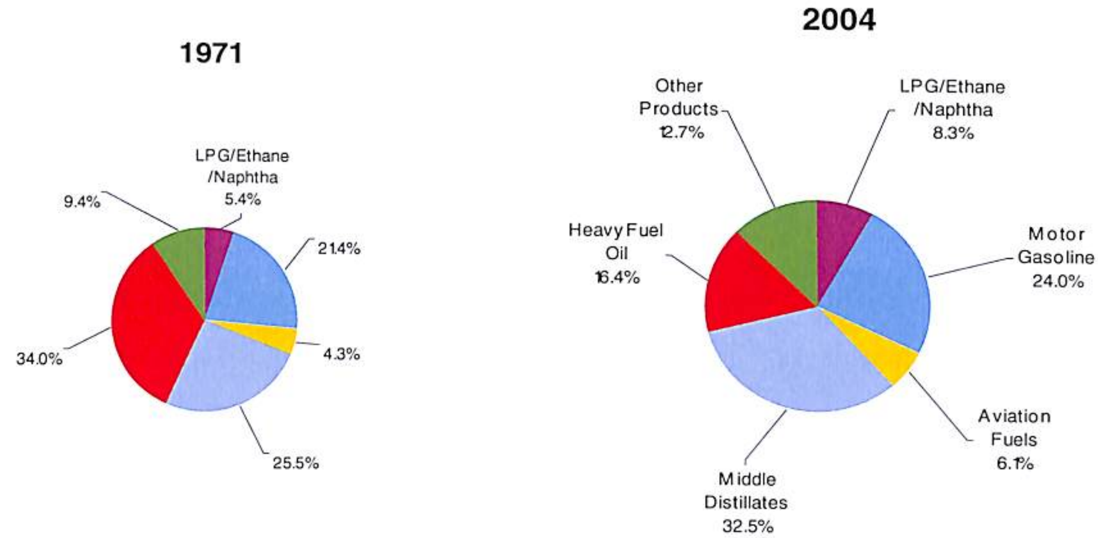


Source: www.eia.doe.gov

Refinery production of secondary oil products changed significantly between 1971 and 2004. The share of heavy fuel oil in the refinery mix fell from 34% in 1971 to 16% in 2004 whereas the share of middle distillates increased from 25% to 33%.

FIGURE 2

Share of refinery production by product



Source: OECD Fact book 2007

New Discoveries

Australasia

Australia -- 2006 has seen very few significant oil discoveries, with the biggest commercial success being Tap's Amulet discovery on the North West Shelf. This has reserves of 10-15MMbo.

Other significant discoveries, for commercial rather than size reasons, were Coogee's Swift North and Swallow wells. Together with Montara, these discoveries have reserves in the region of 30 MMbo (24 MMbo from Montara) and will now make a joint development conceivable. This could help open up the Ashmore and Cartier region to future exploration and development activities.

Papua New Guinea -- SPI's Elk 1 wildcat in Papuan Foldbelt license PPL 238 is potentially a significant find that has tested up to 50 MMcfg/d, while a second DST over the interval 1,640-1,856m flowed 21.7 MMcf/d through a 60/64-inch choke. High quality condensate with an API between 46-49° also flowed. Analysis suggests the existence of a possible oil leg at Elk and a theoretical gas column in excess of 1,000 meters.

Commonwealth of Independent States (CIS)

In 2006-- Kazakhstan -- Petrom claims its Rovnaya South 1 wildcat in the Turgay Basin is a significant discovery, with the well flowing 6.9 MMcfg/d and 440 bc/d, from what is thought to be the Middle Jurassic Doshchan Play. TengizChevroil wildcat Ansagan 1X, some 18 kilometers west of the Tengiz Field, establishes a 135-meter oil column in a low permeability reservoir in what is believed to be a pre-salt Carboniferous limestone unit. The result high grades a number of pre-salt structures in the area.

In 2005--The Zhaik 1 well may be considered significant as it is OMV's first success. The Carboniferous and Permian carbonate play is well established in northwestern Kazakhstan; this well's full potential is yet to be established. Sulfur-free 40 degree API oil was recovered.

In 2006-- Russia -- The Vasyukanskaya Yuzhnaya 1 wildcat makes it three out of three for BP/Rosneft on its offshore Kaygan-Vasyukanskiy block (Sakhalin-5 project), an area that was opened by the Pela Lache find in 2004. Rosneft estimates reserves for the structure at 110 MMb.

In 2006-- Uzbekistan -- The Yumay 1 wildcat drilled by Uzbekneftegas proved to be a modest oil discovery in the gas-prone basin Amu-Darya Basin. The well flowed 264 bo/d through a 3.5mm choke from the Callovian-Oxfordian carbonates.

Europe

In 2005-- United Kingdom -- Talisman's 13/23b-5 exploration well is a new Lower Cretaceous sandstone discovery with reserves of between 20 to 50 MMbo. Appraisal 13/23b-5Z, sidetracked to the southwest, found thicker oil bearing sands and tested 35-degree API oil at a rate of 6,700 bo/d.

United Kingdom -- Nexen says exploration well 15/18b-11 discovered 10 meters of gas and approximately 16 meters of oil pay in Palaeocene Balmoral sandstone. The well flowed up to 1,500 boe/d on test.

Far East

In 2005-- China -- PetroChina-Xinjiang flowed commercial oil and in new-pool wildcat An 5 in Lease Block Southern Margin West, southern Junggar Basin. The well tested 660 bo/d and 233 Mcfg/d, having previously flowed 121 bo/d and 42 Mcfg/d from the middle part of the Anjihai Formation. The well is significant in that this is the first time commercial hydrocarbon flows have been obtained from the Anjihai Formation along the basin's southern margin. The structure has hydrocarbon resources forecasted at 668 MMboe. PetroChina-Tarim flowed oil and gas from a second interval in new-field wildcat Tazhong 82, in the Takla Makan desert, central Tarim Basin. The company tested 1,702 bo/d and 13,225 Mcfg/d from the second interval having earlier flowed 126 bo/d and 706 Mcfg/d from a deeper zone.

Indonesia -- PT Caltex Pacific proved with its deviated Reco 1 well that exploration upside still exists in mature basins. Targeting Upper Pematang Formation sandstones within the Rokan PSC, the well tested 2,880 bo/d.

Latin America

Brazil -- Petrobras suspended 4-ESS-164A (4-BRSA-406A-ESS), a well that may be regarded as its best discovery in 2006; the company reports it had discovered 280 MMboe of 38° API oil. It lies in 871 meters of water and was targeting Cretaceous turbidites.

Peru -- Repsol-YPF's Raya 1-X oil discovery on Block 39 in the Maranon Basin only flowed around 2,000 bo/d from two intervals, but it may tip the balance in favor of developing a series of discoveries in a heavy oil trend. In 2005 Petro-Tech tested 1,200 b/d of 35-degree API oil from the Paleozoic in San Pedro 1X, a wildcat in the southwest corner of offshore Sechura Basin shelf Block Z-2B. Petro-Tech calls it Peru's biggest crude oil discovery in the last 30 years. It also is the first oil discovered in the Sechura Basin, despite an exploration history in the area dating back 100 years, and the basin's first substantial discovery of any kind. The basin's northern part has had some small gas discoveries, but only minor production. It also is further south than any oil previously discovered offshore in Peru. San Pedro 1-X has opened a whole new productive trend in the Paleozoic in this basin, where reserves are thought to be 500 to 1000 MMbo. Peru has little Paleozoic exploration or production, and this find has renewed interest in the offshore. Energy and Mines Minister Glodomiro Sanchez Mejia announced Buena Vista 1-X in the south central portion of Block 39 in the Maranon Basin as an important oil discovery. The well flowed 2,830 b/d of 13.7-degree API oil from the Chonta and Casablanca formations. Reserves have been estimated at 70 MMb. The well is located about 14 kilometers south of Barrett Resources 1998 discovery well Pirana 1X, and 19 kilometers northeast of Tangarana 1-X, abandoned in 1975 by

Union Oil with heavy oil shows. The Buena Vista 1-X could be considered as the fourth heavy oil find in the area and, if developed together, could generate a 280 MMbo reserve estimate.

Middle East

In 2005-- Iran -- Norsk Hydro spent three and a half months testing its Azar 2 oil discovery on the Anaran block. No test results have been disclosed, but Norsk Hydro's executive vice president with special responsibility for oil and energy, Tore Torvund, was quoted by Reuters as saying, "There may be more than a billion barrels, at least, in the structure. I would say that totally from this area we will in the long term be able to produce about 100,000 b/d."

Kuwait -- Umm Niqa 1 is significant as it marks the first time that a well in Kuwait tested light crude in the Lower Jurassic Upper Marrat Formation; three test intervals yielded 1,879 b/d of 45-degree API of crude with 10.2 MMcf/d of associated gas. Also, two intervals in the Middle Jurassic Najmah/Sargelu formation flowed 1,300 b/d of 49-degree API crude with 14.5 MMcfg/d while two intervals in the Lower Jurassic Middle Marrat Formation flowed 2,455 b/d of 45.4-degree API crude and 14.4 MMcfg/d.

In 2006-- Iraq -- DNO's Tawke 1 in the Kurdistan region was suspended after the well yielded a maximum flow of 5,000 bo/d from one shallow reservoir estimated to be up to 800 meters thick, at a depth of 350 meters. DNO had estimated oil reserves in the Tawke structure at 330 MMb in place with 100 MMb recoverable, figures that may increase given the successful appraisal. The well is regarded as the country's first significant oil find since 1993

Frontier North America

Gulf of Mexico -- The deepwater Jack discovery drilled by Chevron in 2005 was tested in 2006, and this provided confirmation with regard to the commerciality of the emerging Lower Tertiary trend. The significant discovery on this trend in 2006 was BP's Kiskida well, located in 1,791 meters of water, this encountered 244 meters of net Lower Tertiary pay; the two wells are 130 kilometers apart. In 2005 two deepwater Gulf of Mexico discoveries could be considered significant: BP's "Stones" (WR 508) and Unocal's "Knotty Head" (GC 512) prospects.

Stones is significant because it is yet another discovery made beneath the Sigsbee salt canopy in the L. Tertiary age section. It is on trend with the L. Tertiary discoveries made by Chevron at "Jack" (WR 759), Unocal's St. Malo (WR 678), which has a 396-meter oil column and recoverable reserves over 250 MMboe, together with BHP's Chinook (WR 468) and Cascade (WR 206) discoveries. BP has yet to release Stones' reserve levels, but it does represent more success in the early stages of this major new deepwater trend.

Knotty Head is still drilling (now over 9,700 meters) and has encountered pay in a shallower, secondary objective that Unocal says is large enough to develop on its own. No news as yet on the deeper objectives, but the well is drilling in the very prolific middle and Lower Miocene age trend just north of BP's Holstein and Chevron's Tahiti Fields

Saharan Africa

Egypt -- Apache successfully tested a new Jurassic play with its Kahraman B-22 well in the Khalda Concession. The well appraised the westward extent of the shallow Kahraman "B" Bahariya oil field and investigated deeper traps in the Alam el Bueib and Jurassic Safa formations. It logged a total of 25.6 meters of net pay in Jurassic sands between 3,773 and 3,916 meters. The Lower Safa tested at an average rate of 16 MMcfg/d and 486 bc/d on a two-inch choke.

New wells are planned in the Shushan "C" concession to investigate the possible extension of this Jurassic play, as Apache believes both sand quality and pay may improve to the north.

Sub-Saharan Africa

Cameroon -- Total's Dissoni Marine 2 appraisal well in its Dissoni Block, Rio del Rey Basin, shallow offshore intersected around 50 meters of oil pay in a massive oil bearing sandstone in the Alternances Formation. This successful appraisal of a 2000 discovery may signal the start of a new offshore development, the first in a number of years.

Nigeria -- Shell's Bonga North 2X dual leg appraisal to the Bonga North 1X discovery in OPL 212 penetrated 90 meters of hydrocarbon-bearing sands in several intervals.It is believed Shell is trying to prove up enough reserves (500 MMb+) that could lead to Bonga North being developed separately from Bonga. Sao Tome JDZ. The first deepwater well in the JDA, Chevron's Obo 1 encountered a

cumulative 45 meters of net hydrocarbon pay in multiple reservoirs. Reserves are rumored to be not as large as expected, leading to speculation that the well was not sited at the most prospective location but rather on the edges of a major structure to check its extent.

Uganda -- 2006 hosted a run of discoveries that proved a significant step forward not only for Uganda but for East Africa in general.

Hardman's Mputa 1 wildcat was hailed as the country's first oil discovery; Waraga 1 (also Hardman) achieved an aggregated test rate of over 12,000 bo/d -- an important incentive for future exploration of the Albertine Graben and other rift basin areas.The Kingfisher 1 discovery drilled by Heritage confirms the trend.

In2005, Angola -- Astraea 1, Ceres 1, Hebe 1 and Juno 1 are discoveries located in the ultra-deepwater Block 31 in the Congo Fan. All are in Tertiary channels and presumably do not exceed 250 MMbo reserves each, suggesting a joint development as an attractive option.

Congo -- Murphy announced in January 2005 that its Azurite Marine 1 wildcat in 1,381 meters of water in the Mer Profonde Sud exploration permit encountered more than 49 meters of net oil pay with no associated water in two main levels in the Lower Miocene. The oil is described as high quality and the reservoir properties are excellent. Indications are that the structure could contain more than 100 MMbo. The first appraisal, Azurite Marine 2 has been successfully completed testing nearly 8,000 bo/d from a single zone

1.1.2 Domestic Scenario

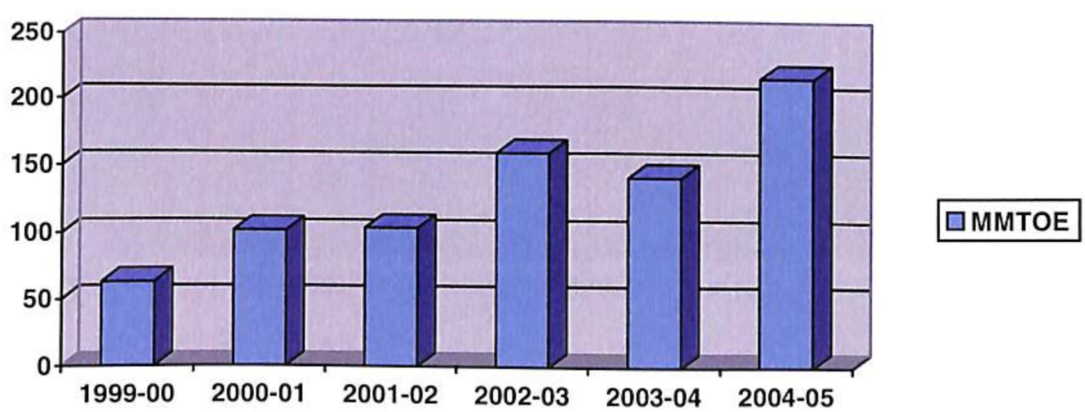
India remains one of the least explored regions in the world with a well density of 20 per 10000km2. Of the 26 sedimentary basins, only 6 have been explored so far. The Oil and Natural Gas Corporation (ONGC) and the Oil India Limited (OIL)- the two upstream public sector oil companies- in 1981/82 had taken their search to previously unexplored areas. Number of wells drilled as well as the meterage increased . However current reserve accretion continues to be low. Recoverable crude oil reserves in 2005-06 stood at 786 mn tones. In 2000-01 crude oil reserves were around 703 mn tones, After which they stayed around 730-740 mn tones till 2005 -06.The recent increase is due to a spurt of recent discoveries by private players who have been included in the exploration activity in the country ,due to

certain changes in policies ,by way of NELP rounds. The government in order to increase exploration activity approved the New Exploration Licensing Policy (NELP) in March 1997 which would level the playing field in the upstream sector between private and public sector companies in all fiscal, financial and contractual matters. Powered by the India Hydrocarbons Vision- 2025 report, which gave priority to a huge push in exploration efforts, the government has moved into overdrive. As many as 94 blocks have been given out for exploration under the New Exploration and licensing Policy since April 2000 against just 22 blocks in the preceding 10 years. While ONGC holds 57. 2 per cent of the total areas licensed by the government for oil exploration, Reliance Industries and Oil India Ltd have grabbed licences covering around 26. 6 percent respectively.

FIGURE 3

RESERVE ACCRETION TREND

(AGGRESSIVE IMPLEMENTATION OF **NELP** HAS ENHANCED DOMESTIC RESERVES)



Source: ONGC, OIL&DGH

As in 1-4-06, there were 247 oil and gas fields and 24 oil fields owned players in offshore and onshore areas. ONGC has 8 oil fields and 216 oil and gas fields, OIL, the other major player has 16 oil fields and there are 31 oil and gas fields under the ownership of private players or in the form of joint ventures. Oil India's performance has been steadily improving over the years and has reached 3234000 tonnes in 2005-06. For the six months ended June 30, 2006, the total gross production rate from fields in which

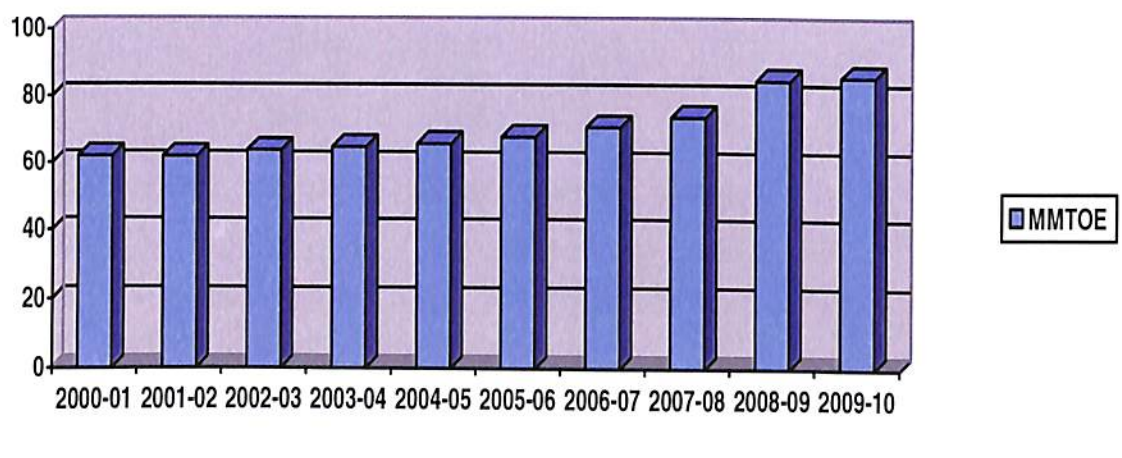
Cairn India operates was approximately 87,500 barrels of oil & gas equivalent per day (boepd) of which Cairn India had a working interest in 24,000 boepd. Cairn India currently operates 11 offshore platforms, approximately 200 km of sub-sea pipelines and 2 processing plants. The ravva PSC was

signed between Government of India, ONGC, Videocon Petroleum Ltd (name changed to Petrocon India Limited, now stands merged with Videocon Industries Ltd), Command Petroleum, and RAVVA Oil (Singapore) of Marubeni Group.The oil production from this joint venture is approximately 8% of India's total production(150 million barrels)in 2005.

The country imports around 70%of its crude oil requirement but with a huge refining capacity the country is a net exporter of petroleum products since 2000 as shown in table 2.

FIGURE 4

OIL PLUS OIL EQUIVALENT GAS PRODUCTION TREND



Source: ONGC, OIL and DGH

TABLE 2

PRODUCTION OF CRUDE OIL (ONSHORE and OFFSHORE)

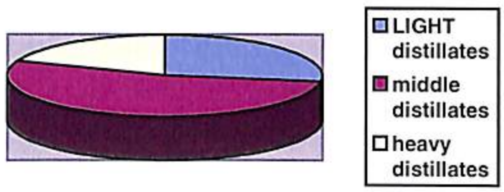
ITEM	1990-91	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. CRUDE OIL PRODUCTION ++ ('000' Tonnes)							
(a) Onshore:							
Gujarat	6357	5815	6002	6042	6131	6187	6251
Assam/Nagaland	5070	5199	5095	4660	4592	4703	4474
Arunachal Pradesh	41	78	69	74	77	83	104
Tamil Nadu	302	436	440	395	375	391	385
Andhra Pradesh	14	263	283	300	281	226	216
Total (a)	**11784**	**11791**	**11889**	**11471**	**11456**	**11590**	**11430**
of which							
OIL	2647	3286	3182	2951	3002	3196	3234
ONGC	9137	8428	8636	8445	8380	8320	8095
JVC/Private	0	77	71	75	74	74	101
(b) Offshore:							
ONGC	20376	16629	16074	17560	17677	18165	16309
JVC/Private	Nil	4006	4069	4013	4240	4226	4451
Total (b)	**20376**	**20635**	**20143**	**21573**	**21917**	**22391**	**20760**
Grand Total (a+b)	**32160**	**32426**	**32032**	**33044**	**33373**	**33981**	**32190**

Gross Imports :						
(a) Qty : Crude Oil	74.10	78.71	81.99	90.43	95.86	99.41
Pol. Products	9.27	7.01	6.74	7.90	8.83	11.68
Total (a)	83.37	85.72	88.73	98.33	104.69	111.09

Exports :							
a) Qty :							
Pol. Products	Mn.Tonne	8.37	10.07	10.29	14.62	18.21	21.51
Net Imports :							
a) Qty : Crude Oil	Mn.Tonne	74.10	78.71	81.99	90.43	95.86	99.41
Pol. Products	"	0.90	-3.06	-3.55	-6.72	-9.38	-9.83

FIGURE 5

SHARE OF REFINERY PRODUCTION BY PRODUCT



NEW DISCOVERIES

In January 2004, Cairn India discovered the Mangala field, the largest onshore crude oil field discovery in India since 1985, with reserves of 428 mmboe.

Reliance Industries Ltd (RIL), India's largest private firm, in June 2006 announced an oil discovery in its gas-rich D6 block in Bay of Bengal, where the company is investing US$2.49 billion to bring the 14 trillion cubic feet gas find to production.

There are also overseas acquisition undertaken by the NOCs and the private companies. For eg. The ONGC Ltd and GAIL Ltd., is to take a 49 percent stake in the Venezuelan oil field of San Cristobal and PDVSA. To the west, India has secured energy deals in Africa, including in Libya, Sudan and in the Ivory Coast

1.2 Natural gas supply prospects

World wide natural gas resources are sufficient to meet projected increase in natural gas demand. Proven reserves of gas have increased steadily since 1970s,as reserve additions have outpaced production by a wide margin. According to BP Statistical review 2005, reserves stood at around 180 Tcm-almost twice as high as twenty years ago. Reserves are equivalent to 66 years of production at current rates. The

increase in reserves has resulted both from sustained exploration and appraisal activity and from advances in technology that upgrade existing reserves .These two approaches are also important because the majority of gas that has been discovered so far has been in the course of oil exploration and as with oil fields new gas fields which have been found are generally smaller than in the past.

A significant number of fields which have been on production for over 20 years can certainly be regarded as mature.eg. Gas production in the UK sector of the North Sea began in 1967 and oil production in 1975. In the year 2000 production hit 4.5 million boe/d and it is now widely accepted that 2005 represented a production peak from which UKCS production will now decline.

The growing challenge of managing mature assets in the North Sea over the last ten years has seen a number of very different approaches being taken. However all have a common theme - that continued investment is paramount to maximizing value. Taking the case of Statfjord field-the production strategy over the field's life has been pressure maintenance through water and gas injection, a common approach in North Sea developments. Optimization of this strategy has been achieved through the drilling of deviated and horizontal wells, continued infill drilling, WAG (water and gas) injection as well as facility modifications.

However, the approach to field management in Statfjord is about to change with an objective of maximizing value the decision has been taken to depressurize the field and switch the emphasis from oil production to gas. Estimates show that the fresh approach will increase ultimate gas recovery from 53%-74% and will take oil recovery up to 68%.

Overall natural gas demand is expected to increase by an average of 2.9% in developing countries by 2025. According to estimates ,the industrialized countries demand would be higher than their supply capacity and thus they will rely on other parts of the world for around 30% of their supply. In FSU production will exceed consumption by 0.33 tcm and in the developing world the excess production will be around 0.46 tcm in 2025 .Thus, these two regions are expected to be major source of exports.

Over the next three decades, 7.3 tcm of new gas production capacity will be needed,i.e. 260 bcm every year.new capacity will be needed for two purposes:-

1. To meet rising demand
2. To tackle declining production.

Around 71% of natural gas produced is from onshore fields this share is expected to drop to 64% in 2030 as exploration and development shifts to offshore sitesNorthwest europ continent l shelf and the gulf of Mexico together will account for almost 33%of new offshore capacity.Asian countries will account for around 25% of it.

1.2.1 International scenario

Gas is more widely distributed geographically than oil but it's important to realize that three countries Russia, Qatar and Iran hold 55% of global gas reserves. Russia owns one third of the reserves but this share has steadily decreased in the past due to low exploration activity .the reserve production ratio is still high at 77 years. Middle East holds 40%reserves, reserve to production ratio is around 200 years and share of production is increasing with new discoveries and up gradations in Iran, Qatar and Saudi Arabia. In 2005, World wide natural gas production was close to the 10 year average.The BP statistical review showed increase from 95.2 tcf in 2003 to 95.3 tcf and then to 97.53tcf in 2005.

NON OECD

Non-OECD Europe and Eurasia and the Middle East account for almost three-quarters of the world's natural gas reserves, but in 2003 they accounted for only 39 percent of world production. Middle East production was 10.3 tcf in 2005, its share in world production stood at 10.6%.Together, these two regions account for 47 percent of the projected increase in global natural gas production from 2003 to 2030, much of it for export to OECD countries.

Central and South America's production was 4.78 tcf in 2005 its world share stood at 4.9%.

Non-OECD Asia -China recorded the world's largest volume growth of 22.2% in 2005 over 2004, its world share was 1.8%, whereas India saw a meager rise of 1.3% with its world share barely over 1%.

Russia is already the world's single largest exporter of natural gas, it accounts for nearly 29% of world natural gas exports, with net exports of 151.28 billion cubic metres in 2005, entirely by pipeline. There are also some plans to export natural gas from the Middle East, but much of the region's increase in production is projected to be used domestically—particularly in the electric power sector, where shifts from petroleum to natural gas allow the producing countries to monazite more of their oil assets through export.

Africa, production remained around the 5.1 tcf mark before rising to 5.75 tcf in 2005(world share 5.9%) mainly because Egyptian production increased by 29% as LNG exports commenced. A considerable amount of the incremental production in Africa—from Algeria, Nigeria, Libya, and Egypt—is slated for export, both by pipeline and in the form of liquefied natural gas (LNG). This region with its rich and underdeveloped natural gas resources is expected to experience the fastest growth rate in natural gas production worldwide, with supply rising by 4.9 percent per year from 2003 to 2030.

OECD

In 2005, the OECD countries accounted for 39.1 percent of the world's total natural gas production, (these countries produced 38.1 tcf of natural gas in 2005 and 38.71 tcf in 2004) and 52 percent of total natural gas consumption; in 2030, they are projected to account for only 25 percent of production and 40 percent of consumption. Natural gas supply from the OECD nations increases by an average of only 0.5 percent per year in the IEO2006 reference case, whereas demand increases by 1.5 percent per year. As a result, the OECD countries rely increasingly on imports to meet natural gas demand (Figure 39), with a growing percentage of traded natural gas coming in the form of LNG. OECD countries are expected to rely on natural gas produced in other parts of the world to meet more than one-third of their natural gas consumption in 2030, up from 22 percent in 2003.For OECD North America, in particular, production stood at 26.8 tcf in 2004 and 26.5 tcf in 2005 implying a 1 % slide in 2005 over 2004, this decline was primarily due to hurricane related disruptions .Its share in total natural gas production in 2005 was 27.2%.

LNG is expected to become an increasingly important source of supply to meet the world's demand for natural gas. Although there were only 12 LNG-exporting countries in 2004, the number is increasing. In 2005, Egypt joined the ranks of LNG-producing countries with the start of two separate liquefaction projects. Russia also entered the LNG business in 2005, not with LNG it produced but with LNG for which it traded pipeline natural gas. The number of countries installing the infrastructure necessary to accept LNG imports is also increasing. More than 30 years had passed since the United Kingdom imported LNG, but in 2005 it rejoined the ranks of LNG importers, with the startup of its Isle of Grain regasification terminal. China, Canada, and Mexico all have their first LNG import terminals under construction; and Germany, Poland, Croatia, Singapore, and Chile are among the other countries considering their first regasification terminals.

NEW DISCOVERIES

In a year of nationalizations (Venezuela and Bolivia, for instance) and severe contract and political challenges (Russia and just about everywhere else), 2006 was a year with few jaw-dropping discoveries being reported. However, there were some important finds that opened up some new areas, bolstered nearby producing areas and provided more building blocks for the future.

Australasia

Australia -- Drilled by Chevron, it is located to the west of Gorgon. Although no official reserves estimate has been released, it is understood to be "significant" and to have encountered a 190-meter gas column in the Mungaroo Sands, the biggest to date in Australia.It also is rumored to be lower in CO2 than the nearby Gorgon Field, which could mean that the Gorgon gas project could be developed without initially requiring so much CO2 re-injection and so lowering the upfront development costs. Xena 1ST1. Drilled by Woodside, it is not a large discovery (reserves estimated at less than 0.5 Tcf), but it is located in the same block as the 2005 Pluto discovery, which is undergoing a fast track LNG development.On its own, Pluto is considered just about large enough to support such a project. However, various developmental problems, such as much of the Burrup Peninsula becoming protected due to Aboriginal rock art and the possibility of domestic gas reservations, mean that additional gas, again discovered on a 100 percent Woodside-owned basis, can only help this project fly.

In 2005, Pluto 1 is a large gas discovery encountering 111 meters of net gas pay in the Mungaroo and Brigadier formations and overlying Tithonian sediments. Estimated 2P recoverable reserves of 3.0 Tcf of gas. Owned and operated (100 percent) by Woodside, it was discovered in April and has been fast-tracked, with Woodside announcing in December that it had agreed to key commercial terms with customers in North Asia for the supply of LNG from Pluto. Caldita 1 is a large ConocoPhillips gas discovery with estimated 2P recoverable reserves of 1.5 Tcf of gas. The discovery is located about 55 kilometers east of Tassie Shoal, where Methanol Australia has received approval to build a methanol and LNG complex on concrete artificial islands. Development of infrastructure in this region may also assist development of 11.5 Tcf Evans Shoal gas discovery.

2005

Russia -- The BP/Rosneft Elvary Neftegaz joint venture recorded a second discovery in an unexplored basin with the Udachnaya 1 wildcat in the offshore Kaygan-Vasyukanskiy block (Sakhalin-5 project). The well encountered three pay zones, and one was tested flowing 2,190 bo/d through an 11mm choke. The Udachnyy prospect is located some 40 kilometers offshore between the Sakhalin coast and Pela Lache 1, the joint venture's first discovery drilled in 2004. Rosneft estimates potential hydrocarbon resources of the entire Kaygan-Vasyukanskiy block at 1.8 billion barrels oil and 1 Tcf gas.

Europe

Norway -- Statoil encountered gas in several Late Triassic Sandstones in its 7122/6-2 (Tornerose) well. Although not tested, the discovery is to be evaluated as part of the resource base for a potential expansion of the LNG plant at Melkøya. Further development of the LNG plant, however, would require more gas than Tornerose could potentially supply.

This result is seen as giving a boost for Barents Sea exploration plans.

2005

Norway -- Norsk Hydro's 35/2-1 (Peon) encountered a large Pliocene gas deposit at a total depth of 687 meters -- the shallowest prospect ever drilled on the Norwegian Continental Shelf. Located in 384 meters of water, the discovery marks a whole new regional exploration model; Hydro says the possibility for a commercial development is very good. Norsk Hydro tested gas in the 6605/8-1 (Stetind-A6) well in a relatively unexplored area of the Norwegian Sea. Located in 828 meters of water, the well sought Cretaceous Lysing Formation sandstones; a production test flowed 4.2 MMcfg/d. Shell reported its 6406/9-1 well in the Onyx South West prospect as a significant discovery. Gas was encountered in Jurassic sandstones, where two production tests in two zones, each flowed a maximum of 49.4 MMcf/d through a £-inch choke. Several layers in the Jurassic also contained condensates. The results indicate the presence of a significant gas column while the NPD estimates that the size of the discovery may approach 2 Tcf of producible gas.

2006

United Kingdom -- ConocoPhillips well 30/6-6 (and 6z) on the Shoei prospect confirmed the presence of a substantial commercial hydrocarbon accumulation. Partner BG Group reported that the estimated recoverable reserves are between 100 and 275 MMboe, making this one of the largest North Sea finds in recent years.

It is on first round acreage that has been held under license for over 40 years.

Far East

China -- Located in 1,480 meters of water in the South China Sea, Husky's Liwan 3-1 1 in the PSCA 29/26 license is a significant gas discovery, as it is the first true deepwater discovery and it has possibly identified a structure with potential reserves of 6 Tcf. The well is located on the eastern end of the Zhu II Depression, seeking objectives in the Upper Oligocene Zhuhai Formation and Lower Miocene Zhujiang Formation. The well logged 56 meters of net gas pay in two zones, and extends the natural gas trend first revealed by Panyu 30-1 1 and Panyu 34-1 1 wells. Sinopec Star's Yaoshen 1 wildcat is a good gas discovery well, a single drillstem test flowing 7.2 MMcfg/d from a deep volcanics reservoir between 3,540-3,750 meters in the Lower Cretaceous Yingcheng Formation. The discovery is estimated to hold roughly 1.1 Tcf of 2P gas in-place.

Malaysia -- In the PC4 1 well, located in the north of the open SK-310A permit, Petronas intersected a 630-meter gas column, a record for Sarawak.

2005

Indonesia -- The Kondur-operated MS BY-1ST Deepening is considered significant as it fits with the operator's plans to develop gas reserves in the block to supplement supply to Chevron's Duri steam flood project. Drilled by Lasmo in 1991-92, it was deepened to test the Pematang Brownshale and Pematang Basal Clastics and also to evaluate the Menggala Formation oil shows. Kondur says that contingent gas resources range between 230-580 Bcf, with a most likely figure of 380 Bcf. Cumulative flow from four zones was quoted as 50 MMcfg/d plus more than 1,000 bc/d. Two appraisals will be drilled in early 2006. PetroChina's Betara Southwest 1 in the Jabung PSC flowed 4,250 bo/d and 3.4 MMcfg/d, making it the country's highest flowing discovery of 2005.

Latin America

Brazil -- The Petrobras 1-RJS-628A (1-BRSA-369A-RJS) oil and gas discovery tested 4,900 bo/d 30° API and 5.3 MMcfg/d through a 40/64-inch choke. This well potentially could have discovered a field greater than 1 Bboe, and if proved would represent a supergiant field in a totally new geological province in Brazil. It would certainly represent the most important discovery in Brazil since Roncador in 1996.

2005

Brazil -- Petrobras filed an oil and gas show report with the ANP for the 4-SPS-043DA (4-BRSA-334DA-SPS) well, suggesting it was a successful confirmation of the 1-SPS-037A (1-BRSA-201A-SPS) gas discovery the operator completed in July 2003. Petrobras is calling this the Cedro Field, a separate pool discovery of the Mexilhao Field located 10 kilometers to the northeast. The find extends the Cedro Field eight kilometers to the southwest, and although not confirmed, reserves are estimated here to be at least in the 500 Bcf range.

Colombia -- Canadian explorer Pacific Stratus Ventures plans early production of its La Creciente 1 (LC-1) as a gas discovery on the La Creciente Block in the Lower Magdalena Basin. In the primary Cienaga de Oro Formation objective the company flowed 29.1 MMcfg/d through a 32/64-inch choke, saying the well has the potential to yield up to 71.8 MMcfg/d

Mexico -- The Noxal 1 wildcat, drilled by Pemex in the Catemaco Fold Belt offshore, is claimed as Mexico's first gas discovery in its deep waters of the Gulf of Mexico. A test in the interval 2,137 to 2,147 meters in the Lower Pliocene flowed 9.5 MMcf/d of high porosity gas. Reserve estimates are placed at 245 Bcf in this previously considered oil-prone sector of the Gulf of Mexico.This likely new producing region, to be known as Coatzacoalcos Profundo (Deepwater Coatzacoalcos), might hold as much as 10 billion barrels of oil and gas equivalent.

Trinidad & Tobago -- BHP-Billiton's Kingbird 1 apparently penetrated a number of thrust faults resulting in repeats of the Lower Miocene and Oligocene section without reaching the top of Cretaceous. The well encountered hydrocarbon bearing Oligocene Angostura sands and approximately 24 meters of gross hydrocarbon pay. The subsequent Ruby 1 well was even more significant, establishing 366 meters of gross hydrocarbon bearing sands, including more than 244m of net pay. The well tested at a rate of approximately 5,000 bo/d on a 7/8-inch choke.

Middle East

Iran -- NIOC's Kish 2 gas discovery is ranked a supergiant find with reserves of 36 Tcf, and one of the most important gas discoveries in the world in recent years.

The Triassic Kangan Formation tested 31 MMcfg/d; the underlying Permian Upper Dalan tested at 30 MMcfg/d; with the Nar Member flowing at 14 MMcfg/d, all using the same 5/8-inch choke.

Iran -- The second sidetrack in Ramin 7 is significant in that it is deemed to have established a new deeper pool, assumed to be the Middle Cretaceous Sarvak Formation. According to oil minister Bijan Zanganeh, 5.7 billion barrels of oil in place had been indicated in the Ramin oil field and that recoverable reserves had been estimated at 855 MMbo from four reservoirs together with 8,544 Bcf of gas, with 1,200 Bcf recoverable. The field currently produces around 2,000 b/d from the Asmari Formation, but with the new deeper pool, this should increase to 80,000 to 90,000 b/d.

Saudi Arabia -- Saudi Aramco's Karan 6 deeper pool wildcat tested gas at a rate of 40 MMcf/d, and is claimed as the Kingdom's largest gas discovery with reserves of 10 Tcf. The well was the first in an 11-well deep gas exploration program, and through 2006 was followed by gas finds at Nujayman, Kassab and Zamlah.

2005

Turkey -- Madison Oil's Akkaya 1 well in the 486-square-kilometer 3499 Black Sea block, South Akcakoca sub-basin, established a 283 meter gross gas column in which a test over an 84.5-meter interval flowed 7.6 MMcf/d from the Eocene Kusuri Formation through a 36/64-inch choke.

Saharan Africa

Algeria -- Repsol's Kahlouche 2 (KL-2) wildcat in Blocks 351c/352c, Reggane Nord permit, Timimoun Basin is a significant discovery because it opens up a new trend by testing gas in the Carboniferous section for the first time in this basin. The well flowed an aggregate of 44.0 MMcf/d from two intervals.

DST 1 tested 26.95 MMcf/d through a 32/64-inch choke in a Sieganian section below 3,983 meters. DST 2 tested 17.06 MMcf/d, through a 32/64-inch choke in the Turnaisian below 2,360 meters.

Sub Saharan africa.

2005

Equatorial Guinea -- Three discoveries: Esmeralda 1, drilled by Exxon Mobil in Block B; O-1, drilled by Noble in Block O; and P-1, drilled by Devon in Block P. The Devon (Rio Muni Basin) and Noble (Douala Basin) wildcats are particularly interesting, as both were drilled in little explored areas. The size and characteristics of the oil find made by Devon in Block P will be further evaluated in 2006. The gas and condensate flow rates in well O-1, 24 MMcfg/d and 1,225 bc/d, were limited by surface test equipment. The structure remains very promising, and a multi-well exploration and appraisal program is being considered for 2006. Gas processing infrastructure is relatively close by.

1.2.2 Domestic scenario

AVAILABILITY & UTILISATION OF NATURAL GAS

1. Natural gas has emerged as the most preferred fuel due to its inherent environmentally benign nature, greater efficiency and cost effectiveness. The demand of natural gas has sharply increased in the last two decades at the global level. In India too, the natural gas sector has gained importance, particularly over the last decade, and is being termed as the Fuel of the 21st Century.
2. Production of natural gas, which was almost negligible at the time of independence, is at present at the level of around 87 million standard cubic meters per day (MMSCMD). The main producers of natural gas are Oil & Natural Gas Corporation Ltd. (ONGC), Oil India Limited (OIL) and JVs of Tapti, Panna-Mukta and Ravva. Under the Production Sharing Contracts, private parties from some of the fields are also producing gas. Government have also offered blocks under New Exploration Licensing Policy (NELP) to private and public sector companies with the right to market gas at market determined prices.
3. Out of the total production of around 87 MMSCMD, after internal consumption, extraction of LPG and unavoidable flaring, around 74 MMSCMD is available for sale to various consumers.

4. Most of the production of gas comes from the Western offshore area. The on-shore fields in Assam, Andhra Pradesh and Gujarat States are other major producers of gas. Smaller quantities of gas are also produced in Tripura, Tamil Nadu and Rajasthan States. OIL is operating in Assam and Rajasthan States, whereas ONGC is operating in the Western offshore fields and in other states. The gas produced by ONGC and a part of gas produced by the JV consortiums is marketed by the GAIL (India) Ltd. The gas produced by OIL is marketed by OIL itself except in Rajasthan where GAIL is marketing its gas. Gas produced by Cairn Energy from Lakshmi fields and Gujarat State Petroleum Corporation Ltd. (GSPCL) from Hazira fields is being sold directly by them at market determined prices.
5. Natural gas has been utilised in Assam and Gujarat since the sixties. There was a major increase in the production & utilisation of natural gas in the late seventies with the development of the Bombay High fields and again in the late eighties when the South Bassein field in the Western Offshore was brought to production.

UTILISATION OF NATURAL GAS

6. The gas produced in the western offshore fields is brought to Uran in Maharashtra and partly in Gujarat. The gas brought to Uran is utilised in and around Mumbai. The gas brought to Hazira is sour gas which has to be sweetened by removing the sulphur present in the gas. After sweetening, the gas is partly utilised at Hazira and the rest is fed into the Hazira-Bijaipur-Jagdhishpur(HBJ) pipeline which passes through Gujarat, MadhyaPradesh, Rajasthan, U.P., Delhi and Haryana. The gas produced in Gujarat, Assam, etc; is utilised within the respective states.
7. Natural Gas is currently the source of half of the LPG produced in the country. LPG is now being extracted from gas at Duliajan in Assam, Bijaipur in M.P., Hazira and Vaghodia in Gujarat, Uran in Maharashtra, Pata in UP and Nagapattinam in Tamil Nadu. Two new plants have also been set up at Lakwa in Assam and at Ussar in Maharastra in 1998-99. One more plant is being set up at Gandhar in Gujarat. Natural gas containing C2/C3, which is a feedstock for the Petrochemical industry, is currently being used at Uran for Maharashtra Gas Cracker Complex at Nagothane. GAIL has also set up a 3 lakh TPA of Ethylene gas based petrochemical complex at Auraiya in 1998-99.

The rapid expansion of the Indian gas market and the high probability of it replacing other conventional fuels is evident from the occurrence of recent events .It is also evident that demand will far outgrow its availability ,if steps are not taken to improve the supply scenario in the country.

To ensure availability the following steps would need to be taken:-

- ◊ Exploration and production companies need to intensify efforts
- ◊ Coal bed methane technology and economics need to be worked at
- ◊ Importing gas through ,LNG and Pipelines

Gas producing areas are:-

- Western offshore fields, which include South Bassein fields, Joint Venture fields (Panna Mukta and Tapti) and associated gas from Mumbai High
- Cambay basin
- Cauvery basin
- KG basin
- North eastern region including Assam and Tripura
- Rajasthan

The domestic availability of natural gas has shown un upward trend from 1.5 BCM in 1980-81 to 31.767BCM in 2004-05.The gas supply in 2005-06 was around 99 mmscmd(as against the demand of 135-185 mmscmd).

The availability of adequate supply of gas at an affordable price is a pre-requisite to energy security

And this very need for energy security has prompted the country to look at supply options within and outside the country. A number of new discoveries were made in the last five years which is expected to enhance the gas reserves of the country in the coming years and thus narrow down the demand supply gap.

In the last five years ONGC and OIL have made 25 significant oil and gas discoveries, of which 10 are offshore and 15 onshore.

Offshore discoveries were in: - Kutch and Mumbai Basins, Western Offshore (6) and KG Basin, Eastern offshore (4).

Onshore discoveries OIL made 5 discoveries in upper Assam shelf and ONGC mad 10 discoveries in Rajasthan, Cambay, Cauvery, KG and Assam Arakan Basins.

During 2003-04 ONGC made six finds in KG Deepwater, KG Onland, Tripura fold belt, Assam shelf, Cambay Basin and Mumbai offshore.

In the last five years private and joint venture companies have also made considerable progress in terms of 41 significant hydrocarbon discoveries. These discoveries were made in 5 major areas: Mahanadi-NEC offshore, KG Offshore, Gulf of Cambay, Onland Rajasthan and Cambay basin

In June 2005, GSPCL's KG-8 well on the KG-OSN-2001/3 (Krishna-Godavari Offshore) block encountered an 800-850 meter gross gas column, The gas is expected to be available for commercial use by December 2007 giving a production rate of 40-50 mmscmd.

ONGC's G-1-12 (Vashistha 1A) well on the KG-OS-DW-IV (Krishna-Godavari Offshore) block reportedly encountered multiple levels of gas-bearing sands between 1,962-2,182 meters, with an estimated pay thickness of 42 meters and potential reserves of around 4 Tcf. It is located in 540 meters of water and targeted turbidite deposits in Pliocene aged Godavari Clays.

ONGC's D-1 well on the KG-DWN-98/2 (Krishna-Godavari Offshore) block is in about 600 meters of water. Although a formal announcement is yet to be made, the well apparently is a significant gas discovery, with approximately 60 meters of net pay encountered. Operational problems reportedly prevented the well from being tested.

RIL made a discovery, estimated to be 102 bcm in Madhya Pradesh in the month of July .

In August 2005,ONGC witnessed CBM gas find in Jharkhand.The block covers an area of 95 sq km and has resource potential of 53.8 BCM .

In 2006 - Drilled by Reliance, the D6-MA-1 (Dhirubhai 26) exploration well on the KG-DWN-98/3 (D6) (Krishna-Godavari Offshore) is located in 1,800 meters of water and is the first Cretaceous discovery to be made on the acreage. It is understood to have penetrated 26 meters of net oil pay and 72 meters of net gas pay; the oil horizon tested at an equipment-restricted flow rate of over 6,700 bo/d and 10.96 MMcf/d through a 64/64-inch choke, while the upper gas horizon flowed over 32 MMcf/d and 3,370 bc/d through a 80/64-inch choke.

The well is believed to have opened a significant new play and could have a material impact on the future exploration potential of the block.

CBM

Total CBM resources in 16 blocks (7800 Sq KM) are estimated to be 820 BCM. Expected peak production =23MMSCMD.Number of drilled=70.It is expected that the commercial production of CBM would commence by 2007

Methane to Markets

Short and Mid-term Plans

• Short Term

– Awareness campaign for Indian Oil and gas Companies

• Reducing emissions & loses

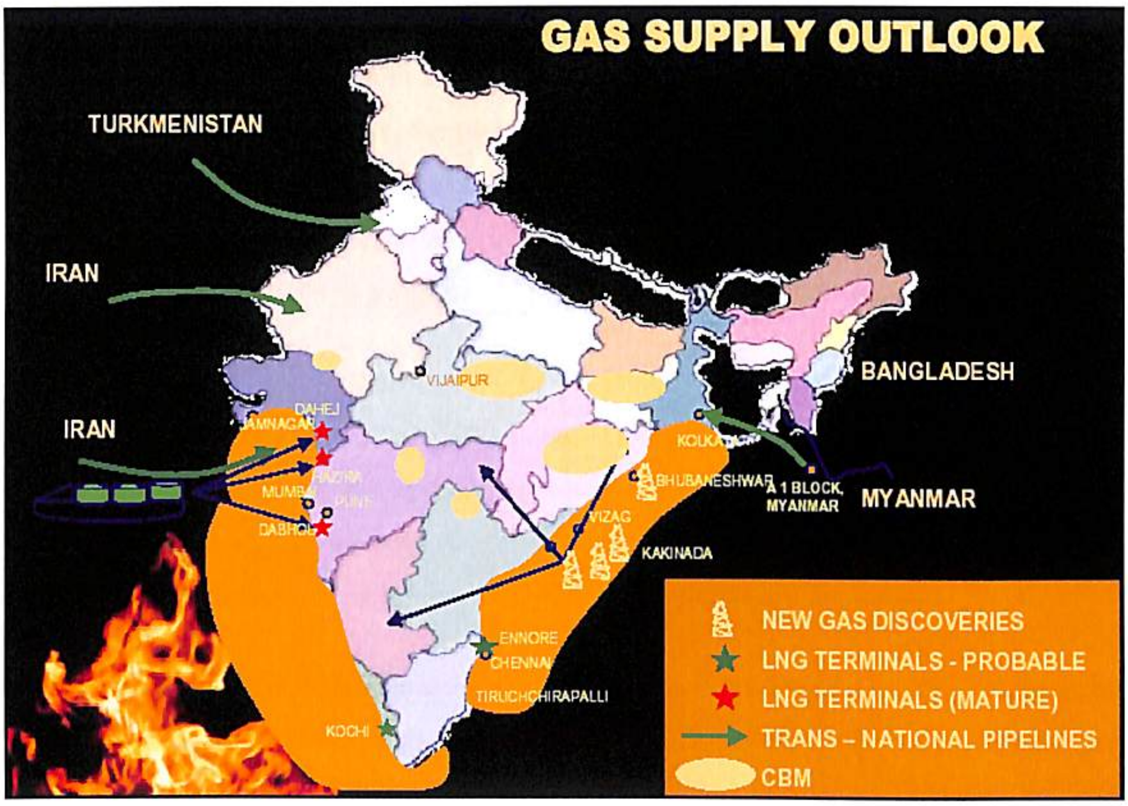
• Best practices

– Crate awareness with help of our agencies – PCRA, Petrofed.

• Medium Term

– Organising and hold workshop on Methane to Markets opportunities involving all the stake holders in India and experts including from abroad.

FIGURE 6



But the growth of indigenous production is not sufficient to meet its energy demands .Thus it is necessary for the country to look into other gas rich nations for importing gas.

The importing options which can be looked into ,to supplement the natural gas supply in the country are Iran, Qatar, Myanmar, Bangladesh, Australia, Oman in the form of LNG and through pipelines. For this purpose ,LNG terminals are being set up at Kochi and Dabhol,apart from the existing Dahej and Hazira, negotiations are underway to build pipelines to import gas from Iran and Myanmar.

IMPORT OF NATURAL GAS TO INDIA THROUGH TRANSNATIONAL GAS PIPELINES.

(a) Iran-Pakistan-India (IPI) Pipeline Project

In pursuance of Government decision in February 2005, Minister (P&NG) led a delegation to Pakistan during 4-8 June 2005. During the talks, the two Ministers reviewed the Iran-Pakistan-India gas pipeline proposal. They agreed that the project, which envisaged supply of gas to Pakistan and India through a transnational pipeline, would go a long way in meeting the energy security requirements of the two countries, and thus should be seen as a significant project for the benefit of the people of these countries.

The Indian and Pakistani delegations agreed to exchange information in regard to the financial structuring, technical, commercial, legal and related issues to realize a safe and secure world class project. To this end, it was agreed that the momentum pertaining to the project should be accelerated by constituting a Joint Working Group at the Secretary level at the earliest, which will meet regularly and report the progress to the Ministers to facilitate definitive decisions by them.

An Indian delegation also visited Iran from 11-14 June 2005 and discussed the issue of import of natural gas from Iran through on-land pipeline transiting via Pakistan. Both sides noted with satisfaction that as a result of regular discussions on technical issues pertaining to the project, a Heads of Agreement between NIGEC and the Indian companies concerned had been finalized. With a view to undertaking further studies and discussions in regard to relevant issues so that the project could take off by early next year, it was agreed to establish a special JWG on the Iran-Pakistan-India gas pipeline project.

A Pakistani delegation led by the Secretary, Ministry of Petroleum and Natural Resources, Govt. of Pakistan visited New Delhi on July 12-13, 2005 for the first meeting of India-Pakistan JWG. The second meeting of the JWG was held in Islamabad on 8-9 September, 2005. The first meeting of the Special JWG on Iran-Pakistan-India Pipeline Project was held in New Delhi on 3-4 August, 2005. The second meeting of the Special JWG on Iran-Pakistan-India Pipeline Project was held in Tehran on 24th October,2005. The Indian side was led by Secretary (P&NG). Indian side has already appointed financial consultants i.e., M/s Ernst & Young and is in the process of finalizing appointment of legal & technical consultants for the project. During the 2nd JWG meeting, the Pakistani side informed that they will also shortly be appointing their Financial Consultants.

(b) Myanmar-Bangladesh-India Gas Pipeline Project.

To pursue the matter at the Government level, for bilateral and trilateral discussions with Myanmar and Bangladesh, the Minister (P&NG) visited Yangon during 11-13th January 2005. A Memorandum of Understanding (MOU) for cooperation in the petroleum sector between the two Governments was signed. The MOU provides for furthering cooperation in the hydrocarbon sector and for establishing a cooperative institutional relationship in the field of petroleum industry on the basis of equality and mutual advantage, taking into account the possibilities for cooperation available in each country. The two. Governments will designate a body of experts comprising three representatives of each party to identify and implement the projects in the hydrocarbon sector.

A trilateral meeting between the Petroleum Ministers of India, Myanmar and Bangladesh held on 12.1.2005. After the meeting a Joint Press Statement was issued by the three Ministers. The three sides agreed to transport of natural gas from Myanmar to India by pipeline transiting through Bangladesh. The route of the pipeline will be determined by mutual agreements of the three Governments. It was also decided to establish a Techno-Commercial Working Committee (TCWC) comprising duly designated representatives of the three Governments to prepare a draft MOU prescribing the framework of cooperation among the three Governments, including the Myanmar-Bangladesh-India gas pipeline project. The MOU would be signed at Dhaka at the earliest mutually convenient date.

In pursuance of the MoU, a Techno-Commercial Working Committee has been constituted by the three Governments. The First Meeting of the TCWC was held on 24-25 February, 2005. The TCWC has finalized draft MoU proposed to be signed by the three oil Ministers.

However, there are certain bilateral issues which have to be sorted out with Bangladesh. Simultaneously, India is also exploring the other option of import of natural gas from Myanmar. A high level delegation led by Minister, Energy, of Myanmar recently visited India during July 5-7, 2005. All aspects of Myanmar-Bangladesh-India gas pipeline were discussed. Minister (P&NG) visited Bangladesh during 5-6 September 2005 to pursue the matter with Government of Bangladesh. The matter is being pursued vigorously and the proposed gas imports from Myanmar would be finalized shortly notwithstanding the response of Government of Bangladesh. GAIL has been asked to do a pre-feasibility study of the onland pipeline route from Myanmar to India through North-Eastern Indian States, bypassing Bangladesh territory. The option of getting Bangladesh on board is also being simultaneously pursued. Another official level meeting was held in Yangon on 29-30 August 2005, where two sides agree to take definite steps for gas supply from Myanmar.

(c) Turkmenistan-Afghanistan-Pakistan (TAP) pipeline

Daulatabad area of Turkmenistan has reported to have sufficient gas reserves. The Governments of Turkmenistan-Afghanistan-Pakistan (TAP) proposed the transnational gas pipeline to exploit the available gas reserves in Turkmenistan. They designated ADB as the lead development partner. ADB has carried out the study and approached India for participating in the project. Minister (P&NG) discussed this matter with Pakistani side during his visit to Pakistan 4th to 8th June 2005. This was also discussed by Secretary (P&NG) with President ADB during the latter's visit to New Delhi on 1.9.2005. Although, India is not yet formally involved in TAP project, Minister (P&NG) has been invited to the next Steering Committee Meeting to be held in Ashgabat in early December, 2005.

Liquefied Natural Gas (LNG)

Natural gas at -1610C transforms into liquid. This is done for easy storage and transportation since it reduces the volume occupied by gas by a factor of 600. LNG is transported in specially built ships with cryogenic tanks. It is received at the LNG receiving terminals and is regassified to be supplied as natural gas to the consumers. LNG projects are highly capital intensive in nature. The whole process consists of five elements:-

1. Dedicated gas field development and production.
2. Liquefaction plant.
3. Transportation in special vessels.
4. Regassification Plant.
5. Transportation & distribution to the Gas consumer.

LNG supply contracts are generally of long term nature and the prices are linked to the international crude oil prices. However, the LNG importing countries in recent times had started asking for medium/short term contracts with varying linkages.

LNG Imports to India

The LNG trade started in mid 60's and has increased rapidly. In 1992 it was around 80 Billion Cubic Metres (BCM) per annum and crossed the 100 BCM mark in 1996. World trade in LNG is currently in the range of 150 BCM. The major exporting countries of LNG are Algeria, Qatar, Indonesia, Malaysia, Australia, whereas, the major importers are Japan, South Korea, Taiwan and Western Europe.

Geographically, India is very strategically located and is flanked by large gas reserves on both the east and west. India is relatively close to four of the world's top five countries in terms of proven gas reserves, viz. Iran, Qatar, Saudi Arabia and Abu Dhabi. The large natural gas market of India is a major attraction to the LNG exporting countries. In order to encourage gas imports, the Government of India has kept import of LNG under Open General License (OGL) category and has permitted 100% FDI.

LNG Projects

Petronet LNG Limited (PLL), a JV promoted by GAIL, IOCL, BPCL and ONGC was formed for import of LNG to meet the growing demand of natural gas. PLL has constructed a 5 MMTPA capacity LNG terminal at Dahej in Gujarat. The terminal was commissioned in February 2004 and commercial supplies commenced from March 2004. PLL is planning to expand this terminal to 10 MMTPA capacity by 2008-09 to meet the growing demand of LNG.

Shell's 2.5 MMTPA capacity LNG terminal at Hazira has been commissioned. Dabhol LNG terminal (total 5 MMTPA capacity, with about 2.9 MMTPA available for merchant sales) may also become operational by 2006 subject to availability of LNG for the project. LNG terminals at Kochi in Kerala, Mangalore in Karnataka and Krishnapatnam/Ennore in Tamil Nadu are also under active consideration and may fructify in next 4-5 years time.

The price of LNG for the Dahej project is linked to the JCC crude oil price. It has a fixed price for the first five years, i.e. upto December 2008 and a floating floor and ceiling price thereafter. At present the selling price of LNG in Gujarat is $4.87/MMBTU (Rs. 8777/MCM) and outside Gujarat is $4.88/MMBTU (Rs. 8800/MCM). At this price, LNG is comparatively cheaper than alternative fuels/feedstock's e.g. naphtha, Furnace Oil, LSHS, Light Diesel Oil, LPG, etc

LNG expansion

Currently DAHEJ Has a capacity of 10 mmtpa and hazira holds a 2.5 mmtpa capacity the projects likely to ocme online by 2009-12 are Dabhol with 5 mmtpa ,cochin with 5 mmtpa and ennore with 2.5 mmtpa capacity .thus the regassification capacity is ex[pected to touch 25 mmtpa by 2009-10,out of which 12.5 is already tied up.thus LNG is expected to become a significant supply source.

FIGURE 7

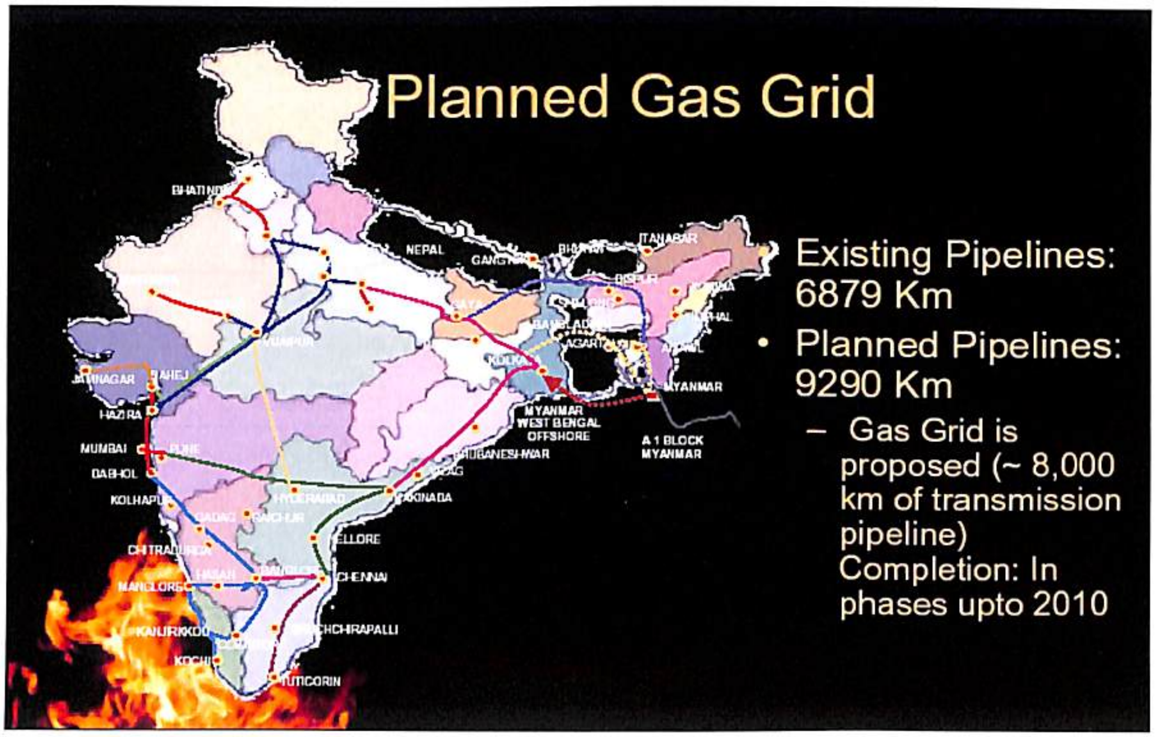


TABLE 3 Source: DGH

CNG IN INDIA

Particulars	Delhi			Mumbai			Total
Year	1998	2004	2005	1998	2004	2005	2005
No.of stations	9	125	144	7	93	119	263
No. of CNG vehicles in thousands	1	92	106	7	142	178	284

Source: DGH

It's important to note that future plans are there to set up CNG infrastructure in another 28 cities.

PIPED NATURAL GAS INFRASTRUCTURE

In New Delhi there are 46,727 domestic and around 90 commercial consumers. The sales volume are around 15,200,664 SCM.Mumbai has 2, 54,331 domestic,740 commercial and 43 industrial consumers .it has over 1809 kms of medium pressure and lower pressure PE pipelines and 200 kms of high pressure steel network. There are future plans to set up similar city gas distribution project in other cities as well.

CHAPTER 2

ENERGY DEMAND SCENARIO

2.1 Expected Crude Oil Demand

Demand for crude oil is derived from the demand for the finished and intermediate products that can be made from it. In the short-term, however, demand for crude oil may be mismatched with the underlying demand for petroleum products. This misalignment occurs routinely as a result of stock changes: the need to build stocks to meet seasonal demand, for instance, or the desire to reduce stocks of crude oil for economic reasons. In the longer term, blending non-petroleum additives into petroleum products (such as ethanol or other oxygenating agents into gasoline) can also reduce crude oil demand relative to demand for finished products.

2.1.1 International Scenario

The industrialized countries are the largest consumers of oil but until 1998 had not been the most important growth markets for some years. The countries of the Organization for Economic Cooperation and Development (OECD), for instance, account for almost 2/3 of worldwide daily oil consumption. In contrast, however, oil demand in the OECD grew by some 11 percent over the 1991-97 period, while demand outside the OECD (excluding the Former Soviet Union) grew by 35 percent. The Former Soviet Union presents a special case. The collapse of the Russian economy that accompanied the collapse of Communism led to a decline in oil consumption of more than 50 percent over the 1991-98 period. The global appetite for crude in 2003 grew by a robust 1.9 percent, or 1.44 million barrels a day, and in 2004 by 1.5 percent, or 1.16 million barrels a day. The daily demand growth in the two years was 160,000 barrels and 90,000 barrels, approximately. World oil consumption rose by about 1.2 million barrels per day in 2005, after an increase of 2.6 million barrels per day in 2004. The non-OECD countries accounted for 1.1 million barrels per day of the 2005 increase, and the OECD as a whole accounted for 0.1 million barrels per day. Unlike in 2004, when China's oil use increased by 0.9 million barrels per day, its demand rose by only 0.4 million barrels per day in 2005, despite continued strong economic growth. In the United States, a 0.4-percent decline in oil demand in 2005 resulted from a combination of high prices, hurricane-related disruptions, and a mild winter. It was the first decline in U.S. demand since 2001.

In the *IEO2006* reference case, growth in world oil demand averages 1.4 percent per year over the 2003 to 2030 period, as the world continues to experience strong economic growth. World oil prices in 2025 are 35 percent higher than projected in *IEO2005*, and as a result world oil demand grows more slowly in this year's reference case, to 111 million barrels per day in 2025, as compared with 119 million barrels per day in the *IEO2005* reference case. In *IEO2006*, total demand for petroleum liquids rises to 118 million barrels per day in 2030.

The developed economies use oil much more intensively than the developing economies, and Canada and the United States stand almost alone in their consumption of oil per capita. For instance, oil consumption in the United States and Canada equals almost 3 gallons per day per capita. (The difference is these countries' transportation sectors, with their dependence on private vehicles to travel relatively long distances.) Oil consumption in the rest of the OECD equals 1.4 gallons per day per capita. Outside of the OECD, oil consumption equals 0.2 gallons per day per capita.

Regionally, the largest consuming area remains North America (dominated by the United States), followed by Asia (with Japan the largest consumer), Europe (where consumption is more evenly spread among the nations), and then the other regions. Asia was the region with the fastest demand growth until the 1998 economic crisis in East Asia. The region's economic upheaval is a central reason for the oil price collapse of 1998. With China's economy expanding rapidly and a recovery simmering in other countries, demand for oil will increase faster than expected in 2004.

On a regional basis, two parts of the world lead the projected growth in world oil demand: non-OECD Asia and OECD North America. Outside North America, oil consumption in the OECD regions grows much more slowly (by 0.2 percent and 0.5 percent per year in Europe and Asia, respectively), reflecting expectations of slow growth or declines in population and slow economic growth over the next 25 years. In the non-OECD countries, strong expansion of oil use is fueled by robust economic growth, burgeoning industrial activity, and rapidly expanding transportation use. The fastest growth in oil demand is projected for the economies of non-OECD Asia, averaging 3.0 percent per year from 2003 to

2030. Figures show that Asian countries other than China, the former Soviet Union, and the Middle East are the driving force in forecasts of growing demand for oil.

In Europe, on the other hand, actual demand fell by over 1 percent in the first quarter and demand growth are also falling lower in China and the United States. Further, global demand growth for oil in 2005 has been predicted by OPEC to likely amount to 1.78 million barrels per day, compared to a demand growth of 2.79 million barrels per day in 2004.

In China, demand grew by 19.3 percent in the first quarter of 2004. In contrast, 2005's first-quarter growth there is estimated at only 4.5 percent. Reasons for this fall-off in demand are said to include a lower incentive to import oil because the government limits retail prices. In Europe, oil deliveries in the first quarter of the year were down 11.6 percent in Germany and by 6.4 percent in Italy.

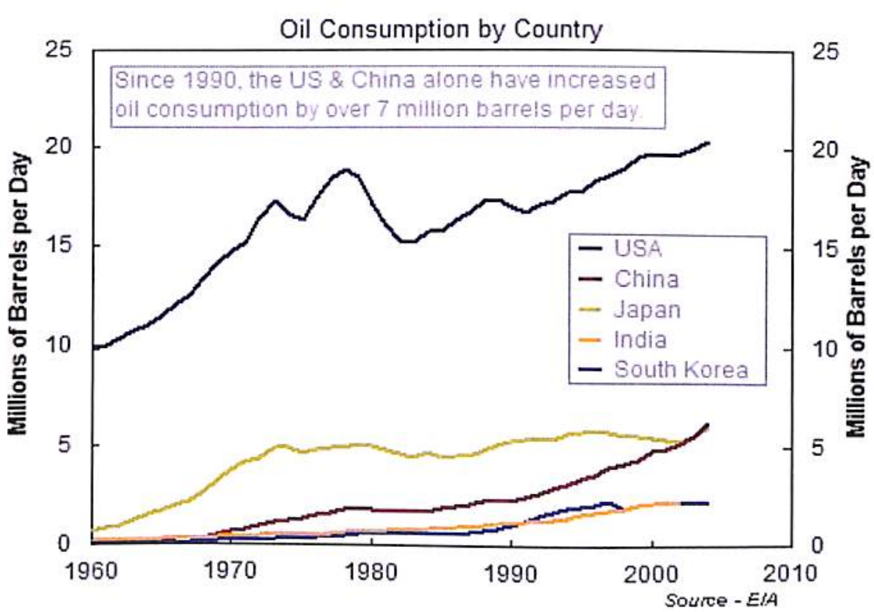
Meanwhile, in the United States demand grew 1.2 percent in the first quarter. This was less than half the demand growth in the same quarter last year, and a bit below expectation. The slackening demand growth in the US has been blamed mostly on higher prices. In real numbers, US demand is expected to rise by 260,000 barrels per day in 2005, compared to a rise in demand of 490,000 barrels per day last year.

Fast-paced increases are also expected for the other non-OECD regions, including annual growth of oil use that averages 1.4 percent in non-OECD Europe and Eurasia, 1.5 percent in the Middle East, 1.8 percent in Central and South America, and 2.3 percent in Africa.

Economic development in Asia will be crucial to long-term growth in oil markets. China, India, and the other nations of non-OECD Asia are expected to experience combined economic growth of 5.5 percent per year between 2003 and 2030, the highest rate of growth in the world. This robust expansion in gross domestic product (GDP) contributes to a 3.0-percent annual increase in regional oil use.

Much of the world's incremental oil demand is projected for use in the transportation sector, where there are few competitive alternatives to petroleum; however, several of the technologies associated with unconventional liquids (gas-to-liquids, coal-to-liquids, and ethanol and bio diesel produced from energy crops) are expected to meet a growing share of demand for petroleum liquids during the projection period. Of the projected increase in oil use in the reference case over the 2003 to 2030 period, one-half occurs in the transportation sector .The industrial sector accounts for a 39-percent share of the projected increase in world oil consumption, mostly for chemical and petrochemical processes. The United States and Canada use oil more for transportation than for heat and power, but the opposite pattern holds for most of the rest of the world: most regions use more oil for heat and power than for transportation. As a result, global demand for oil is highest in the Northern Hemisphere's cold months. There is a swing of 3-4 million barrels per day (some 5 percent) between the 4th quarter of the year, when demand is highest, to the 3rd quarter, when it is lowest. (The precise amount varies from year-to-year, depending on weather, economic activity and other factors.) While the 4th quarter is not the coldest in any region, estimated demand calculations are swollen by the traditional stock building that occurs during the period.

FIGURE 8



2.1.2 Domestic Scenario

Top 10 crude oil importers are U.S., japan, china, germany, South Korea, France ,Italy, Spain, India, Taiwan.

Uncertainty in future supplies has also worked in conjunction with demand increases to force higher prices for crude oil. With the exception of Germany, all of the countries mentioned above exhibited steady growth in crude oil consumption over the past 10 to 15 years. Germany's consumption declined due to strategic investments in alternative energy such as wind and biodiesel. India and China have shown high sustained growth in energy demand, and are recent additions to the list of top ten countries importing crude oil.

China and India are the most populous countries in the world and are also among the countries with the fastest growing economies. This economic growth is fueling a rapid increase in energy consumption, particularly fossil fuels. As illustrated in Table below, the rate of growth in oil consumption in China and India has conspicuosly outpaced the rest of the world. In fact, China and India alone account for about one-third of the total world increase in oil demand over the period 1995 to 2005. Their combined average annual rate of growth is nearly 7 percent compared to less than 2 percent for the rest of the world.

TABLE 4

CHINA &INDIA OUTPACE WORLD OIL DEMAND GROWTH

	Crude Oil Consumption 1,000 Bbl/d		Average Annual Growth
	1995	2005	1995-2005
China	3,363	6,950	7.53%
India	1,575	2,450	4.52%
China & India	4,938	9,400	6.65%
World, less China & India	*65,080*	*74,220*	*1.32%*
Total World	70,018	83,620	1.79%

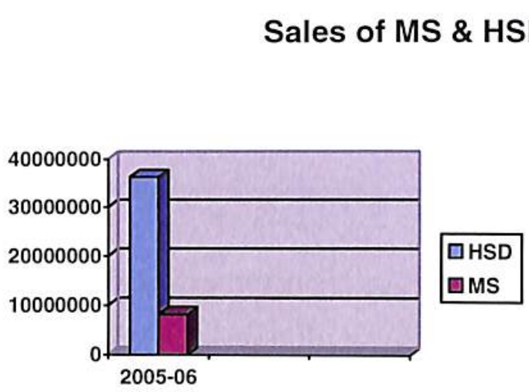
Source: BP

Still, in terms of global oil consumption, India is still a relatively small player. Although India is home to more than 15 percent of the world's population, it accounts for only 3 percent of world oil consumption. China, by contrast, consumes 7.6 percent of the world's oil. India's energy needs are rising sharply, however. In 2004 alone, India's crude oil consumption increased by 10 percent. Moreover, India is highly dependent on oil imports. Some seventy percent of India's oil is imported and oil imports account for one third of the total value of all India's imports. By 2020 India is expected to have to import 80 percent of its energy needs.

India has the world's fastest-growing car market, which is driving oil consumption and imports. Economic growth, rising oil prices and recent disruptions in oil supplies due to the US military interventions in Iraq and Afghanistan are propelling the Indian government to join the hunt for cheap and secure sources of oil and natural gas.

Consumption in terms of final products can be gauged by the sales figures of MS and HSD in the last year. The consumption of HSD has increased by 5.6%and of LPG at around 8%.the other categories have also increased except naphtha.

FIGURE 9



Source: petroleum.nic.in

2.2Expected Natural Gas Demand

2.2.1 International Scenario

Natural gas is the fastest growing energy source according to industry experts, and the consumption of natural gas is projected to rise by almost 70 percent (i.e. by an average of 2.3 % annually) by 2025 from 92 trillion cubic feet to 156 trillion cubic feet and reaching 4900 bcm by 2030 The electric power sector makes up almost half of the total growth in world natural gas demand over this time period, since its share in the world gas market will increase to 47% in 2030. The greatest increase in demand for natural gas is expected to occur among the emerging economies. Despite rising prices natural gas will be the preferred fuel for Combined Cycle Gas Turbines used in power stations, besides this there will be demand from gas to liquid plants as well as for production of hydrogen for fuel cells.

Industrial consumption of natural gas is also projected to rise over the next 10 to 15 years from 8 trillion cubic feet in 2003 to 10.3 trillion cubic feet in 2025 according to OECD reports. It is expected to increase more rapidly in developing countries, by 2.9 % annually. While natural gas consumption is expected to increase for most industrial sectors, industry reports suggest that decreases are expected to occur in the iron, steel and aluminum industries. The largest increases in natural gas consumption from 2003 to 2025 are anticipated in petroleum refining, metal durables, bulk chemicals and food industries.

Residential consumption is also projected to grow over this time period by nearly 1 percent. The type and amount of energy used by households vary from country to country, depending on income levels natural resources and available energy infrastructure .consequently residential sector energy use is generally higher in the mature market economies.

Service sector energy consumption is driven by economic and population growth trends .The degree to which additional needs are fulfilled depends upon economic resources and economic growth.

Russia is the world's largest producer of natural gas. In addition, the largest increases in world natural gas consumption are also projected to occur in Russia, Eastern Europe, and the emerging economies of Asia. By 2025 natural gas consumption is projected to grow by 63 percent. Emerging economies in Asia are expected to almost triple its current consumption rate in 2025.

The emerging economies are also expected to experience the fastest growth in natural gas production. In comparison, the industrialized or 'mature economies' production in natural gas is projected to decline in 2025, making up only 29 percent while accounting for nearly 45 percent of world consumption. The emerging economies natural gas production is predicted to increase by 4.1 percent by 2025.As industrialized economies natural gas consumption grows and production rates slow down, while emerging economies production increases, the industrialized economies will increasingly be dependent upon imports of natural gas from the emerging economies.

2.2.2 Domestic Scenario

The demand for 2004-05 is estimated to be 102 mmscmd, against an allocation of 120 mmscmd. As against this the supply in 2004 -05 was 93.7 mmscmd (including internal consumption, flaring and LPG shrinkage)

The developed infrastructure (the HVJ pipeline), which had initially led to the build-up of capacities along the trunk pipeline, continues to dominate demand.Petronet LNG Limited's Dahej terminal and Shell's terminal in Gujarat also met the gas demand of the northern and western regions ,but with

increased availability of gas expected from the LNG terminal being planned in the south and RIL's KG basin gas ,the southern region will also see a spurt in the demand ,with additional gas of over 30 mmscmd being available from these sources.

The gas consumption break up reveals that, gas is primarily consumed by power and fertilizer sectors i.e. 40% and 29% respectively, the other consumers are petrochemical (9%) steel (3%) industries (15%) and city gas(4%).

TABLE 5

Industry-wise Off-takes of Natural Gas in India (2000-2001 to 2004-2005)					
(Million Cubic Metre)					
Industry	2000-01	2001-02	2002-03	2003-04	2004-05
(a) Energy Purposes					
Power Generation	8801	9214	10510	11478	12099
Industrial Fuel	2870	2979	2939	3099	3569
Tea Plantation	151	147	119	142	142
Domestic Fuel	335	485	654	93	343
Captive use/LPG Shrinkage	5004	5339	5409	4865	4944
Others	38	70	136	1263	231
Total (a)	**17199**	**18234**	**19767**	**20940**	**21328**
(b) Non-Energy Purposes					
Fertiliser Industry	8480	7957	7955	7889	8173
Petro-Chemicals	779	909	1027	1128	1236
CNG	0	0	0	1	0
Others	1402	937	1215	948	37
Total (b)	**10661**	**9803**	**10197**	**9966**	**9446**
Grand Total (a+b)	**27860**	**28037**	**29964**	**30906**	**30774**
% to Grand Total					
Energy Purposes	61.7	65	66	67.8	69.3
Non-Energy Purposes	38.3	35	34	32.2	30.7

Source: Ministry of Petroleum & Natural Gas, Govt. of India

CHAPTER 3

SECTOR WISE DEMAND SUPPLY SCENARIO

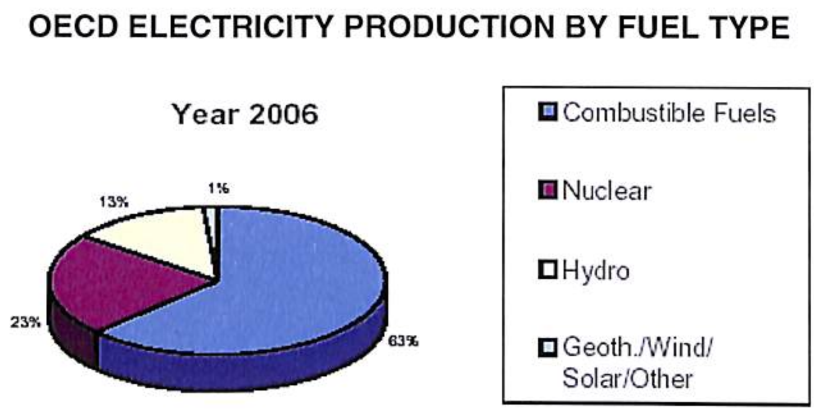
3.1POWER SECTOR

3.1.1 International Scenario

The mix of primary fuels used to generate electricity has changed a great deal over the past two decades on a worldwide basis. Coal has remained the dominant fuel, although electricity generation from nuclear power increased rapidly from the 1970s through the mid-1980s, and natural-gas-fired generation grew rapidly in the 1980s and 1990s. In contrast, in conjunction with the high world oil prices brought on by the oil price shocks after the oil embargo of 1973-1974 and the Iranian revolution in 1979, the use of oil for electricity generation has been slowing since the mid-1970s. High world oil prices encouraged switching from oil-fired generation to natural gas and nuclear power and reinforced coal's important role in world electric power generation. Similarly, the relatively fossil fuel prices of recent years are raising renewed interest in nuclear power and making renewable energy sources more competitive economically.

Electricity production in the whole of OECD was 863.4 Twh in Jan '07 this was 2.8%lower than production in Jan last year.Geo thermal,wind,solar showed the most significant percent change of 9%over the previous month, this region is a net importer of electricity.Total OECD production reached 10016 TWh an increase of 0.7%. Geo thermal,wind ,solar showed the strongest growth of 18%,combustible fuels show a 0.3% growth and nuclear and hydro production grew by 1%and 0.7%respectively.In January 2007,United States electricity production was to the tune of 316384 GWh .This was 3.7%lower compared to January ,2006.Hydro production showed a 20.1% increase over December 2006,this was the most significant change.The consumption on the other hand was 17679 Gwh greater than the indigenous production in 2006.In United Kingdom,the electricity production was 36685 Gwh, this was lower by 902 Gwh from January 2006.Geo thermal,wind ,solar showed the most significant percent change of 8.5%over the previous month. The demand supply gap in 2006 was 9171 Gwh. In Japan ,combustible fuels still account for a major proportion of the electricity generation though share of hydroelectricity has gone up slightly from Dec '06 to Jan '07.Over here the entire consumption is indigenously produced.In Australia the electricity production and consumption stood at 240620 Gwh ,there is no nuclear capacity in this region.

FIGURE 10



Source: EIA

TABLE 6

Source: EIA

WORLD TOTAL NET ELECTRICITY GENERATION ,2000-04 (Billion Kilowatt hours)					
Region/Country	2000	2001	2002	2003	2004
North America	4,590.35	4,516.82	4,655.17	4,668.81	4,795.40
Central & South America	781.85	768.39	792.81	835.00	881.43
Europe	3,207.92	3,268.17	3,284.97	3,361.56	3,439.93
Eurasia	1,204.93	1,224.42	1,236.70	1,278.30	1,307.27
Middle East	437.90	463.27	498.43	526.37	566.60
Africa	416.96	432.29	460.35	478.81	505.44
Asia & Oceania	3,955.84	4,126.41	4,413.81	4,734.65	5,103.04
World Total	14,595.75	14,799.76	15,342.24	15,883.52	16,599.09

TABLE 7

WORLD TOTAL NET ELECTRICITY CONSUMPTION ,2000-04 (Bn kwhs)

Region/Country	2000	2001	2002	2003	2004
North America	4,286.22	4,240.07	4,342.27	4,373.79	4,464.58
Central & South America	726.95	714.96	737.32	776.15	819.63
Europe	2,989.17	3,052.41	3,070.10	3,143.70	3,217.47
Eurasia	1,114.64	1,125.35	1,139.79	1,169.27	1,194.80
Middle East	406.51	430.53	463.53	489.48	526.80
Africa	389.22	401.62	428.03	445.18	469.59
Asia & Oceania	3,679.36	3,837.48	4,104.54	4,405.37	4,748.39
World Total	13,592.08	13,802.43	14,285.58	14,802.94	15,441.26

Source: EIA

3.1.2. Domestic Scenario

The power sector has registered significant progress since the process of planned development of the economy began in 1950. Hydro -power and coal based thermal power have been the main sources of generating electricity. Nuclear power development is at slower pace, which was introduced, in late sixties. The concept of operating power systems on a regional basis crossing the political boundaries of states was introduced in the early sixties. In spite of the overall development that has taken place, the power supply industry has been under constant pressure to bridge the gap between supply and demand.

In 2000-01 31.5% of natural gas produced in the country was allotted to the power sector. In 2001-02 the share rose to 32.8%, this further rose to 35%and 37% in 2002-03 and 2003-04 respectively. In 2004-05, the share was close to 40% (39.3%). In 2001about 11%of the installed capacity in the country was based on natural gas .The total installed power generating capacity as on march 2006 was 1, 28,432 MW out of which thermal segment accounted for 84,400 MW (65.6%) up from the previous year when the total installed capacity was 1, 26,089MW, and a meagre1713 MW in 1950, registering a 74 fold increase in 56 years. The per capita consumption of electricity in the country also increased from 15 kWh in 1950 to about 338 kWh in 1997-98, to 606kWh in the latest estimates, which is about 40 times. In the field of

Rural Electrification and pump set energisation, country has made a tremendous progress. About 80% of the villages have been electrified except far-flung areas in North Eastern states, where it is difficult to extend the grid supply.

Gas based power plants account for 10.6% of the total installed capacity for power generation and 16.09% of the total thermal capacity for power generation ,further of the total planned capacity addition of 62213 MW during the next five year period of 2007-2012 about 9000 MW or 15 % is based on gas. Gas scores over all other fuels for power generation because of zero fuel storage cost, no ash handling equipment required, fuel gas desulphuriser not required, low capital cost, consistent operation at high PLF s, LNG fueled gas turbine yields higher thermal efficiency than those fed on Indian or imported coal, apart from this the gestation period for gas based plants is much smaller s compared to coal based plant. Presently the gas requirement of gas based power plants at 90%Plant load factor is 49.79MMSCMD, whereas the supply to the power sector stands at 30.70 MMSCMD, last year shortage of gas has led to significant loss of around 6425.6 MU in generation capacity. Since 1990's gas fired plants have contributed 20.3% of the new capacity created in the power sector .Consumption of power sector increased at a CAGR of 6.57% from 8801 mcm in 2000-01 to 12099 mcm in 2004-05.Due to severe supply constraints ,gas based power generation could not grow as fast as expected but The electricity act 2003 is expected to boost the demand for gas in the power sector due to lower capital costs(compared to coal base plant), higher efficiency(56% guaranteed gas turbine efficiency), lower gestation period, and higher standardization of the equipment of a gas fired plant as compared with a coal based plant .moreover the act also gives a boost to the captive power plants and given the high level of shortages, it is possible that many industrial users will install gas based captive power plants. According to the projections of Ministry Of Power, the gas requirement of gas based power plants at 90% peak load factor would reach 78.28 MMSCMD by March 2007and 142.8 MMSCMD by March 2012.According to latest data from April 2006-January 2007 the shortfall in energy stands at 9.3%and peak demand deficit amounts to 13.9%.

TABLE 8

1.Total Installed Capacity:

Sector	MW	%age
State Sector	71,250	55.4
Central Sector	43,231	33.7
Private Sector	13,951	10.9
Total	**1,28,432**	

Fuel	MW	%age
Total Thermal	**84,400**	**65.6**
Coal	69,616	54.1
Gas	13,582	10.6
Oil	1,202	0.9
Hydro	33,942	26.5
Nuclear	3,900	3.0
Renewable	6,191	4.8
Total	**1,28,432**	

2.High Voltage Transmission Capacity:

Capacity	MVA	Circuit KM
765/800 KV	--	2,037
400 KV	91,052	73,753
220 KV	1,52,967	112,901
HVDC	3,000	5,872

3.Per Capita Consumption of Electricity:

(Year 2004-05)	606 KWH / Year

4.Rural Electrification:

No. of Villages (Census 1991)	**593,732**
Villages Electrified 30th May 2006)	**471,360**
Electrification %age	**79.4%**

Rural Households (Census 2001)	**138,271,559**
Having access	**60,180,685**
Electrification %age	**44%**

5.Power Situation: (April 2006-January 2007) (Provisional)

	Demand	Met	Surplus/ Deficit
Energy	572,812 MU	519,656 MU	-9.3 %
Peak Demand	100,403 MW	86,425 MW	-13.9 %

Source:powermin.nic.in
MW: Mega Watt
MVA: Mega Volt Ampere
MU: Million Unit

A Zone wise analysis of the power sector performance would give a better understanding of the power sector demand supply situation and for us to realize the importance to find the fuels whose capacity needs to be revamped in each of the states and hence decide on a separate strategy for each zone

NORTHERN REGION

◊ DELHI

◊ HARYANA

◊ PUNJAB

◊ J&K

◊ RAJASTHAN

Delhi power statistics show that thermal and gas hold major share in the installed capacity since 1998-99.In 2005-06 thermal accounted for 320MW and gas contributed in 612.40 MW with others contributing a small 0.07 MW .The only major capacity additions in the period between 1998-99 and

2005-06 were in 2001-02 of 104.6 MW in gas segment and of 225.80 MW in the next year in the same segment. In 2005-06 the energy shortage stood at 1.5% and peak demand shortage was around 3.3%.

Haryana faces a peak demand shortage of 9.3% and energy shortage of 8.9%.This is so probably due to the lack of capacity additions in the state barring thermal capacity additions in 2000-01 to the tune of 210MW and 500 MW in 2004-05 and 62.74 MW added by hydro in 2005-06.Thermal segment accounted for 62% of the installed capacity in 2005-06.

Jammu and Kashmir has had no major capacity additions in installed capacity after 2001-02.This has led to the power supply situation worsening and the 2005-06 figures indicate a peak demand deficit of 11.4% and an energy deficit of 9.2%.In J&K hydro contributes 61% of the installed capacity with gas being the second largest contributor with 34.7%share.

Punjab's fuel wise capacity indicates there is no gas capacity in the state ,the installed capacity is primarily made up of Hydro and thermal and 3%is contributed by the others segment. The only significant capacity additions were made in 2000-01 in the hydro segment, to the tune of 600 MW and then in 2005-06 of around 75.78 MW in the hydro segment. The state suffers from a huge peak demand shortage of 20.3%.

Rajasthan has a huge thermal capacity forming a large share (62.5%)of the total capacity. Hydro 's share is 26% and gas accounts for 3%.The gas segment experienced capacity addition in 2002-03 after that the additions have only been made in the thermal and the hydro segment. In 2005-06 the state experienced energy shortage of 3.5%and peak shortage of 13.7%.

TABLE 9

RAJASTHAN POWER PROFILE

		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW)									
	Thermal	1225.00	1475.00	1475.00	1975.00	1975.00	2420.00	2420.00	2420.00
	Hydro	971.09	971.09	1107.12	971.62	971.62	971.62	971.62	1008.84
	Gas	38.50	38.50	38.50	38.50	113.80	113.80	113.80	113.80
	Others	0.00	2.00	4.25	14.00	27.70	60.70	271.22	323.47
	Total	2234.59	2486.59	2624.87	2999.12	3088.12	3566.12	3776.64	3866.11
INSTALLED CAPACITY BY OWNERSHIP									
	State Sector	2234.59	2486.59	2624.87	2991.52	3066.82	3511.82	3511.82	3775.93
	Private/Licencee	0.00	0.00	0.00	7.60	21.30	54.30	264.82	90.18
	Total State & Private Sectors	2234.59	2486.59	2624.87	2999.12	3088.12	3566.12	3776.64	3866.11
	Share in Central Sector			1942.00	1472.00	1472.00	1472.00	1472.00	1586.68
	Total			4566.87	4471.12	4560.12	5038.12	5248.64	5452.79
CAPACITY ADDITION (MW)									
	Thermal	250.00	250.00	0.00	500.00	0.00	445.00	0.00	0.00
	Hydro	0.00	0.00	136.03	-135.50	0.00	0.00	0.00	37.22
	Gas	0.00	0.00	0.00	0.00	75.30	0.00	0.00	0.00
	Others	0.00	2.00	2.25	9.75	13.70	33.00	210.52	52.25
	Total	250.00	252.00	138.28	374.25	89.00	478.00	210.52	89.47
POWER SUPPLY POSITION									
Energy	Requirement	23440	25155	25080	24745	25917	26611	29207	32017
(MUs)	Availability	22766	24024	24178	24495	25382	26486	28974	30883
	Shortage (%)	2.5	4.5	3.6	1.0	2.1	0.5	0.8	3.5
Peak	Requirement	3651	3672	3755	3700	3880	4134	4786	5588
(MW)	Peak Met	3498	3672	3663	3657	3820	4134	4414	4822
	Shortage (%)	4.2	0.0	2.5	1.2	1.5	0.0	7.8	13.7

Source:powergrid

Thus, it can be concluded that the northern region faces a shortfall of 7421 MUs.Since the total energy demand stands at 121195 MUs and the availability is 113774MUs and the combined peak demand shortage is around 3013 MUs.

TABLE 10

CAPACITY ADDITION UNDER Xth PLAN IN NORTHERN REGION

Sl.no.	Project	Fuel	Capacity (MW)	Present Status
	CENTRAL SECTOR			
1	Rihand-II /NTPC	Coal	1000.00	Commissioned
2	Unchahar-III /NTPC	Coal	210.00	Commissioned
3	Dulhasti /NHPC	Hydro	390.00	Commissioned
4	Chamera II /NHPC	Hydro	300.00	Commissioned
5	Dhauliganga /NHPC	Hydro	280.00	Commissioned
6	Tehri HEP /THDC	Hydro	1000.00	Commissioned
7	Nathpa-jhakri /SJVN	Hydro	1500.00	Commissioned
8	RAPP - V/NPC	Nuclear	220.00	Under execution
	Total Central Sector		4900.00	
	STATE SECTOR			
9	GHTP-II/Punjab	Coal	500.00	Delay in Boiler Hydraulic test, erection of cooling tower & turbine.
10	Panipat U-7&8/Haryana	Coal	500.00	Commissioned
11	Larji-I /H.P.	Hydro	126.00	Commissioned
12	Pragati /Delhi	Gas	225.78	Commissioned
13	Baghaliar / J&K	Hydro	450.00	Under execution
14	Suratgarh-III/Rajasthan	Coal	250.00	Commissioned
15	Ramgarh-II/Rajasthan	Gas	75.32	Commissioned
16	Kota-IV /Rajasthan	Coal	195.00	Commissioned
17	Dholpur CCPP/Rajathan	Gas	330.00	Efforts are being made to commission 1 GT by March'07
18	Giral TPP/Rajasthan	Coal	125.00	Commissioned
19	Parichha Extn. /U.P.	Coal	420.00	Commissioned
20	Maneri Bhali-II/Uttranchal	Hydro	304.00	U-1 boxing up completed. U-2 HV testing in startor completed.
	Total State Sector		3501.10	
	PRIVATE SECTOR			
21	Baspa/ H.P	Hydro	300.00	Commissioned
22	Vishnu Prayag/Uttranchal	Hydro	400.00	Commissioned
	Total Private Sector		700.00	
	Grand Total		9101.10	

Source: Power Grid

WESTERN REGION

- ◊ GUJARAT
- ◊ MADHYA PRADESH
- ◊ MAHARASHTRA
- ◊ GOA
- ◊ CHATTISGARH

Gujarat: The latest data shows Gujarat has undertaken capacity additions in all segments in 2005-06 amounting to a total of 272.21 MW .In this state also like in many others thermal accounts for the largest share, gas occupies the second largest share (23.7%).The peak shortage in 2005-06 stood at 22.2% and energy shortage was around 8.2%,but the situation is bound to increase with the huge capacity additions undertaken off late.

TABLE 11

GUJARAT POWER PROFILE

Key Facts and figures

		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW)									
	Thermal	4586.48	4836.48	4836.48	4836.48	4836.48	4836.48	4961.48	5086.48
	Hydro	547.00	547.00	547.00	547.00	563.00	563.00	713.00	745.00
	Gas	1673.04	1673.04	1673.04	1802.10	1757.10	1863.72	1863.72	1908.72
	Others	166.90	166.90	166.90	166.90	166.90	173.10	236.67	306.88
	Total	6973.42	7223.42	7223.42	7352.48	7323.48	7436.30	7774.87	8047.08
INSTALLED CAPACITY BY OWNERSHIP (MW)									
	State Sector	4333.62	4583.62	4583.62	4712.68	4683.68	5210.30	5685.30	5769.73
	Private Sector	2639.80	2639.80	2639.80	2639.80	2639.80	2226.00	2289.57	2277.35
	Total State & Private Sectors	6973.42	7223.42	7223.42	7352.48	7323.48	7436.30	7974.87	8047.08
	Share in Central Sectors Stations	-	-	1538.30	1538.30	1538.30	1538.30	1538.30	1801.29
	Total			8761.72	8890.78	8861.78	8974.60	9513.17	9848.37
CAPACITY ADDITION (MW)									
	Thermal	460.00	250.00	0.00	0.00	0.00	0.00	125.00	125.00
	Gas	0.00	0.00	0.00	129.06	-45.00	106.62	0.00	32.00
	Hydro	60.00	0.00	0.00	0.00	16.00	0.00	150.00	45.00
	Others			0.00			6.20	63.57	70.21
	Total	520.00	250.00	0.00	129.06	-29.00	112.82	338.57	272.21
POWER SUPPLY POSITION									
Energy (Mus)	Requirement	45685.00	51202.00	53038.00	53693.00	60175.00	57171.00	59681.00	57129.00
	Availability	42835.00	46994.00	47877.00	47530.00	53316.00	50292.00	52724.00	52428.00
	Shortage (%)	6.20	8.20	9.70	11.50	11.40	12.00	11.70	8.20
Peak (MW)	Requirement	7018.00	7554.00	7801.00	8005.00	8641.00	9820.00	10162.00	9783.00
	Peak Met	5877.00	5962.00	6905.00	6700.00	7336.00	7204.00	7578.00	7610.00
	Shortage (%)	16.30	21.10	11.50	16.30	15.10	26.60	25.40	22.20

Source: Power Grid

Madhya Pradesh undertook hydro capacity addition in 2002-03 and then in 2005-06 ,the rest of the sectors have been devoid of any additions in the last 8 years. The power supply situation has been worsening with the peak shortage increasing every year to 21.7% in 2005-06,energy shortage has also increased to 14.2%in 2005-06.The state doesn't have any gas capacity ,thermal and hydro are the major contributors.

TABLE 12

MAHARASHTRA POWER PROFILE

Key Facts and figures

		1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW)									
	Thermal	7655.00	7655.00	8075.00	8075.00	8075.00	8075.00	8075.00	8075.00
	Hydro	2073.13	2847.13	2847.13	2847.13	2874.17	2874.17	2914.17	3224.66
	Gas	1832.00	1832.00	1832.00	1832.00	1832.00	1832.00	1832.00	1832.00
	Others	156.98	156.98	156.98	320.20	399.20	401.20	452.92	706.68
	Total	11717.11	12491.11	12911.11	13074.33	13180.37	13182.37	13274.09	13838.34
INSTALLED CAPACITY BY OWNERSHIP (MW)									
	State Sector	8496.19	9270.19	9690.19	9690.19	9770.57	9772.57	9812.57	10189.42
	Share in Pench Project in M.P (33%)	53.38	53.38	53.38	53.38				
	Private Sector	3167.54	3167.54	3167.54	3330.76	3409.80	3409.80	3461.52	3648.92
	Total State & Private Sectors	11717.11	12491.11	12911.11	13074.33	13180.37	13182.37	13274.09	13838.34
	Share in Central Sector Stations	-	-	2027.90	2027.90	2027.90	2027.90	2027.90	2318.39
	Total			14939.01	15102.23	15208.27	15210.27	15301.99	16156.73
CAPACITY ADDITION IN STATE & PRIVATE SECTORS (MW)									
	Thermal	740.00	0.00	420.00	0.00	0.00	0.00	0.00	0.00
	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hydro	8.00	774.00	0.00	0.00	27.04	0.00	40.00	310.49
	Others	0.00	0.00	0.00	163.22	79.00	2.00	51.72	253.76
	Total	748.00	774.00	420.00	163.22	106.04	2.00	91.72	564.25
POWER SUPPLY POSITION									
Energy (MUs)	Requirement	66332.00	66332.00	79527.00	80489.00	87152.00	87933.00	92715.00	102780.00
	Availability	63778.00	63778.00	71184.00	73438.00	75472.00	78966.00	81541.00	84132.00
	Shortage (%)	3.90	3.90	10.50	8.80	13.40	10.20	12.10	18.10
Peak (MW)	Requirement	10665.00	10665.00	12535.00	12265.00	13697.00	14503.00	14986.00	16069.00
	Demand Met	8675.00	8675.00	10596.00	10726.00	10984.00	11868.00	12464.00	12360.00
	Shortage (%)	18.70	18.70	15.50	12.50	19.80	18.20	16.80	23.10

Source: Power Grid

Maharashtra: With a huge energy requirement of 102780 MUs the state can only manage 84132 MUs implying a shortfall of 18.1%the peak shortage is higher at 23.1%.In 2004-05 and 2005-06 some additions have been made in the hydro and others segment but they haven't been enough to bridge the shortfall. Thermal segment occupies the largest share with Hydro contributing 23.2%in the total installed capacity.

Goa: The installed capacity stands at 48.07 MW with the entire capacity comprising of gas .The power supply situation looks satisfactory with the energy and peak demand being met since 2003-04 .The energy figures show the demand supply situation equating at 2338 Mus and peak demand stands at 368 Mus in 2005-06.

Chattisgarh:-Figures since 2001-02 indicate that thermal segment constitutes the majority of installed capacity in the state. This capacity has stayed constant at 1280 MW and hydro has been contributing another 120 MW which increased to 125 MW in 2005-06.The total installed capacity was 1439.01MW .There was no capacity addition from 2001-04 after which there have been increase I n the others segment of 11.50 and 22.50 MW in 2004-05 and 2005-06 .There was a also a 5MW increase in hydro capacity in the last year. The energy shortage for the state was 1.7% in 2005-06 but the peak shortage stood at 7.6%.

The following table gives a clear view of the power supply situation in the western region, with the help of the latest data. It shows that all the states are facing shortage with Maharashtra's situation being the grimmest, facing a deficit of 17349 MUs.The peak demand deficit is also highest in Maharashtra which stands at 4548 MUs i.e. a shortage of 25.89%.

TABLE 13

POWER SUPPLY SITUATION

State/ U.T	FEBRUARY'2007			APRIL,2006- FEBRUARY,2007		
	Requirement (MU)	Availability (MU)	Shortage (%)	Requirement (MU)	Availability (MU)	Shortage (%)
Chattisgarh	1235	1141	7.58	11805	11016	6.68
Gujarat	5433	4657	14.27	53126	45542	14.28
M.P.	3612	2873	20.47	33855	28548	15.68
Maharashtra	10182	7588	25.47	91056	73707	19.05
(*)Daman & Diu	119	117	2.00	1170	1128	3.57
(*)Dadar Nagar Haveli	242	237	1.99	2370	2297	3.09
Goa	215	210	2.40	2117	2048	3.26

Source : powermin

TABLE 14

PEAK DEMAND /DEMAND MET

State/ U.T	FEBRUARY'2007			APRIL,2006- FEBRUARY,2007		
	Requirement (MW)	Availability (MW)	Shortage (%)	Requirement (MW)	Availability (MW)	Shortage (%)
Chattisgarh	2331	1954	16.17	2372	1954	17.62
Gujarat	10645	8117	23.75	12047	8538	29.13
M.P.	6857	5782	15.80	8290	6600	20.39
Maharashtra	17858	12802	28.31	17567	13019	25.89
(*)Daman & Diu	206	188	8.74	208	187	10.10
(*)Dadar Nagar Haveli	380	380	0.00	396	370	6.57
Goa	457	407	10.94	413	389	5.81

Source: powermin

TABLE 15

CAPACITY ADDITION UNDER Xth PLAN IN WESTERN REGION

Sl.no.	Project	Fuel	Capacity (MW)	Present Status
	CENTRAL SECTOR			
1	Vindhyachal - III / NTPC	Coal	1000.00	Commissioned
2	Sipat II / NTPC	Coal	1000.00	1 unit sheduled for March'07
3	Indirasagar / NHPC	Hydro	1000.00	Commissioned
4	Omkareshwar / NHPC (JV)	Hydro	260.00	Under execution
5	Tarapur / NPC	Nuclear	1080.00	Commissioned
	Total Central Sector		4340.00	
	STATE SECTOR			
6	Korba East Extn./Chattisgarh	Coal	500.00	1 unit scheduled for March'07
7	Banasagar-III / M.P.	Hydro	20.00	Commissioned
8	Banasagar-II / M.P.	Hydro	15.00	Commissioned
9	Bansagar-IV / M.P.	Hydro	20.00	Commissioned
10	Madhikheda / M.P.	Hydro	40.00	Commissioned
11	Birsingpur Extn. / M.P.	Coal	500.00	1 unit scheduled for March'07
12	Amarkantak/M.P	Coal	210.00	PFC sanctioned a loan of Rs.782 Crs. MOEF clearance obtained.LOA placed on BHEL.
13	Ghatghar PSS/Maharashtra	Hydro	250.00	1 unit scheduled for March'07
14	Parli Extn./Maharashtra	Coal	250.00	Commissioned
15	Paras TPS Extn./Maharashtra	Coal	250.00	1 unit scheduled for March'07
16	Sardar Sarovar/Gujarat (Multi State)	Hydro	1450.00	Commissioned
17	KLTPS Extn/Gujarat	Lignite	75.00	Boiler drum lifted
18	Dhuvaran Gas/Gujarat	Gas	106.62	Project Commissioned.
19	Dhuvaran Gas Extn./Gujarat	Gas	112.00	GT commissioned (72 MW)
20	Akrimota/Gujarat	Lignite	250.00	Project Commissioned.
	Total State Sector		4048.62	
	PRIVATE SECTOR			
22	Dabhol-II / Maharashtra	Liquid Fuel	1444.00	740 MW commissioned
23	O.P. Jindal TPP/Chattisgarh	Coal	250.00	Boiler drum lifted
	Total Private Sector		1694.00	
	Grand Total		10082.62	

Source:Powergrid

EASTERN REGION

- ◊ BIHAR
- ◊ JHARKHAND
- ◊ ORISSA
- ◊ WEST BENGAL

Bihar's power profile shows that there have been no capacity additions in any segment from 2001-02 till 2005-06 .The only addition has been in the others segment in the last year. The state is devoid of any gas capacity, with thermal contributing 88%.The peak shortage was 15.1% and the energy shortage was 9.3%in 2005-06.

Jharkhand:_The installed capacity has remained stagnant at 1680 MW till 2004-05 .In the last year some capacity additions in the thermal segment led to increase in the installed capacity to 1754.13 MW. The energy shortage stood at 2.2% and peak shortage was 1.7% in 2005-06.

Orissa:-In 2005-06 Hydro accounted for 82% of the total capacity with thermal contributing the rest. The state has no gas capacity and the latest capacity additions in the last year have been made in Hydro. The power supply situation indicates a shortage of 1.7%in peak time and 1.3% as energy shortage.

West Bengal: Power profile indicates the state suffered an energy shortage of 1.7%and peak shortage of 3% in 2005-06.Fuel wise analysis shows that the gas segment has accounted for 100 MW since 1998-99 and thermal segment accounted for 93% in the installed capacity in 2005-06.Gas hydro and other s' segment has shown no progress. The only hydro capacity addition was in 1999-2000 and the capacity in fact decreased in 2005-06.Despite these factors the situation has improved as compared to 2002-03 as far as the peak shortage is concerned because of the performance of the thermal segment which occupies the prime position, contributing 93%in the total generation mix. On the other hand the energy supply situation has changed from that of surplus in 2000 to a deficit of 1.7%.

TABLE 16

WEST BENGAL POWER PROFILE

		1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW) as on 31st March									
	Thermal	3876.38	4086.38	4506.38	4506.38	4506.38	4506.38	4518.58	4398.58
	Hydro	142.21	164.71	164.71	164.71	164.71	164.71	164.71	161.70
	Gas	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Others	13.20	13.20	13.20	13.20	13.20	13.20	7.53	66.65
	Total	4131.79	4364.29	4784.29	4784.29	4784.29	4784.29	4790.82	4726.93
INSTALLED CAPACITY BY OWNERSHIP (MW)									
	State Sector (including WBPDC)	2930.27	3162.77	3582.77	3582.77	3582.77	3582.77	3582.87	3638.46
	Private Sector	1201.52	1201.52	1201.52	1201.52	1201.52	1201.52	1207.95	1088.47
	Total State & Private Sectors	4131.79	4364.29	4784.29	4784.29	4784.29	4784.29	4790.82	4726.93
	Share in Central Sector Stations			2013.00	1766.45	1766.45	1766.45	1976.45	684.06
	Total			6797.29	6550.74	6550.74	6550.74	6767.27	5410.99
CAPACITY ADDITION (MW)									
	Thermal	250.00	210.00	420.00	0.00	0.00	0.00	12.20	-120.00
	Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hydro	15.00	22.50	0.00	0.00	0.00	0.00	0.00	-3.01
	Others	0.00	0.00	0.00	0.00	0.00	0.00	-5.67	59.12
	Total	265.00	232.50	420.00	0.00	0.00	0.00	6.53	-63.89
POWER SUPPLY POSITION									
Energy (MUs)	Requirement	16319.00	17951.00	18787.00	20670.00	20551.00	22091.00	23115.00	24936.00
	Availability	16778.00	18298.00	18958.00	20575.00	20249.00	21608.00	22789.00	24509.00
	Shortage (%)	-2.80	-1.90	-0.90	0.50	1.50	2.20	1.60	1.70
Peak (MW)	Requirement	2981.00	3217.00	3594.00	3614.00	3752.00	3836.00	4117.00	4743.00
	Peak Met	2808.00	3010.00	3426.00	3414.00	3418.00	3652.00	3965.00	4599.00
	Shortage (%)	5.80	6.40	4.70	5.50	8.90	4.80	3.70	3.00

Source:powergrid

TABLE 17

CAPACITY ADDITION UNDER Xth PLAN IN EASTERN REGION

Sl.no.	Project	Fuel	Capacity (MW)	Present Status
	Central Sector			
1	Kahalgaon-II Phase I /NTPC	Coal	1000.00	1 unit scheduled for March'07
2	Kahalgaon-II Phase II /NTPC	Coal	500.00	Boiler Hydraulic test completed.
3	Talcher /NTPC	Coal	2000.00	Commissioned.
4	Teesta-V /NHPC	Hydro	510.00	Under execution.
5	Mejia-4 TPS Extn./ DVC	Coal	210.00	Commissioned.
6	Mejia-5 / DVC	Coal	250.00	1 unit scheduled for March'07
7	Mejia-6 / DVC	Coal	250.00	Main plant order placed on BHEL.. Boiler erection commenced. BHEL to acclerate supplies.
8	Chandrapura / DVC	Coal	500.00	Boiler drum lifted. Boiler Hydraulic test expected in Jan.07.
	Total Central Sector		5220.00	
	State Sector			
9	Balimela-II/Orissa	Hydro	150.00	1 unit scheduled for March'07
10	Bakreswar -II /W.B.	Coal	210.00	Under execution. Problems with BHEL piping centre.
11	Durgapur TPS Extn./W.B.	Coal	300.00	scheduled for March'07
12	Sagardighi-I/ W.B.	Coal	600.00	Boiler drum lifted.
13	Santaldih TPP/W.B.	Coal	250.00	Boiler drum lifted.
14	Purulia PSS / W.B.	Hydro	225.00	1 unit scheduled for March'07
	Total State Sector		1735.00	
	Private Sector			
15	Jojobera-II /Jharkhand	Coal	120.00	Commissioned.
	Total Private Sector		120.00	
	Grand Total		**7075.00**	

Source:powergrid

SOUTHERN REGION

- ◊ KARNATAKA
- ◊ TAMIL NADU
- ◊ KERALA
- ◊ ANDHRA PRADESH

Karnataka:-In 2005-06 the state managed to bridge the gap between energy requirement and availability to 0.7% shortage (251MUs)from 4.2%shortage in 2004-05.The peak shortage was 602 MUs in 2005-06 i.e.9.8%.The installed capacity in the state mainly comprises of hydro capacity (52%)followed by thermal ,the gas capacity has stayed constant at 220 MW since 2001-02.The hydro segment has been undergoing additions since 1998-99 and capacity additions have been stopped in the thermal segment post 2002-03 .Gas has got the least attention in meeting the states energy supply.

Tamil Nadu: Thermal segment experienced constant capacity additions till 2002-03 after which there have been no additions. The Gas sector has been undergoing capacity additions since 2000-01 and hydro has got a boost in 2005-06 with a capacity addition of 150 MW .In 2005-06 energy shortage was 0.6% and the peak time shortage stood at 8.6%.The thermal sector accounts for 40%of the total installed capacity followed by others category and hydro, gas occupies only 9.7%of the mix.

TABLE 18

TAMILNADU POWER PROFILE

		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW)									
	Thermal	3275.66	3275.66	3275.66	3381.66	3631.66	3631.66	3631.66	3631.66
	Hydro	1965.15	1995.15	1995.15	1995.15	1995.15	1995.15	1995.15	2145.85
	Gas	70.00	70.00	462.00	567.50	661.50	761.50	831.50	919.30
	Others	787.70	787.70	787.70	832.30	925.60	990.30	1856.25	2721.83
	Total	6098.51	6128.51	6520.51	6776.61	7213.91	7378.61	8314.56	9418.64
INSTALLED CAPACITY BY OWNERSHIP (MW)									
	State Sector	5191.55	5221.55	5221.55	5221.55	5315.55	5415.55	5415.55	6616.70
	Private/Licencee	906.96	906.96	1298.96	1555.06	1898.36	1963.06	2899.01	2801.94
	Total State & Private Sectors	6098.51	6128.51	6520.51	6776.61	7213.91	7378.61	8314.56	9418.64
	Share In Central Sector Projects			1869.00	1969.00	2179.00	2389.00	2439.00	2912.20
	Total			8389.51	8745.61	9392.91	9767.61	10753.56	12330.84
CAPACITY ADDITION (MW)									
	Thermal	200.00	0.00	0.00	106.00	250.00	0.00	0.00	0.00
	Gas	0.00	0.00	392.00	105.50	94.00	100.00	70.00	87.80
	Others	0.00	0.00	0.00	44.60	93.30	64.70	865.95	865.58
	Hydro	7.50	30.00	0.00	0.00	0.00	0.00	0.00	150.70
	Total	207.50	30.00	392.00	256.10	437.30	164.70	935.95	1104.08
POWER SUPPLY POSITION									
Energy (Mus)	Requirement	37706.00	38873.00	42702.00	46232.00	46125.00	45665.00	47872.00	54183.00
	Availability	33268.00	35797.00	39462.00	42951.00	43346.00	45062.00	47570.00	53859.00
	Shortage (%)	11.80	7.90	7.60	7.10	6.00	1.40	0.60	0.60
Peak (MW)	Requirement	5950.00	6446.00	7131.00	7158.00	7448.00	7455.00	7647.00	9114.00
	Peak Met	5190.00	5640.00	6038.00	6218.00	7123.00	7228.00	7555.00	8334.00
	Shortage (%)	12.80	12.50	15.30	13.10	4.40	3.00	1.20	8.60

Source:powergrid

Kerala: The fuel mix for installed capacity primarily comprises of hydro ,contributing nearly 80%.Thermal contributes 11% of the share. There have been only two capacity addition and that too in the others category in the last two years ,all the major additions were undertaken between 1998-99 and 2001-02.In 2005-06 power supply situation looked under control with energy shortage coming uncer 1%(0.7%)and peak time shortage settling at 1.9%.

Andhra Pradesh: In 2005-06 major capacity additions have been undertaken in all areas except thermal (which experienced expansion only once in 2001-02 in the 8 year period of analysis). Gas experienced additions to the tune of 626.30MW and hydro added another 14.42MW there were 150 MW addition in the others category. The energy shortage was 1.1% and peak time shortage came down to 2% from 2.3% in the previous year.

The following table gives a clear view of the power supply situation in the southern region, with the help of the latest data. It shows that all the states are facing shortage with Andhra Pradesh's situation being the grimmest; facing a deficit of 2447MUs.The peak demand deficit is highest in Pondicherry at 2.8%.

TABLE 19

POWER SUPPLY SITUATION

State/ U.T	FEBRUARY,2007			APRIL,2006- FEBRUARY,2007		
	Requirement (MU)	Availability (MU)	Shortage (%)	Requirement (MU)	Availability (MU)	Shortage (%)
A.P.	5201	4685	9.92	53798	51351	4.55
Karnataka	3673	3574	2.70	36670	35972	1.90
Kerala	1213	1177	2.97	13368	13101	2.00
T.N.	4952	4821	2.65	52535	51617	1.75
Pondichery	128	123	3.91	1509	1470	2.58

Source:powermin

TABLE 20

PEAK DEMAND /DEMAND MET

State/ U.T	FEBRUARY,2007			APRIL,2006- FEBRUARY,2007		
	Requirement (MW)	Availability (MW)	Shortage (%)	Requirement (MW)	Availability (MW)	Shortage (%)
A.P.	9878	8267	16.31	8403	8281	1.45
Karnataka	6046	5959	1.44	6046	5959	1.44
Kerala	2800	2742	2.07	2800	2742	2.07
T.N.	8762	8584	2.03	8762	8584	2.03
Pondichery	242	231	4.55	250	243	2.80

The following table reveals the capacities, which have been added by the central, state and the private sector. The central sector has commissioned 1520 MW of capacity out of 1000 MW is in the thermal segment. The state sector has also added capacity to the tune of 2389 MW out of which 194 Mw is in gas, 1136 MW is in coal and the rest is in hydro. The private sector has been more active in the state contributing 7148 MW .The capacity additions are more in the gas segment, with171 MW being contributed by coal and one plant of 250 MW of lignite being commissioned in Tamil nadu.

TABLE 21

CAPACITY ADDITION PROGRAMME UNDER Xth PLAN IN THE SOUTHERN REGION

Sl.no.	Project	Fuel	Capacity (MW)	Present Status
	CENTRAL SECTOR			
1	Simhadri /NTPC	Coal	500.00	Commissioned
2	Ramagundam/NTPC	Coal	500.00	Commissioned
3	NLC Extn.I /NLC	Lignite	420.00	Commissioned
4	Kaiga NP / NPC	Nuclear	220.00	Under execution
5	Kudankulam U - I	Nuclear	1000.00	Under execution
6	MAPPS Extn.	Nuclear	100.00	Commissioned
	Total Central Sector		2740.00	
	STATE SECTOR			
7	Pykera Ultimate /T.N.	Hydro	150.00	Commissioned
8	Kuttalam CCPP / T.N.	Gas	100.00	Commissioned
9	Valuthur CCPP / T.N.	Gas	94.00	Commissioned
10	Bhawani Katlai / T.N.	Hydro	30.00	Commissioned
11	Srisalam LBH /A.P.	Hydro	450.00	Commissioned
12	Jurala Priyadarshini / A.P.	Hydro	39.10	Under execution. E&M works critical
13	Rayalaseema-II/A.P.	Coal	420.00	1 Unit commissioned
14	Kuttiyadi augmentation/Kerala	Hydro	100.00	Commissioned
15	Almati Dam/Karnataka	Hydro	290.00	Commissioned
16	Raichur Unit-7/Karnataka	Coal	210.00	Commissioned
17	Bellary/Karnataka	Coal	500.00	Boiler hydraulic test completed
18	Rangat bay/ A&N	Coal	6.00	Commissioned
	Total State Sector		2389.10	
	PRIVATE SECTOR			
19	Neyveli Zero / T.N.	Lignite	250.00	Commissioned
20	Pedapuram / A.P.	Gas	78.00	Commissioned
21	Vemagiri-I/ A.P.	Gas	370.00	Commissioned
22	Gautami-I / A.P.	Gas	464.00	Under execution
23	Jegrupadu Extn./ A.P.	Gas	220.00	Commissioned
24	Konaseema / A.P.	Gas	445.00	Commissioned
25	Bamboo flat DG / A&N	DG	20.00	Commissioned
26	Karuppur CCPP/ T.N.	Coal	119.80	Commissioned
27	Valantharavai CCPP/ T.N.	Coal	52.80	Commissioned
	Total Private Sector		2019.60	
	Grand Total		7148.70	

Source:SRLDC/powergrid

NORTH EASTERN REGION

- ARUNACHAL PRADESH
- ASSAM
- MANIPUR
- NAGALAND
- TRIPURA

Arunachal Pradesh: Since 2000 till 2004 the state has successfully met its peak time requirement but the situation has changed in the last two years with the data showing a shortage of 1.6%and 2.7%respectively.The energy shortage was 1%in 2005-06 after the power situation being totally under control in 2004-05.The states installed capacity comprises of thermal, hydro and unconventional sources with gas capacity being non-existent.

TABLE 22

ASSAM POWER PROFILE

		1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
INSTALLED CAPACITY (MW)									
	Thermal	350.69	350.69	350.69	350.69	350.69	350.69	350.69	350.69
	Hydro	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Gas	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00
	Others	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.23
	Total	621.69	621.69	621.69	621.69	621.69	621.69	621.81	621.92
INSTALLED CAPACITY BY OWNERSHIP(MW)									
	State Sector	597.19	597.19	597.19	597.19	597.19	597.19	597.19	597.30
	Private/Licencee	24.50	24.50	24.50	24.50	24.50	24.50	24.62	24.62
	Total State & Private Sectors	621.69	621.69	621.69	621.69	621.69	621.69	621.81	621.92
	Share in Central Sector Stations			320.80	497.80	497.80	522.80	522.80	509.00
	Total			942.49	1119.49	1119.49	1144.49	1144.61	1130.92
CAPACITY ADDITION (MW)									
	Thermal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gas	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hydro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Others	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.11
	Total	5.00	0.00	0.00	0.00	0.00	0.00	0.12	0.11
POWER SUPPLY POSITION									
Energy (MU)	Requirement	2876.30	2868.30	2868.30	3450.50	3458.00	3527.00	3787.00	4051.00
	Availability	2799.20	2918.40	2918.40	3425.20	3349.00	3321.00	3582.00	3778.00
	Shortage (%)	2.70	-1.70	-1.70	0.70	3.20	5.80	5.40	6.70
Peak (MW)	Requirement	531.00	565.00	565.00	688.00	668.00	738.00	659.00	733.00
	Peak Met	514.00	556.00	556.00	618.00	589.00	635.00	621.00	679.00
	Shortage (%)	3.20	1.60	1.60	10.20	11.80	14.00	5.80	7.40

Source:powergrid

Assam: Post the increment in gas capacity by 5 MW in 1998-99, there has been no capacity additions in the state. Thermal and gas hold major shares and the energy shortage was 6.7% and peak shortage was 7.4% in 2005-06.

Manipur : Thermal segment accounts for majority of the installed capacity since 1998-99 and in 2005-06 its share was 89%.The state has no gas capacity .There haven't been any major capacity additions in the last three years .The requirement in the state was 510 MU and availability was 489 MU the peak time shortage was 3.5.% .

Nagaland: The power supply situation in Nagaland has worsened over the years with the energy shortage increasing to 4.7% in 2005-06 from 1.8% in 2004-05.The state has undertaken no capacity additions since 1998-99.In 2005-06 Hydro accounted for 83% of the installed capacity.

Tripura: The Power supply situation has been worsening over the years .After being in surplus in 1999 and 2000 the state went into deficit and suffered an energy shortage of 10.6% in 2005-06, the peak shortage though has reduced from 15.4%to 9.4%from the last year. Gas holds the major share in the installed capacity, contributing nearly 85% in 2005-06.

The following table gives a clear view of the power supply situation in the north eastern region, with the help of the latest data. It shows that all the states are facing shortage with Meghalaya's situation being the grimmest; facing a shortage of 19.46%.The peak demand deficit is highest in Meghalaya at 38%followed by Tripura and Assam.

TABLE 23

POWER SUPPLY SITUATION

State/ U.T	FEBRUARY'2007			APRIL2006- FEBRUARY,2007		
	Requirement (MU)	Availability (MU)	Shortage (%)	Requirement (MU)	Availability (MU)	Shortage (%)
Arunachal Pradesh	26.33	19.10	27.46	233.37	224.00	4.01
Assam	286.65	266.72	6.95	3655.57	3433.22	6.08
Manipur	29.79	28.80	3.32	419.08	408.10	2.62
Meghalaya	104.23	76.42	26.68	1334.26	1074.62	19.46
Mizoram	19.99	18.70	6.45	197.51	190.80	3.40
Nagaland	23.44	22.00	6.14	283.02	277.30	2.02
Tripura	45.26	40.76	9.94	616.67	568.37	7.86

Source:powermin

TABLE 24

PEAK DEMAND/DEMAND MET

State/ U.T	FEBRUARY'2007			APRIL2006- FEBRUARY,2007		
	Requirement (MW)	Availability (MW)	Shortage (%)	Requirement (MW)	Availability (MW)	Shortage (%)
Arunachal Pradesh	55.00	53.00	3.64	48.95	48.33	1.28
Assam	687.64	638.64	7.13	716.17	637.92	10.93
Manipur	94.56	79.58	15.86	92.67	88.40	4.60
Meghalaya	335.00	208.00	37.91	306.28	191.18	37.59
Mizoram	60.68	60.68	0.00	48.40	46.50	3.93
Nagaland	58.00	55.00	5.17	66.27	65.09	1.78
Tripura	145.00	113.00	22.07	144.15	118.84	17.56

Source: powermin

TABLE 25

CAPACITY ADDITION PROGRAMME UNDER Xth PLAN IN NORTH EASTERN REGION

Sl.no.	Project	Fuel	Capacity (MW)	Present Status
	CENTRAL SECTOR			
1	Kopili - II	Hydro	25.00	Commissioned
	Total Central Sector		25.00	
	STATE SECTOR			
2	Bairabi DGPP/Mizoram	Liquid Fuel	22.92	Commissioned
3	Leimkhong/Manipur	Liquid Fuel	18.00	Commissioned
4	Dimapur DGPP/Nagaland	Liquid Fuel	22.92	Turnkey award on BHEL. Project funded by non lapsable central pool of resources. Most of the civil works at advance stage of completion.
5	Baramura GT/Tripura	Gas	21.00	Commissioned
6	Rokhia GT/Tripura	Gas	21.00	Commissioned
7	Rokhia GT Extn./Tripura	Gas	21.00	Commissioned
8	Karbi Langpi/Assam	Hydro	100.00	U-1 commissioned
	Total State Sector		226.84	
	Grand Total		251.84	

Source:powergrid

The central and the state sectors have undertaken capacity additions in this region. The central station with a capacity of 25 MW is based on hydro. The state projects have been skewed towards liquid fuel and three gas projects have also been planned adding 21 MW each. The Hydro project in Assam is planning to contribute 100 MW.

Some efforts have been made to improve the structure and functioning of this sector. Those are: -

- Reforms in the power sector and targeted technology improvements have helped to enhance the combustion efficiency of conventional coal technology leading to conservation of coal and savings in emissions.
- Power sector reforms include regulatory restructuring, corporatization, privatization and unbundling of state-owned utilities. The 1998 Regulatory Commissions Act empowers commissions to rationalize electricity tariffs and promote environmentally-benign policies.
- Corporatization is altering state electricity boards from state ownership and administration to business-like corporations as defined by the Indian Company Act, 1956.
- The Indian Electricity Act of 1910 and the Electricity Act of 1948 have been amended to permit private participation in the generation and distribution of power.
- Privatization in transmission has been encouraged by the recognition of exclusive transmission companies.To tackle the current situation of persistent demand supply gap the government has also been looking at private generation projects out of which six are expected to reach financial closure very soon; these generation projects hold a capacity of 3300 megawatts.

TABLE 26

Projects to achieve financing by February 2007

Developer	MW	Project, location	Cost (Rupee million)
Navabharat Power	1,040	Dhenkanal, Orissa	46,488
IFFCO	1,000	Premnagar, Chhattisgarh	50,640
Dheeru Power	600	Dheeru, Chhattisgarh	22,500
KVK Nilachal Power	300	Cuttak, Orissa	13,680
RKM Power Gen	350	Bira, Chhattisgarh	14,875
DANS Energy	96	Jorethang, Sikkim	4,920

Source: Inter Institutional Group

Spurred by the success of the ultra mega thermal projects the power authorities are seeking private investments in two major transmission projects on a similar basis. One of which is to transport surplus electricity from the north eastern and eastern regions to the northern region and the other is to set up evacuation system for the 1000 MW Maithon, 500 MW Kodarma and 500 MW Bokaro Extension projects in eastern India.

Another first is the entry of NTPC into merchant power business i.e. a departure from the projects based on long term sale of electricity to distribution licensees. The group has approved 520 MW hydroelectric project as merchant scheme and three more are planned by 2012.

3.2 Fertilizer sector

3.2.1 International Scenario

FERTILIZER PRODUCTION

The production of mineral fertilizers is highly dependent today on just three materials, ammonia, phosphoric acid and mined potash. In turn ammonia production is highly dependent on the supply of natural gas, and phosphate fertilizers on the supply of by-product (non-discretionary) and mined sulphur.

The Nitrogen Fertilizer Industry

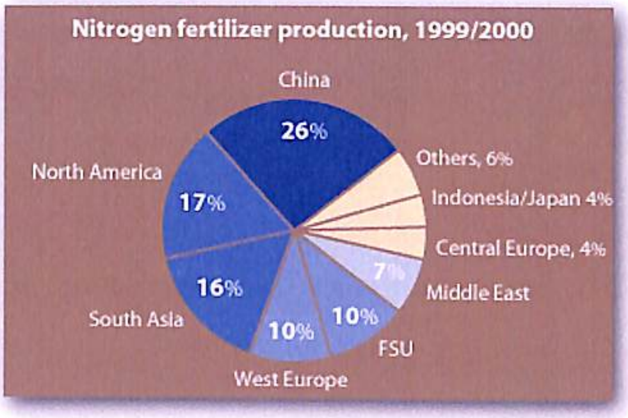


FIGURE 11

Up to the 1960s, the development of the nitrogen industry took place in the developed countries of West Europe, North America and Japan. However, In the 1970's and early 1980's, the construction of new plants shifted to the gas-rich countries of the Caribbean and Middle East and also to some large consuming countries such as China, India, Indonesia and Pakistan. At the same time, many plant closures occurred in West Europe and Japan. West Europe's share fell from 20% in 1980/81 to 11% in 1997/98. In 1980/81 the developing countries accounted for 31% of nitrogen fertilizer production.By 1997/98 their share had increased to 55%.

In 1980/81 the developing countries accounted for 31% of nitrogen fertilizer production. Today their share had increased to more than 55%. Over a third of the world's production is in just two countries, China and India, but ammonia is produced in about 80 countries and urea in about 60.

Ammonia

Anhydrous ammonia is produced in about 80 countries. Approximately 85% is used for nitrogen fertilizer production, including about 6% that is directly applied to the fields.

Figure 11

In 1974 the developing countries accounted for 27% of ammonia capacity. Today their share is 52%.

Some 88% of world ammonia production is processed or used in the countries where it is produced. The remaining 12% of world ammonia production enters international trade directly for all end-users.

World ammonia capacity grew from 119 Mt in 1980 to a peak of 141 Mt product in 1989. Virtually all the growth in capacity occurred in the FSU and Asia. Between 1989 and 1995 capacity remained relatively flat, with increases in Asia being offset by closures in Europe and the FSU. Today ammonia and urea capacities are increasing most rapidly in the Middle East region.

Since 1973 the share of urea in the total world nitrogen fertilizer market has increased from 20% to 50%. Urea is by far the dominant nitrogen fertilizer used in developing countries and is continuously increasing its share in these markets. As with ammonia, most of the increase in capacities is in the Middle East region.

PHOSPHATE

Phosphate Rock

The main producers of phosphate rock and phosphate fertilizers are the USA, the former USSR, China, Africa (the Maghreb countries, Egypt, Senegal, Togo and South Africa), and the Middle East. Several of these countries are developing countries and the phosphate industry makes an important contribution to their economies. More than 75% of the world's commercially exploited phosphate rock is surface mined. The mining techniques take many forms, from manual methods to the employment of highly mechanized technologies, with the remainder recovered by underground mining.

Overall, mineral fertilizers account for approximately 80% of phosphate use, with the balance divided between detergents (12%), animal feeds (5%) and specialty applications (3%), e.g. food grade, metal treatment etc.

The production of phosphate rock peaked in 1988 at a level of 166 million tonnes product, falling to 125 million tonnes today. Production in the FSU has fallen from 39 million tonnes in 1988 to 11 million tonnes. Over 30 countries are currently producing phosphate rock for use in domestic markets and/or international trade. However, the worlds top 12 producing countries account for nearly 95% of the worlds total phosphate production. The main producers are the USA, China and Morocco.

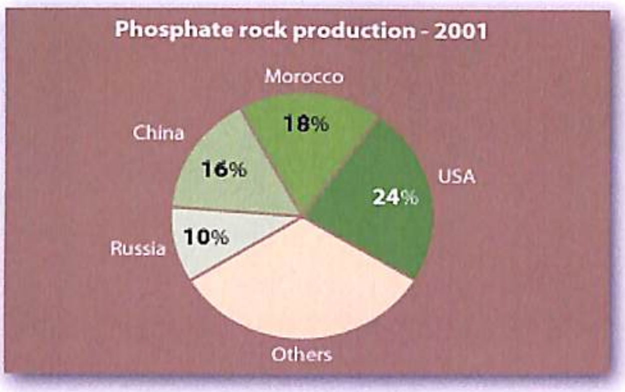


FIGURE 13

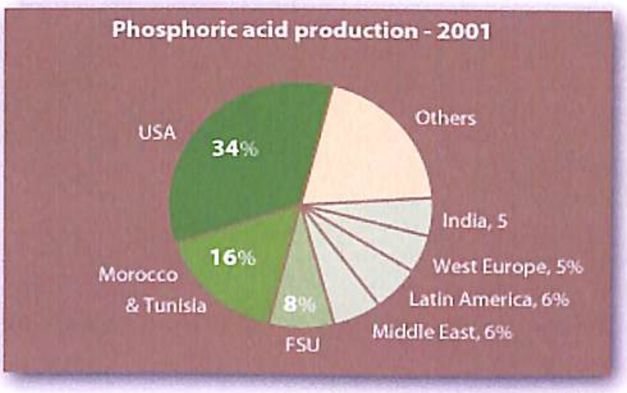


FIGURE 14

Phosphoric acid

Over the past two decades there has been a distinct trend towards the processing of phosphate rock in countries with substantial natural resources of this material, especially in North Africa and the U.S.A., but also in the Middle East and South and West Africa and China. Most plants in West Europe have been closed for economic and environmental reasons.

Some 85% of world phosphate fertilizers are manufactured by reacting phosphate rock either directly with sulphuric acid or indirectly with phosphoric acid produced using sulphuric acid. The purpose is to increase the nutrient concentration in the final product and improve the availability of the phosphate to the plants.

The main environmental problem associated with phosphoric acid production is the disposal of phosphogypsum; some 4 to 5 tonnes of which are produced per tonne of phosphoric acid (expressed as 100% P205) manufactured.

The concentration of phosphoric acid production in just a few countries is likely to continue. Integrated phosphate mining and processing offer significant technical and economic advantages.

POTASH

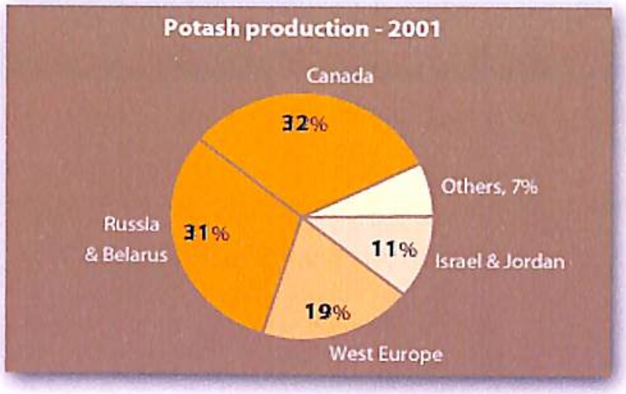


FIGURE 15

The world potash industry consists of over 55 mines and refineries, with a current total capacity of 36.3 Mt K_2O annually.

Potash is produced in the few countries where the economic ore reserves are located. A large proportion of mined potash enters international trade. Twelve countries, plus two of the republics of the FSU, account for all of the world mined production. Canada and the FSU alone account for 55-60%. About 70% of world deliveries are exported as such, and a further 10-12% is exported in multi nutrient fertilizers. Canada and the FSU account for two thirds of world exports.

In Europe a large reduction in German capacity took place following reunification, from 6.2 to 3.7 Mt K20 per year. Potash mines in France will be closed by the year 2004, when the deposits will be exhausted.

SULPHUR

World sulphur production currently amounts to about 60 million tonnes S. The quantity currently used in the production of phosphoric acid is estimated at 27 million tonnes of S. The remainder is used in other industrial processes.

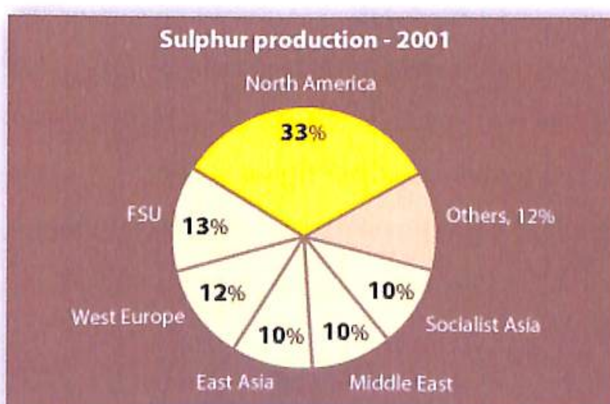


FIGURE 16

Elemental sulphur (brimstone) accounts for over two thirds of the total. Some 8% of total sulphur production is obtained from pyrites and the remainder from sulphur in other forms, principally smelter sulphuric acid. China accounts for three quarters of the world production of pyrites, mostly for the production of single superphosphate. China's production of pyrites is tending to fall.

Almost all the elemental sulphur today is sulphur recovered from the desulphurization of oil products and natural gas. Some 5% is mined, mostly in Poland and Mexico.

FERTILIZER CONSUMPTION

1950 to 1989. During this period, with temporary setbacks notably due to the oil crises in the 1970s, there was a sustained increase of world mineral fertilizer consumption, which increased from 14 to 143 million tonnes $N+P_2O_5+K_2O$, nitrogen, phosphate and potash, or almost 6% per annum.

1989/90 to 1993/94. During these four years world fertilizer consumption fell by 23 Mt, from 143 to 120 Mt total nutrients. The reduction was due to a 23 Mt decline of fertilizer nutrient use in the countries of Central Europe and of the Former Soviet Union, the FSU, and also, to a lesser extent, a fall of almost 5 Mt in West Europe. The falls were partly offset by increases in Asia.

1993/94 to 1999/2001. During this period, world total nutrient consumption increased from 120 to an average of 138 Mt. Consumption in Socialist Asia, South Asia and Latin America increased, that of West Europe stabilized while demand in the FSU fell again.

By 1996 world nitrogen consumption had regained its 1989 level, with increases in developing countries offsetting falls in Europe and the FSU. However, world phosphate consumption remains below its 1988/89 peak (33 versus 38 Mt P2O5), as does that of potash (22 versus 28 Mt K2O). During the period 1998/99 to 2000/01 Socialist Asia, mostly China, accounted for 27% of world fertilizer consumption, South Asia, mostly India for 16%, North America, mostly the USA also for 16%, West Europe for 12% and Latin America for 8% i.e. all together for almost four fifths of total world consumption. Sub-Saharan Africa excluding South Africa accounted for 1%.

TABLE 27

Total fertilizer nutrient consumption - Million tonnes nutrients, N + P_2O_5 + K_2O

Year	West Europe	Central Europe	Eastern Europe & Central Asia	North America	Latin America	Oceania	Africa	WANEA	South Asia	North-east & South-east Asia	East Asia	World	Deve-loped	Deve-loping
1995/96	17.75	3.22	4.29	22.58	8.75	2.57	2.24	5.11	17.88	9.05	36.10	129.56	52.93	76.63
1996/97	18.29	3.63	4.56	22.99	10.13	2.71	2.53	5.43	18.21	9.37	37.02	134.87	54.67	80.19
1997/98	17.94	3.56	4.57	22.88	11.03	2.87	2.51	5.60	20.27	8.97	36.94	137.14	54.19	82.95
1998/99	17.80	3.45	3.96	22.30	11.29	2.89	2.56	5.98	20.91	9.63	37.31	138.10	52.71	85.39
1999/00	17.60	3.20	3.87	22.25	10.99	3.09	2.64	6.20	22.62	9.70	38.23	140.38	52.31	88.07
2000/01	15.98	3.52	3.88	21.34	12.22	3.22	2.54	5.96	21.36	8.55	36.99	135.56	51.27	84.29
2001/02	15.83	3.66	4.03	22.16	12.85	3.38	2.72	5.73	22.10	8.63	38.18	139.27	51.20	88.07
2002/03	15.43	3.57	3.94	22.00	13.14	3.30	2.94	5.64	20.94	9.40	42.56	142.84	48.22	94.62
2003/04	15.47	3.61	3.89	23.89	16.09	3.23	2.77	5.95	21.88	9.90	41.21	147.88	50.08	97.80
2004/05	14.75	3.74	4.14	22.62	16.80	3.40	2.89	6.31	23.98	10.28	45.87	154.77	48.64	106.13
2005/06	**14.06**	**3.80**	**4.21**	**21.33**	**14.72**	**3.27**	**2.59**	**6.45**	**26.11**	**10.20**	**47.34**	**154.07**	**46.67**	**107.40**

Source:ferilizer.org

Developed Countries (including countries with economies in transition)

In 1960, the developed countries, Europe, the USSR, North America, Oceania, South Africa and Japan, accounted for 88 % of the world fertilizer consumption. By 2005-06 their share has fallen to 30.3%, although of a much larger total. Major consuming developed countries/regions were North America (with a 20% share of consumption in developed countries) and West Europe (10%of the total and 13% share amongst developed countries).

From 1980 to 1989 fertilizer consumption in the developed countries tended to stabilize. Population growth had leveled off, almost everyone was adequately fed, and world agricultural exports had stagnated due to economic problems in the importing countries. Then, between 1989 and 1994, fertilizer consumption in developed countries fell from around 84 Mt nutrients to 52 Mt nutrients. In the formerly centrally planned economy countries of Central Europe and the FSU, consumption fell by 70%. Consumption also fell in West Europe, although to a much lesser extent. Phosphate and potash consumption were affected more seriously than nitrogen.

Post 1994 there hasn't been a marked change in the developed countries consumption, though off late it has again started sliding down to reach 46.67Mt in 2005-06.

Developing Countries

In the last few years i.e. 2003-2006 the developing countries share in the total fertilizer consumption has ranged from 66%-70% .Before this, between 1999 and 2002, annual fertilizer consumption in the developing countries averaged some 87 Mt nutrients or 63% of the world total, compared with 12% in 1960. The increase was particularly substantial in the case of nitrogen. It was in 1991/92 that fertilizer consumption in developing countries for the first time exceeded that of the developed countries. Major consuming countries are China (with a 40% share of consumption in developing countries), followed by India (20%) and Brazil (8%).

In many developing countries fertilizer application has become unbalanced i.e. too much nitrogen in relation to the other nutrients, especially in Asia. In other countries the "mining" of soil nutrients is severe, and falling yields have been observed, as nutrients removed by the crops are not replaced. This problem is particularly serious in sub-Saharan Africa.

Thirty-Year Outlook

Since the end of the 1970s, The Food and Agriculture Organization of the United Nations, the FAO, has prepared forecasts of worldwide yields and areas. According to the latest survey, the projected absolute increment in world crop production from 1995/97 to 2030, i.e. 34 years, will be 57%. The rate of increase will be greater in developing countries than in developed countries. The developing countries should account for 72% of world crop production in 2030 compared with 53% in 1961/63.

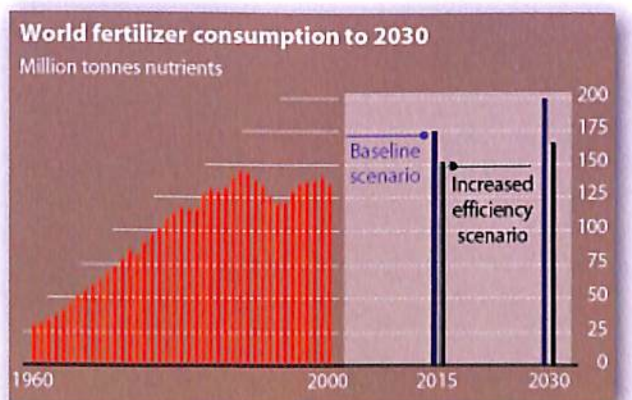


FIGURE 17

Future fertilizer requirements have been related to FAO's latest forecasts of worldwide crop yields and areas*. In order to attain the yields projected by the FAO, it is forecast that fertilizer consumption will have to increase from the present level of 138 million tonnes $N+P_2O_5+K_2O$ to between 167 and 199 million tonnes per year by 2030. This represents an annual growth rate of between 0.7 and 1.3 percent per annum, which compares with an average annual increase of 2.3% p.a. between 1970 and 2000. Most of the increase will be in South and East Asia and in North and South America

3.2.2 Indian Scenario

The Indian fertilizer industry is the third largest in the world. With globalization, the fertilizer industry is linked by a high degree of international trade. As far as raw materials, intermediates and finished products are concerned, ammonia is a key intermediate in the manufacture of nitrogenous fertilizers and is produced from hydrocarbon feedstocks like natural gas, naphtha, fuel oil, etc. The commonly used feedstocks are naphtha and natural gas. These feedstocks are also used in the industries like power, petroproducts, etc. Power generation industry is the biggest consumer of naphtha and natural gas, followed by the fertilizer industry.

Presently natural gas is the most economical feedstock due to its high energy efficiency, cost effectiveness and environmental friendliness. Naphtha is the next available best option. Fuel oil and coal are

not generally preferred because intensive investment and energy are required. For manufacturing nitrogenous nutrients in India during recent years, the proportion of feedstocks have remained as 50% of natural gas, 28% of naphtha, 11% of fuel oil, 6% of direct ammonia supplied, 3% of coal and remaining 3% of coke oven (COG)and others.

TABLE 28

Feedstock Summary as on Dec 1999

Feedstock	Installed Capacity ('000'MT)		
	Qty	N	P
Fuel Oil	2871.7	1207.9	32.8
Naphtha	8776.1	3141.4	750.8
Coal	660.0	303.6	0.0
Gas	14414.6	5821.6	717.1
Ext. Ammonia	2976.5	550.6	1145.2
COG	218.5	45.9	0.0
Rock Phos & Sulphur	6262.8	0.0	1002.1
Total:	**36180.2**	**11071.0**	**3647.9**

Source:fertilizer.org

Fertilizer is generally defined as "any material, organic or inorganic, natural or synthetic, which supplies one or more of the chemical elements required for the plant growth". Sixteen elements those are carbon ,hydrogen,oxygen,nitrogen,phosphorus,potassium,calcium,magnesium,sulphur,boron,chlorine,copper,iro n,manganese,molybdenum and zinc are identified as essential elements for plant growth, of which nine are required in macro quantities and seven in micro quantities. Primary nutrients are normally supplied through chemical fertilizers. They are chemical compounds containing one or more of the primary nutrients and are generally produced by chemical reactions.

TABLE 29

RAW MATERIALS AND INTERMEDIATES

Sr. No.	Intermediate	Raw Materials
		Natural Gas
		Associated Gas
		Naphtha
		Fuel oil
		Coal
		COG
		Power
1	Ammonia (NH3)	Water
		Sulphur
		Pyrites
		Power
2	Sulphuric Acid (H2SO4)	Water
		Rockphosphate
		Sulphuric acid
		Power
3	Phosphoric Acid(H3PO4)	Water
		Ammonia
		Power
4	Nitric Acid (HNO3)	Water

Source:fertilizer.org

FERTILIZER PRODUCTION

At present, there are 64 large size fertilizer units in the country, manufacturing a wide range of nitrogenous and phosphatic/complex fertilizers. Of these, 39 units produce urea, 18 units produce DAP and complex fertilizers, 7 units produce low analysis straight nitrogenous fertilizers and 9 of these units produce ammonium sulphate as a by-product. Besides, there are about 79 small and medium scale units producing single superphosphate. The total installed capacity of fertilizer production in the country for nitrogen was 784.6 ('000) mn tonnes of nitrogen and 266.2('000) mn tonnes of phosphate as on Mar 2001. The production target for March 2007 was fixed at 841.6('000) mn tonnes of nitrogen actual was 923.7('000) mn tonnes and 391('000) mn tonnes of phosphate with the actual figure being 358.6 ('000) mn tones.

The production of nitrogenous fertilizers during 1998-99 was 104.80 lakh tonnes of nitrogen and that of phosphatic fertilizers 31.41 lakh tonnes of phosphate, representing a growth rate of 5.6% in nitrogen and 6.5% in phosphate, as compared to the actual production in 1998-99. As against this, the actual

production upto February 2000 was at 101.16 lakh tonnes of nitrogen and 30.40 lakh tonnes of phosphate. Taking 'N' &'P' together, there was an overall growth of 5.3% over the production during the corresponding period of last year. Offlate, the production has risen to 11577.1('000) mn tonnes of nitrogen and 4516.6 ('000) mn tonnes of phosphate for the period from April'06 –March'07.

The following table gives a detailed analysis of the annual installed capacity of nitrogen and phosphate in public private and cooperative sector, the production in these plants and the capacity utilization in each of them.

TABLE 30

NITROGEN

Name of Company/ Plant	Annual Installed Capacity	Production (`000' MT)		Percentage capacity utilization	
	(01.04-06)	2004-05	2005-06	2004-05	2005-06
Public Sector:					
TOTAL (NFL):	1486.1	1580.3	1538.0	106.3	103.5
TOTAL (BVFCL):	255.3	94.8	115.8	37.1	45.4
TOTAL (FACT):	174.0	157.0	185.6	90.2	106.7
TOTAL (RCF):	1057.0	922.3	887.9	87.3	84.0
MFL:Chennai	366.7	270.9	204.8	73.9	55.8
SAIL:Roulkela	120.0	0.0	0.0	0.0	0.0
By Product	38.7	29.2	19.5	75.5	50.4

Total(Public):	3497.8	3054.5	2951.6	87.3	84.4
Cooperative Sector					
TOTAL(IFFCO):	2048.6	2071.1	2079.9	101.1	101.5
KRIBHCO:Hazira	795.4	830.6	830.6	104.4	104.4
Total(Co-operative):	2844.0	2901.7	2910.5	102.0	102.3
Total(Pub.+Coop.):	6341.8	5956.2	5862.1	93.9	92.4
Private Sector					
GSFC:Vadodara	248.1	235.4	242.0	94.9	97.5
TOTAL(GSFC-Sikka):	177.1	101.8	116.3	57.5	65.7
CFL:Vizag	124.0	164.9	209.8	133.0	169.2
SFC:Kota	174.3	174.3	174.2	100.0	99.9
DIL:Kanpur	332.1	0.0	17.1	0.0	5.1
ZIL:Goa	288.7	307.6	301.1	106.5	104.3
SPIC:Tuticorin	370.7	385.7	357.9	104.0	96.5
MCF:Mangalore	207.2	192.5	219.5	92.9	105.9
CFL:Ennore	41.2	44.9	43.0	109.0	104.4
GNFC:Bharuch	356.7	371.9	379.7	104.3	106.4
TAC:Tuticorin	16.0	18.8	20.0	117.5	125.0
TCL:Haldia	121.5	78.1	99.0	64.3	81.5
PNF:Nangal	16.0	0.0	0.0	0.0	0.0
GFCL:Kakinada	120.6	144.9	164.9	120.1	136.7
IGCL:Jagdishpur	397.7	453.2	457.6	114.0	115.1
Hindalco Inds.Ltd.:Dahej	72.0	51.5	38.0	71.5	52.8
DFPCL:Taloja	52.9	20.6	12.5	38.9	23.6
TOTAL(NFCL):	549.6	640.4	634.5	116.5	115.4
TOTAL(CFCL):	795.4	853.6	874.6	107.3	110.0
TCL:Babrala	397.7	445.4	441.6	112.0	111.0
KSFL:Shahjahanpur	397.7	396.1	412.8	99.6	103.8

IFFCO:Paradeep	325.2	114.6	48.0	35.2	14.8
PPL:Paradeep	129.6	184.3	221.0	142.2	170.5
By Product	7.1	0.6	3.5	8.5	49.3
Total (Private Sector):	5719.1	5381.1	5488.6	94.1	96.0
Total(Pub+Coop+Pvt):	12060.9	11337.3	11350.7	94.0	94.1

Phospate

Name of Company/Plant	Annual Installed Capacity (01.04-06)	2004-05	2005-06	2004-05	2005-06
Public Sector:					
Total(FACT):	126.7	114.9	149.2	90.7	117.8
Total(RCF):	120.1	98.9	116.3	82.3	96.8
MFL:Chennai	142.8	52.5	34.9	36.8	24.4
HCL:Khetri *	30.1	0.0	0.0	0.0	0.0
SSP Units	12.8	0.0	0.0	0.0	0.0
Total(Public):	432.5	266.3	300.4	61.6	69.5
Cooperative Sector					
IFFCO:Kandla	910.0	938.3	961.9	113.7	105.7
Total(Pub.+Coop.):	1342.5	1204.6	1262.3	89.7	94.0
Private Sector					
GSFC:Vadodara	75.9	62.0	85.9	81.7	113.2
TOTAL(GSFC-Sikka):	452.7	260.3	298.4	57.5	65.9
CFL:Vizag	166.0	216.2	244.3	130.2	147.2
ZIL:Goa	197.4	178.0	202.3	90.2	102.5
SPIC:Tuticorin	218.5	176.9	178.6	81.0	81.7
MCF:Mangalore	82.8	84.4	82.2	101.9	99.3
CFL:Ennore	48.0	49.6	50.1	103.3	104.4
GNFC:Bharuch	28.5	36.0	40.7	126.2	142.8
TCL:Haldia	336.9	220.6	274.3	71.1	81.4

GFCL:Kakinada	308.2	373.9	419.7	121.3	136.2
Hindalco:Dahej	184.0	131.7	97.0	71.6	52.7
DFPCL:Taloja	52.9	20.6	12.5	39.0	23.6
IFFCO:Paradeep	802.8	282.7	73.8	35.2	9.2
PPL:Paradeep	331.2	407.3	494.3	123.0	149.2
SSP Units	1030.6	362.4	357.0	40.2	34.6
Total (Private Sector):	4316.4	2862.6	2911.1	68.8	67.4
Total(Pub+Coop+Pvt):	5658.9	4067.2	4173.4	71.9	73.7

FERTILIZER CONSUMPTION

Projections reveal that the demand for NPK is bound to increase in the coming years to sustain the current agricultural production as well as increase the productivity of old fields.

TABLE 31

Demand forecast of fertilizer nutrients for the 11th plan period is given below:-

('000 tonnes)

Year	N	P	K	Total
2007-08	14347	7432	2266	24045
2008-09	14783	7855	2351	24989
2009-10	15231	8303	2441	25975
2010-11	15693	8780	2534	27007
2011-12	16171	9284	2630	28085

Its clear from the forecast that huge quantities of fertilizer nutrients will be required and so will be the raw materials required to manufacture these nutrients , namely natural gas, fuel oil etc.

Analyzing the demand supply gap under two different scenarios it can be concluded:-

1) In case of 90%capacity utilization of existing fertilizer plants the shortfall in the case of nitrogen would be 22.01 lakh metric tones and for phosphate it is 23.19 lakh metric tones in 2006-07.

TABLE 32

Demand Supply Gap in 'N', 'P', 'K' (In Lakh Metric Tonnes)

Year	Demand			Supply		Gap	
	N	P	K	N	P	N	P
2002-03	123.00	55.05	18.64	108.52	47.08	14.48	7.97
2003-04	127.18	59.07	19.48	109.68	47.08	17.50	11.99
2004-05	131.16	62.77	20.26	109.68	47.08	21.48	15.69
2005-06	135.14	66.46	21.04	109.68	47.08	25.46	19.38
2006-07	139.23	70.27	21.83	117.22	47.08	22.01	23.19

Source: department of fertilizer

2)In case the plant utilization is 100%the gap will narrow down to below 10 lakh metric tones for nitrogen and 17.96 for phosphate 2006-07.

TABLE 33

Year	Demand			Supply		Gap	
	N	P	K	N	P	N	P
2002-03	123.00	55.05	18.64	120.58	52.31	2.42	2.74
2003-04	127.18	59.07	19.48	121.74	52.31	5.44	6.76
2004-05	131.16	62.77	20.26	121.74	52.31	9.42	10.46
2005-06	135.14	66.46	21.04	121.74	52.31	13.40	14.15
2006-07	139.23	70.27	21.83	129.28	52.31	9.95	17.96

Source: department of fertilizer

The above two tables highlight the importance of optimum utilization of existing plants and efficient and timely and demand specific construction of new plants in the country .Apart from this its also important to note the demand supply gap for the nutrients in various zones of the country to structure the progress of the industry in an organized manner. Figures reveal that the NPK demand has been higher in north ,south ,west as compared to the east zone all throughout since 2002.The east zone demand has been hovering around 3500,(it was 3793.43('000 tonnes)in 2006-07),whereas the demand in the other zones have all been crossing 6500('000 tonnes).

FEEDSTOCK - LOCAL & GLOBAL SCENARIO

The cost of feedstock plays an important role in determining the selling price of complex fertilizers and its retention price of urea (Exhibit 1). In view of constraints for availability of domestic natural gas and lack of facilities to import, many new projects have been conceived with naphtha as feedstock with the option to use naphtha and/or natural gas as and when available. Since the power and petrochemical industries use a significant share of naphtha/natural gas as feedstock, short supply of natural gas and naphtha is not ruled out and consequently manufacturers shall have to depend on imports. Supply of natural gas is controlled by Gas Authority of India Ltd. (GAIL). The prices are administered depending upon the calorific value of the feedstock and other factors. The prices of natural gas and furnace oil are indicated in Exhibit-1 and compared with selling price of urea during last two decades. The consumption of natural gas may continue to be in the constrained manner. The availability of natural gas was expected to be approximately 22-24 billion cubic metres during 1998-99 and is expected to be stagnant for next three years. The significant imports of gas are also not expected to take place in near future due to non-availability of adequate infrastructure in India.

In India, there exists the Gas Distribution Net work facility. At present there is only one long distance onshore pipeline connecting Hazira-Bijapur-Jagdishpur (HBJ pipeline covering 2200 KMs) with a capacity of 12.1 billion cubic metres per annum. The gas from Bombay High is delivered to Uran terminal near Bombay and is utilized in the Maharashtra State. The gas from free gas field South Basin delivered to Hazira terminal is utilized locally as well as through HBJ pipeline. Expansion of the Hazira terminal in mid 1997 from 20 MMSCMD capacity to 41 MMSCMD capacity was to ensure an availability of 32.55 MMSCMD at this terminal. This was to be transported through the upgraded HBJ pipeline, with a capacity of 33.6 MMSCMD. However, the lower supplies in the terminal from Oil and Natural Gas Corporation Ltd's fields have resulted in the operations of the pipeline at a lower capacity utilization of 71.5%. The Government is seriously considering a National Gas Grid to bridge the gap between supply and demand. New resources for gas discovery are given top priority as well infrastructure to facilitate the import of gas. Government has allowed free import of LNG and many projects have been declared since 1997 involving the global players in the field. The four domestic oil majors IOC, ONGC, GAIL and BPCL have formed PETRONET LNG in 1997. Other foreign firms like

AMCO Corpn, Royal Dutch/Shell Group, ENRON, British Gas Plc. Total sa and Mobil Corp, have shown willingness to invest around USD 10 billion in LNG venture. This will result in production and import of other 15 MMT of LNG by the year 2005. Such kind of long term agreements involving large investment are announced and may take some more time for implementation.

Worldwide industrial sector will be the largest consumer of natural gas (46%) followed by power plant (24%) and domestic use (15%). The developing countries in Asia, Africa, South and Central America and Middle East have found increase in natural gas demand. Africa, FSU and Middle East countries are only surplus areas. Trade of natural gas is not extensively done because of limitations in transportation. Secondly 35% of the production is consumed in the country of origin.

Global trade through pipeline during 1997 was 321.7 billion cubic metres. Trade through LNG was 111.3 billion cubic metres accounting for 5.1% of the world gas demand. LNG trade has shown steady growth at the rate of 6.31%. Japan and South Korea have traded 72% of the total trade in 1997 importing from Indonesia, Malaysia, Australia and Brunei.

World natural gas demand is expected to increase due to increasing energy consumption. Power sector is expected to be the main driver of demand accounting for around 50% of the expected demand growth. By 2000, the demand for natural gas is expected to increase to 2390 billion cubic metres from the present consumption of 2027 billion cubic metres. The demand growth in the medium to long term will continue to depend upon the alternative fuel prices, mainly crude oil and various petroleum products and environmental regulations. Use of natural gas is supported by its ecofriendliness.

In India, the naphtha consumption by 2001-2002 is expected to increase at a CAGR of about 39%. With this, supply demand condition shall produce deficit of naphtha which shall necessitate imports of naphtha. 45% of total natural gas produced in the country presently goes into the fertilizer. If we compare feedstock of naphtha and natural gas, which is constituting the main cost of producing nitrogenous fertilizers, 70 - 80% of total cost is in case of old and 55 - 60% is in case of new plant. The cost of urea manufactured through these two alternate raw materials is given in the following table.

TABLE 34

Urea manufactured through alternate raw materials :-

	NAPHTHA	NATURAL GAS
PRICE(Rs/TON)(Rs/1000 nm3)	9000	3650
Norms (Mkcal/ton or 1000 nm3)	10	8.5
Cost (9rs/Mkcal)	900	430
Energy consumption(Mkcal/ton)	6.6	6
Cost (Rs/ton)	5940	2580

ONE USD circa Rs. 44/-

Presently, the Asia Pacific region depends substantially on the Middle East and other countries for meeting its naphtha requirements. Asian naphtha demand (excluding Indian power demand) was expected to increase at a compound annual growth rate of 3% between 1998 and 1999 and thereafter increase at a compound annual growth rate of 4% till 2001. Additionally, 9.2 MMT of naphtha would be required for power plant in India in 2001.Based on the above, the demand for naphtha in the Asia Pacific region is expected to increase from 90 MMT in 1996 to 116 MT in 2001 or at a CAGR of 6.7% over the period 1998 to 2001.

In India the feedstock is priced at a substantially higher level - about USD 3 per million BTU to plant along the HBJ pipeline and USD 7-8 per million BTU to plant based on naphtha. In the Middle-east countries, gas is available to the plant at less than USD 1 per million BTU. The cost of capital in India is also almost double than that in the other countries.

The major natural gas plants are IFFCO, RCFL, KRIBHCO, NFL, Tata Chemicals, Chambal Fertilizer, Indogulf and Oswal Fertilizer. The major naptha-based plant are Duncan, SPIC, GSFC, ZACL, Shriram Fertilizers and FACT. Plant based on fuel oil and external ammonia are scarce and old.

The major determining factors for profitability in fertilizer industry are feedstock , plant age, plant location and imports. It is essentially linked with competitiveness and profitability of the organisation reflected in its raw material cost and consumption, fixed cost coverage, distribution cost and cash flow management. The gas-based plant are technologically superior to naphtha-based plant as they are more energy efficient by 20-40% and consuming less water by 40-

60%. The gas-based plant have got lower operating cost. Among the gas-based plant , middle aged plant are cheaper on capital cost compared to new plant. Feedstock has a strong influence on location of plant. The plant in seventies and eighties were largely located near consuming areas. All gas-based plant in the nineties have been laid down near HBJ pipeline from Haziara to Shahjahanpur. Naphtha-based plant , though widely distributed, have been laid down near refineries for their supplies.

The working capital requirements of the fertilizer industry are significantly high as they have to depend on import of raw materials and realisation of subsidies granted. Planning for raw material sourcing and inventory holding with long term agreement become unusual as long-term government policies are yet to take shape.

TECHNOLOGICAL DEVELOPMENT

As we continue depleting the energy resources all over the world, we are responsible to take care of all types of technological advancement in the manufacture of fertilizers, to improve fertilizer use efficiency and to conserve the energy source without impairing agricultural production growth to meet with the needs of expanding population. We have also to aim at reducing the energy consumption levels to minimise the requirement of feedstock and fuel. Presently the focus is on alternative means of energy from renewable natural source. In this context, it is imperative that the vintage fertilizer units in India and all over the world adapt themselves to the recent developments in technologies and modernize in terms of productivity, efficiency, safety and environmental standards.

AVAILABILITY AND OPTIONS

In search of options, the recoverable source of gas in the country are presently around 682 BCM. This can sustain the current production level of around 13 BCM for about 22 years. The gas consumption has increased at the rate of about 18% since 1980-81. This may be because of increase in availability. However, the consumption in the last 5 years has found only marginal increase in gross production during the said period. Serious efforts put primarily to reduce flaring has increased the net availability.

Feedstock availability from abroad and domestic market is to be weighed keeping in view pricing, quality, quantity, logistics, reliability etc. Apart from this business policy and culture of suppliers in terms of building up customers-supplier relationship can not be ignored in these days. In the present scenario, monopoly driven relationship is observed rather than cooperative relationship. Time is not far off to think of the co-existence principle for the mutual benefits, as against the present time of steep competition; the idea of such principle becomes next to impossible under the threat of survival.

The feedstock quality and availability have played important role in fertilizer manufacturing. The choice feedstock, for example, for production of ammonia is based on cost, availability and technology. As it is closely related with energy resource, it is important to find out the options for energy resources in order to combat the depletion of energy reserves. The energy consumption for a typical 1350 TPD ammonia plant is around 8.9 Gcal PMT as feedstock plus fuel for naptha-based plant. It is 20% higher than similar NG based plant which will require around 7.2 - 73 Gcal PMT.

LNG available in the international market is an alternative feedstock . LNG is linked up with the international oil price. The LNG price hike from first quarter to last quarter of 1999 is from USD 2 per MBTU to USD 2.8 per MBTU. The importers will have to pay FOB price of Arabian Gulf plus shipping cost plus operating cost at the terminal, which is estimated as USD 3.50 per MBTU for re-gasified LNG from Gulf and it may touch to USD 5 per MBTU at users' port. There will be additional cost for transportation if plant is away from the port. The typical comparison cost figures are given in Exhibit-2.

Some of the countries including India have to think of alternative of imported LNG for fertilizer industry and power plants . It is worth to note here that when the world oil price is going up, the international urea price shows decline. The economic implications of this option are serious. In

the present scenario, only high-energy efficient plants can sustain their production and the balance urea demand can be met by importing the same. The world experts have predicted that currently proven oil reserves will last for 45 years if 100% net recovery is assumed. Indirectly it implies that fuel oil and naphtha-based units will face more problems as petroleum gets heavier and enriched with sulphur. Similar bad situation will be for gas supply also. Recently it is reported that the reserve of natural gas found in the form of gas hydrates in west coast in the area of 60,000 square kms is estimated to be approximately 1900 TCM. Of course, recovery of gas from these hydrate reserves is highly uncertain because of their inherent problems for recovery. Technology updating is required in this regard. The importance of coal as fuel and feedstock has not lost its lustre despite of many environmental concerns and its high ash and sulphur contents. 79% lignite coal is used to generate electricity, 11% is used in generating synthetic industrial gas and 7.5% is used for producing fertilizers worldwide.

A typical comparison based on the latest technologies for different feedstock is given in Exhibit-3. The cost figures given in the table are on preliminary study only. The actual figures may vary according to technology, time, location, etc. In the borderless world, with the effectiveness of WTO, the gas price, if linked up with oil product price, the difference between gas, naphtha, fuel oil and coal price and corresponding cost of production will widen more in days to come. The countries where natural gas is available shall have least ammonia production cost. Naphtha and fuel oil based units will not be economical. The coal based plants will be viable in the countries where coal is mined cheaply.

PROCUREMENT TRANSFORMATION

The future belongs to those organisations who are prepared to change their strategy, structure and systems to take up the challenges of this The feedstock trade can be in turmoil and turbulence because of depletion, substitutes, impact of end product options, closure of plants , fluctuations in demand, etc. etc. The market future is unforeseeable. The integrated approach to reduce input cost by sourcing improved logistics and regulated flow of material could help in survival. In the present scenario, monopoly driven relationship is observed rather than cooperative relationship. Time is not far off to think of the co- existence principle for mutual benefits. Three fundamental variables tremendously affect feedstock balance in the world, namely price, time and quality. Service is going to be so integral, that it will be a part of the product. The companies which could upgrade their service quality will be in a position to earn important share of mind, market and money. The incremental cost of servicing an existing customer is far below the cost of acquiring a new one. The global economy today presents new challenges that require us to focus on our ability to co-operate and collaborate. How we mediate and negotiate will be critical to future success.

With the faster means of communications available, the distance is no more a barrier and time for communication and feedback from any corner of the world is vital, essential and available on line through information technology. In global competition speed of the business assumes prime importance. The information technology is a prime determinant to the velocity of business and operations. In the information net-work, the supplier remains all the time aware of the stock levels and inventory levels at buyers' premises and can plan for supply accordingly. Standardization and traditional techniques means suicidal concept. Creative, innovative and flexible approach shall leave others far behind.

FIGURE 18

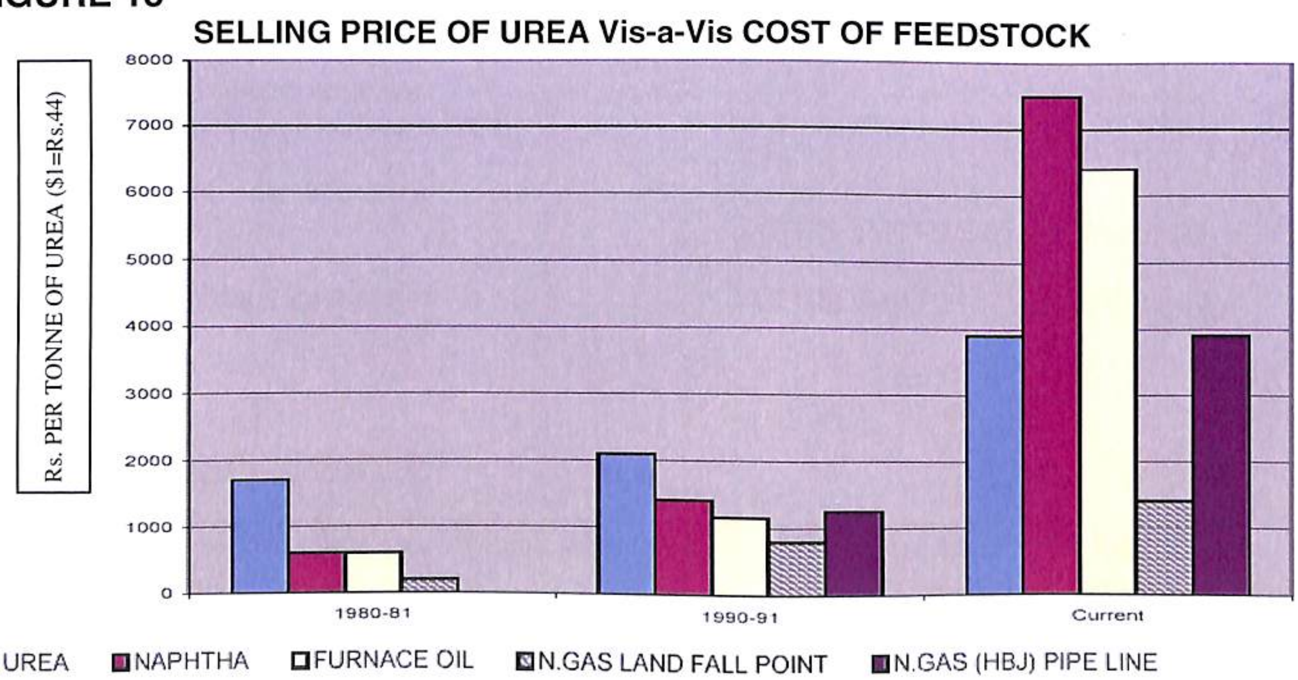


TABLE 35

	Production (feedstock + fuel) Costs, USD/MT of ammonia
Indian Plants:	
Average GAIL supplied NG based:-	
- On-shore units (typical)	59.6
- HBJ remote units (typical)	103.9
Average naptha-based	307.2
Average fuel oil based	316.7
Indian plants if modified to operate on imported LNG	189.0
New modern plant in India, if put up, with LNG feed	148.5
Typical modern plant in US/Europe based on local LNG	80.0

TABLE 36

LNG cost:	5.2 USD/MBTU	(20.63 USD/Gcal)
Calculated cost of production (energy) of ammonia with LNG feed:	161.9 USD/Tonne	
Coal cost :	1.27 USD/MBTU	(5.03 USD/Gcal)
Calculated cost of production (energy) of ammonia with coal feed:	51.4 USD/Tonne	
Min (gas-coal) cost difference for 10 year return:	3.43 USD/MBTU	(13.6USD/Gcal)
Present difference (gas-coal):	3.93 USD/MBTU	(15.6 USD/Gcal)

3.3. Petrochemical sector

Petrochemicals are useful chemicals obtained from cracking petroleum feedstock. The following figure lists the basic petrochemicals produced from petroleum feedstocks and their use. While natural gas based crackers invariably produce light olefins (mainly ethylene), naphtha based crackers have a higher share of propylene and aromatics (benzene and xylenes). While India can boast of having a significant number of steam crackers (both naphtha and natural gas based), it has only one world class aromatics unitthe one set up by RIL at Jamnagar in Gujarat.

While in the end-use of light olefins, commodity plastics account for a significant share, aromatics are mainly used for producing fibre intermediates (from paraxylene) and downstream petrochemicals (mainly from benzene).

The three main petrochemicals produced by a steam cracker are ethylene, propylene and benzene. Additionally, xylenes are produced from aromatic units which use reformate (naphtha produced from catalytic reforming unit or aromatic stream produced from steam crackers).

Ethylene is used to produce mainly polyethylene, ethylene dichloride (chiefly for PVC), ethyl-benzene (for PS) and ethylene oxide (chiefly for the production of ethylene glycols, a fibre intermediate). The other major products obtained from ethylene include vinyl acetate, acetaldehyde and alpha olefins (used as co-monomers in the production of commodity plastics).

The first half of the first decade of the 21st century is drawing to a close, ushering significant changes worldwide. Oil, a scarce commodity, became very expensive, particularly in 2004, followed by a quantum jump in prices in 2005. 2005 was particularly a very bad year for oil prices. Price increased from almost US$45/barrel at the beginning of the year to as high as US$70 on August 31,2005. A rise in oil prices of almost 50% in 12 months has adversely impacted the growth of economies globally. As expected, inflation has not been spared.

High oil prices have directly impacted petrochemical feedstock and polymer prices. Higher prices of polymers have obviously hampered the growth and consumption of polymers to some extent. Had prices been lower than current levels, polymers would have witnessed a healthier growth. Fortunately, a milder winter being experienced in the northern hemisphere so far this season, has controlled demand and oil prices have softened to some extent, dipping to levels of US$56-58/barrel by mid December 2005. Experts believe that oil may attain an average price of US$55/barrel in 2006 as compared to an average price of US$61/barrel in 2005. This estimated 10% decrease has raised the expectations of economists for a better growth globally in 2006 as compared to 2005. However, as economies grow, so does demand for oil prices- as economic growth is accompanied by an increase in demand for oil. With growing economies and corresponding growth in demand, oil prices are likely to reach the level of US$70/barrel sooner than later.

Due to rise in oil and feedstock prices there is a clear shift for new petrochemical capacities. Saudi Arabia and other Middle Eastern countries, with access to abundant oil and feedstock are increasingly building up newer petrochemical capacities. Over the next decade, ethylene capacity in the Middle East is projected to double to 30 million metric tpa and propylene capacity will triple to 7 million tpa. Borealis and Abu Dhabi National Oil Co. are planning a US$2.5 bln project in Ruwais, Abu Dhabi, to be completed in 2010. Innovene and Saudi development firm Delta International signed a MOU to build a US$2 billion petrochemical complex in Al-Jubail, Saudi Arabia, for completion in 2008. SABIC is planning an ethylene cracker for Al-Jubail by 2012.

With the Middle Eastern region bringing over 15 million tons of polymers on stream in the next 5 years, more reorganization, particularly from the European producers is expected in the near future. The high costs of running old petrochemical plants, located particularly in Europe, are increasingly compelling producers to either curtail production or exit from the business.

A prime example is that of Basell, a joint venture between BASF and Shell, being sold to Access Industries for US$5.4 billion. Both BASF and Shell decided to withdraw from this business with US$8.3 billion in 2004 sales, in the largest leveraged buyout in the chemical industry's history in August 2005. Another example of European oil producer going out of petrochemical business is that of State Oil, divesting from its Borealis' Polyolefin business.

The little known Ineos is set to become the sixth-largest chemical company in the world with its purchase of Innovene, the former BP olefins and derivatives unit. The US$9 billion deal, announced in October, will combine Innovene's US$18 billion in annual sales with Ineos' US$8 billion. American oil major Exxon continues to participate in commodity petrochemical business along with another American polymer producer Dow, who continues to grow in this business. Cargill purchased Dow's 50% interest in their Cargill Dow polylactic acid joint venture and renamed it NatureWorks. Interestingly, the same does hold true in the case of specialty polymers as well as ETP businesses. Solvay, the leading producer of ETP, has acquired Gharda Chemicals' polymer business located at Panoli, Gujarat in India. Gharda Chemicals developed PEEK technology in-house and received several US and European patents for innovative process that is different from the Victrex. This acquisition will not only give Solvay the required platform to become the second international supplier of PEEK, but will consolidate its position as a leading supplier of Polysulphone.

Fortunately for the World, overall economy in 2005 is expected to achieve better growth rates than the last 2 years. It appears that people have accepted higher oil prices and its impact on the price of the other commodities. While no clear picture emerges for the global GDP growth in 2005, it is expected to be in the region of 3.5-4%. While the outlook for GDP growth in Europe does not seem to be quite positive for 2005, Asia, with China and India both growing quite well, is expected to contribute well to the global economic growth. Asia is expected to drive the global economic growth between 2005 and 2010. China is expected to grow at 7.5%, while India has shown a growth of 8% in the first half of the financial year of 2005.

It would not be surprising that India will end up with 8% growth in GDP in 2005. India can continue to achieve 7.5% growth in GDP in the coming 5 years despite the fact that the communist parties are part of the Government and restrain radical reforms such as labour laws. India has received foreign investments to the tune of US$10 billion in 2005- a definite boost to the Indian economy. This figure shows growth of more than 10% in 2005 - increasing from US$9 billion in 2004. Despite robust economic growth, the Indian polymer industry did not have a very good 2004, growing by only about 4%. Only two commodity polymers showed decent growth- LLDPE grew by more than 12% while PP grew by 4%. PVC was practically flat or showed a very marginal increase during 2004. Polystyrene, however, experienced a negative growth. EVA has grown well in the last 2 years and will attain consumption levels of 50 KT in 2005. ETP apparently grew well, and particularly Polycarbonate had an impressive growth. The compounding business also showed significant growth resulting in addition of sizeable capacity. The masterbatch business also showed about 12% growth, with impressive increase in capacities.

India's largest polymer producer Reliance Industries has demerged its petrochemical business from Infocom, Power and Capital businesses due to a separation between the two Ambani brothers. Post demerger, Reliance Industries has chalked up very impressive expansion plans.

- Refinery capacity will be increased from the existing 33 million tons to 60 million tons latest by 2010.
- Along with this increase, RIL will increase its PP capacity to almost 2.6 million tons in 4 steps from the existing 1.2 million tons. The first 250,000 ton plant will be on stream by early 2006, whereas the last plant will be set up by 2010.
- During 2005, RIL has almost completed expansion of Ethylene capacity from 700 KT to 1 million tons.

- RIL has also set up a new 280,000 KT PET chip capacity for bottles using new technology from Dupont.
- PVC capacity at RIL has seen a marginal increase of about 30 KT.

- RIL will also increase its export of PP from India that currently stand at over 300,000 tons from its existing plants.
- RIL will achieve full capacity of 60 KT of HDPE with slurry process, 15 KT of EVA with autoclave process and 2 KT of UHMDPE this year, at the NOCIL plant it started in 2004.
- IPCL also plans to increase its LDPE capacity by about 10 KT this year.
- GAIL has increased its PE capacity by 20-30 KT.
- Finolex, another PVC manufacturer will set up a second plant with capacity of 130 KT at its existing site.
- GAIL has also finalized setting up of a project in the state of Assam located in eastern India. This project, consisting of 220 KT capacity will be a swing plant to manufacture LLDPE/HDPE. The new plant will, in all probability, select Nova technology currently under implementation at its plant in Auriya, Uttar Pradesh state in the northern part of India.
- Reliance Industries is setting up a special export zone near its refinery located at Jamnagar, where it has invited international petrochemical giants like Exxon, Dow and others to build up petrochemical projects to manufacture polymers for export purposes.

The plastics processing sector that showed mixed performance in 2004, possibly due to higher price of polymers, is expected to do better in 2005.

Some new capacity build up was witnessed in PVC pipes in 2005. PVC pipe is expected to recover in 2005, hence PVC may show some growth although it may not be as spectacular (16%) as what was observed in 2003.

PE pipes continued to show good performance in 2005, with total demand for pipes pegged at just below 100 KT pa. Reliance Industries, after acquiring Nocil's PE plant, attained a total capacity of 80 KT of PE pipes. This, along with the fact that telephone ducting, a major market of PE pipe, has not shown any growth, has prevented any further investment by independent processors in this sector.

New processing capacity has been added in raffia sector, expected to do quite well in 2005. Cement sector that consumes almost 190 KT of PP woven bags is expected to achieve a growth of almost 12% in 2005.

Fertilizer industry, using HDPE woven sacks is expected to show growth of about 4% in 2005. Demand has been coupled with enhanced export opportunities as major traders from Europe such as Interjute and Zakencentral have increased their buying from India. FIBC export is expected to rise, making this sector attain a level of about 60 KT.

PE film had a mixed year in 2005. The blockage of drains due to heavy rains in Mumbai on 26 July 2005 has led the Maharashtra State Government to call for a total ban on PE bags and films. Sale of PE bags has been adversely affected in these 4 months in Maharashtra.

New capacity addition in 5 and 7 layer PE films is on the rise. India has 5 players in layer PE film. With the introduction of 7 layer lines by Supreme Industries and Vishakha Polyfab, Indian food packaging sector will be able to increasingly use barrier films for packaging. Until the Indian market graduates to higher packaging, 7 layer films would be available for the international packaging companies in India. Competition is quite fierce in the commodity monolayer and 3 layer PE film sectors. The traditional markets of PE film - milk packaging as well as detergent packaging will continue to grow.

In the BOPP film sector, Jindal Polyester is to expand capacity by 45 KT at Nashik in Maharashtra in Q1- 2006.

TQPP film sector has been adversely affected because BOPP film is increasingly used to replace TQPP

film. New capacity totaling to 4 KT capacity is being built in PP non woven by 2 new entrants in Q1-2006.

BOPET film is expected to achieve 15% growth in 2005.

Rigid packaging sector has also shown growth, though not as good as the flexible packaging sector.

Rotational moulding sector is growing very well and is expected to achieve 12% growth in 2005. Sintex is a leading manufacturer of rotational moulding products with the capacity of 12 KT/year. Most of the rotational moulding is for water tanks (almost 85-90%). However, with the setting up of a division of the US Rotational Moulding Association in India, the development of other products is expected in the near future. The Indian rotational moulders have started in this direction with the development of fuel tank for the farm sector (tractors, etc) as well as insulation boxes/containers. Two leading European rotational moulding companies have set up plants in India. Saeplast Ltd from Iceland, a leading manufacturer of doublewall PE containers with PU insulation used for fisheries industry, set up a joint venture plant at Ahmedabad in Gujarat State. Motion Technology Ltd. from Norway set up a fully owned plant at Pune in Maharashtra.

Wire and cable sector has shown some growth mainly due to increased spending on infrastructure projects by the Government, as well as capacity addition in power by the private sector. Wire and cable industry is expected to have good growth potential in the next 5 years due to increased capital outlay for power projects in India.

Injection moulding sector continues to grow well mainly because of good growth in the automotive sector, coupled with good opportunities in consumer products due to a rise in surplus available with middle class Indian families. India is increasingly becoming a preferred source for auto parts that including plastic moulded parts.

PET bottles continue to grow at almost 15%.

Indian plastics processors are increasingly looking for international opportunities. Plastindia 2006, to be held in February, will have a separate hall under the name of Proplast and will showcase the capabilities of Indian processors. Those international buyers looking for plastic finished products for any application

certainly should visit this exhibition and look for any business tie ups with Indian leading plastic processors. According to available data consumption of polymers in India during 2005 financial year were:-Total PE consumption around 1745 KT (36% of total), PVC consumption is 1000 KT and the total stands at 4820 KT.

3.3.1 International Scenario

Global economy continues to show strong growth despite high-energy costs, leading to spurt in petrochemicals demand. While first round of capacity creation is appearing in the market, strong demand growth means that prices are not likely to ease up, at least for now. Operating rates of major petrochemical product segments are over 90 % with leading analysts predicting extended up cycle.

Asian markets, led by China and India, have firmly established themselves as the epicenter of global petrochemical activities during the current decade. With economic growth starting to slow down in the US, Asia will only strengthen its position as global petrochemical hub both for production as well as for demand.

Indian economic growth has been lifted to a higher plane at around 8% p.a plus. Expanding middle class is providing boost to consumption of various goods and services. Petrochemical industry is a big beneficiary of this transformation. Plastics consumption in India is currently growing over 14% per annum.

With emergence of Middle East, rest of the world is busy adjusting to changes in the petrochemicals competitive matrix. By 2010, with ongoing capacity additions in place, 25% of global supply will come from Middle East primarily Saudi Arabia & Iran.

Major challenges facing global petrochemical industry today are:
(1) High feedstock and energy costs - their impact on demand.
(2) Changing dynamics in manufacturing competitiveness.
(3) Increasing project cost & longer lead times.

Global supply and demand trends for ethylene and ethylene derivatives

(1)Global demand for ethylene derivatives

Global demand for ethylene derivatives in 2002 (ethylene conversion) came to 94.9 million tons, a 4.7% increase from the previous year. Global demand in 2003 came to 98.3 million tons, which was an increase of 3.5% from the previous year. Despite modest drops in demand in North America and Korea, overall demand was solid and there was a particularly strong rise in demand from China (14.4% increase from the previous year).

Overall global demand for ethylene derivatives is expected to grow at an annual rate of 4.9% between 2002 and 2008 with overall demand in 2008 coming to 126.8 million tons, which would be an increase of 31.9 million tons over the level for 2002, provided that the world economy enjoys steady growth from 2003.

The rate of demand growth will vary from region to region. The demand for ethylene derivatives in the Asian region is expected to grow at an annual rate of 6.7%. demand from China is expected to continue rising sharply. In fact, demand from China alone is expected to increase by 11.2 million tons during the period from 2002 to 2008. demand in other regions is expected to rise steadily during this period demand in North America is forecast to rise at an annul rate of 3.6%, while demand in Western Europe is expected to rise at a steady 2.2% annually.

Demand in Japan came to 5.5 million tons in 2002 and 5.6 million tons in 2003. Japanese demand for 2008 is expected to be around 5.4 million tons based on several assumptions such as a certain level of economic growth, expanded imports of ethylene and the likelihood that some users will be moving operations overseas.

TABLE 37

Global demand for ethylene derivatives (ethylene conversion)

(Unit: million tons)

	Global Total	Asian Total							Western Europe	North America	Middle East
			South Korea	Taiwan	China	ASEAN	India	Japan			
Demand 2002	94.9	33.7	3.9	2.6	13.5	4.5	2.7	5.5	21.8	24.1	2.2
2008	126.8	49.7	4.6	3.3	24.6	6.0	4.4	5.4	24.8	29.8	3.7
Increase 02-08	31.9	16.1	0.7	0.7	11.2	1.5	1.7	-0.1	3.0	5.7	1.5
Growth rate 02-08	4.9%	6.7%	2.7%	4.2%	10.6%	5.4%	8.5%	-0.3%	2.2%	3.6%	9.2%

TABLE38

Changes in global demand for ethylene derivatives (ethylene conversion)

(Unit: million tons)

	2002	2003	2004	2005	2006	2007	2008	Average growth rate 02-08
Demand volume	94.9	98.3	103.4	108.7	114.5	120.8	126.8	—
On year growth rate	4.7%	3.5%	5.1%	5.2%	5.3%	5.5%	5.0%	4.9%

(2)Global production capacity of ethylene derivatives

The global production capacity of ethylene derivatives came to 112.6 million tons as of the end of 2002. Global production at the end of 2008 is expected to be 131.4 million tons, based on the current plans for raising production capacity. This would mark an increase of 18.8 million tons over the level for 2002, which is equivalent to an average annual increase of 2.6%.

Global production capacity of ethylene (monomer), the raw material, is expected to rise from 109.3 million tons as of the end of 2002 to 128 million tons in 2008 for an average annual increase of 2.7%. Huge gains in production capacity are expected for China and the Middle East.

TABLE 39

Global production capacity of ethylene derivatives (ethylene conversion)

(Unit: million tons)

	Global Total	Asian Total							Western Europe	North America	Middle East
			South Korea	Taiwan	China	ASEAN	India	Japan			
Capacity 2002	112.6	33.7	5.7	3.2	6.9	7.0	3.0	8.0	25.1	31.9	7.8
2008	131.4	40.3	5.9	3.8	11.7	7.7	3.4	7.8	26.6	33.0	14.6
Increase 02-08	18.8	6.6	0.3	0.6	4.8	0.7	0.5	-0.2	1.5	1.1	6.8
Growth rate 02-08	2.6%	3.0%	0.7%	2.9%	9.2%	3.1%	2.4%	-0.3%	0.9%	0.6%	11.1%

Note: The figures in these forecasts are based solely on very reliable plans for increases in new production equipment, and so it is very likely that the actual growth in production capacity will top these estimates.

TABLE 40

Global production capacity of ethylene (monomer)

Unit: million tons)

	Global Total	Asian Total							Western Europe	North America	Middle East
			South Korea	Taiwan	China	ASEAN	India	Japan			
Capacity 2002	109.3	29.6	5.5	2.5	5.5	6.0	2.9	7.2	23.4	33.3	8.7
2008	128.0	37.6	5.8	4.1	9.9	6.3	4.2	7.4	24.9	33.0	15.8
Increase 02-08	18.7	8.0	0.3	1.6	4.4	0.3	1.3	0.2	1.5	-0.3	7.0
Growth rate 02-08	2.7%	4.1%	0.8%	8.6%	10.3%	3.0%	6.1%	0.4%	1.1%	-0.1%	10.3%

Note: The figures in these forecasts are based solely on very reliable plans for increases in newproduction equipment, and so it is very likely that the actual growth in production capacity will top these estimates.

(3) Global supply and demand balance for ethylene derivatives

Based on current and very reliable information regarding plans for new and expanded production, the growth in supply in China will not keep pace with growing demand. As such, the negative demand-supply balance (excess of imports over exports) for China is expected to expand to 14.4 million tons in 2008. The import position of ethylene derivatives for all of Asia is expected to expand to 15.1 million tons in 2008.

On the other hand, the excess of exports over imports for the Middle East is expected to increase to 10.1 million tons in 2008. For products such as LDPE, HDPE and EG there will likely be a sharp rise in the excess of imports over exports for Asia, while at the same time there will be a sharp rise in excess of exports over imports for the Middle East. In other words, there will be an increase in the flow of these products from the Middle East to Asia.

TABLE 41

Global supply and demand balance for ethylene derivatives (ethylene conversion)

(Unit: million tons)

		Global Total	Asian Total							Western Europe	North America	Middle East
				South Korea	Taiwan	China	ASEAN	India	Japan			
2002	Production	95.4	28.8	5.6	2.7	6.0	5.1	2.4	7.0	21.2	27.9	7.5
	Demand	94.9	33.7	3.9	2.6	13.5	4.5	2.7	5.5	21.8	24.1	2.2
	Balance	0.4	-4.9	1.7	0.1	-7.4	0.6	-0.3	1.5	-0.6	3.8	5.3
2008	Production	116.9	34.7	5.2	3.1	10.2	6.3	3.0	6.9	22.7	31.6	13.8
	Demand	126.8	49.7	4.6	3.3	24.6	6.0	4.4	5.4	24.8	29.8	3.7
	Balance	-9.9	-15.1	0.6	-0.2	-14.4	0.2	-1.3	1.5	-2.1	1.8	10.1

Note: The forecasts for production and demand in each country are based on current and very reliable plans for increases in new production equipment and so there may not be perfect agreement between the global totals for production capacity and demand. (Production capacity forecasts were conservative and so supply is less than demand.)

TABLE 42 Supply and Demand balance for ethylene derivatives by product for Asia

(Unit: million tons)

		Total	LDPE	HDPE	SM	PVC	EG
2002	Capacity	33.7	10.2	9.2	2.8	5.7	3.4
	Production	28.8	8.7	7.9	2.7	5.2	3.0
	Demand	33.7	9.9	8.5	3.0	5.2	5.3
	Balance	-4.9	-1.2	-0.6	-0.3	-0.0	-2.3
2008	Capacity	40.3	12.0	10.7	3.9	6.9	4.3
	Production	34.7	10.5	9.3	3.5	6.5	3.8
	Demand	49.7	15.0	12.3	4.3	7.6	8.7
	Balance	-15.1	-4.5	-3.0	-0.8	-1.1	-4.9

TABLE 43

Supply and Demand balance for ethylene derivatives by product for Middle East

(Unit: million tons)

		Total	LDPE	HDPE	SM	PVC	EG
2002	Capacity	7.8	2.7	2.3	0.3	0.3	1.7
	Production	7.5	2.5	2.2	0.3	0.3	1.6
	Demand	2.2	0.7	0.6	0.1	0.3	0.1
	Balance	5.3	1.8	1.6	0.2	0.0	1.5
2008	Capacity	14.6	5.0	4.3	0.6	0.5	3.2
	Production	13.8	4.9	3.8	0.5	0.5	3.0
	Demand	3.7	1.0	0.9	0.1	0.4	0.4
	Balance	10.1	3.2	2.8	0.4	0.1	2.6

TABLE 44

Supply and Demand balance for ethylene derivatives by product for Asia + Middle East

(Unit: million tons)

		Total	LDPE	HDPE	SM	PVC	EG
2002	Balance	0.4	0.6	1.0	-0.1	-0.0	-0.8
2008	Balance	-5.0	-1.3	-0.2	-0.7	-1.1	-2.3

2. Global supply and demand for propylene derivatives and propylene

(1) Global demand for propylene derivatives

The global demand for propylene derivatives (propylene conversion) is expected to rise at an average annual rate of 5.4% from the 2002 level of 56.2 million tons to 77.1 million tons in 2008, topping the rise in demand for ethylene derivatives. The average annual rate of demand growth for this period is xpected to be 6.1% in Asia, 5.4% in North America and 3.3% in Western Europe. demand from China alone is expected to rise at a brisk 8.7%.

TABLE 45

Table Global demand for propylene derivatives (propylene conversion)

(Unit: million tons)

	Global Total	Asian Total							Western Europe	North America	Middle East
			South Korea	Taiwan	China	ASEAN	India	Japan			
Demand 2002	56.2	20.4	1.7	1.0	8.3	2.7	1.6	4.6	14.4	13.9	1.3
2008	77.1	29.0	2.1	1.3	13.7	3.4	2.8	5.3	17.5	19.1	2.2
Increase 02-08	20.9	8.7	0.3	0.3	5.4	0.7	1.2	0.7	3.1	5.2	0.9
Growth rate 02-08	5.4%	6.1%	2.8%	4.1%	8.7%	5.3%	9.7%	2.4%	3.3%	5.4%	9.1%

(2) Global production capacity of propylene derivatives

Global production capacity of propylene derivatives came to 62.8 million tons as of the end of 2002 (propylene conversion). Based on the current plans for production increases, this level is expected to reach 76.8 million tons by the end of 2008, which would be an increase of 14 million tons over the 2002 level and represents an average annual growth rate of 3.4%.

The average annual production growth rate during the 2002-2008 period is expected to be 4.1% in Asia, 3.5% in North America, 0.3% in Western Europe and 14% in the Middle East.

Production capacity of propylene, the raw material, is expected to rise from the 2002 level of 67.4 million tons to 82.5 million tons in 2008, which would be an average annual increase of 3.4%.

TABLE 46

Global production capacity of propylene derivatives (propylene conversion)

(Unit: million tons)

	Global Total	Asian Total							Western Europe	North America	Middle East
			South Korea	Taiwan	China	ASEAN	India	Japan			
Capacity 2002	62.8	21.4	3.2	1.4	6.0	4.0	1.5	5.2	16.4	16.7	1.5
2008	76.8	27.2	3.5	2.2	10.2	4.2	1.5	5.6	16.7	20.5	3.4
Increase 02-08	14.0	5.8	0.3	0.7	4.2	0.2	0.0	0.4	0.3	3.9	1.8
Growth rate 02-08	3.4%	4.1%	1.3%	6.8%	9.2%	1.9%	0.0%	1.3%	0.3%	3.5%	14.0%

Note: The figures in these forecasts are based solely on very reliable plans for increases in new production equipment and so it is very likely that the actual growth in production capacity will top these estimates.

TABLE 47

Global production capacity of propylene(monomer)

(Unit: million tons)

	Global Total	Asian Total	South Korea	Taiwan	China	ASEAN	India	Japan	Western Europe	North America	Middle East
Capacity 2002	67.4	20.7	3.7	1.3	5.2	3.5	1.5	5.5	16.6	20.4	2.0
2008	82.5	26.4	3.9	2.6	8.5	4.0	1.5	5.9	17.5	25.0	4.1
Increase 02-08	15.1	5.7	0.2	1.3	3.3	0.5	0.0	0.4	1.0	4.6	2.0
Growth rate 02-08	3.4%	4.1%	0.9%	12.1%	8.5%	2.0%	0.0%	1.2%	0.9%	3.5%	12.3%

Note: The figures in these forecasts are based solely on very reliable plans for increases in new roduction equipment, and so it is very likely that the actual growth in production capacity will top these estimates.

(3) Supply and demand balance for propylene derivatives and propylene

The growth in supply of propylene derivative products in China is not keeping pace with the growth in demand. As such, the negative demand - supply balance (excess imports over exports) for propylene derivative products in China is expected to increase to 5.4 million tons in 2008.

The import position of propylene derivatives for the Asian region is expected to expand to 4.6 million tons.

TABLE 48

Global supply and demand balance for propylene derivatives and propylene (propylene conversion)

(Unit: million tons)

		Global Total	Asian Total	South Korea	Taiwan	China	ASEAN	India	Japan	Western Europe	North America	Middle East
2002	Production	55.9	19.3	3.0	1.2	5.6	3.2	1.4	5.0	14.7	15.4	1.4
	Demand	56.2	20.4	1.7	1.0	8.3	2.7	1.6	4.6	14.4	13.9	1.3
	Balance	-0.3	-1.0	1.3	0.2	-2.8	0.5	-0.2	0.4	0.3	1.5	0.1
2008	Production	71.3	24.4	3.3	1.7	8.3	4.1	1.4	5.6	16.1	19.6	3.0
	Demand	77.1	29.0	2.1	1.3	13.7	3.4	2.8	5.3	17.5	19.1	2.2
	Balance	-5.8	-4.6	1.2	0.3	-5.4	0.7	-1.4	0.4	-1.4	0.5	0.8

Note: The forecasts for production and demand in each country are based on current and very reliable plans for increases in new production equipment and so there may not be perfect agreement between

The global totals for production capacity and demand. (Production capacity forecasts were conservative and so supply is less than demand.)

TABLE 49

Global supply and demand balance for propylene (monomer)

(Unit: million tons)

		Global Total	Asian Total							Western Europe	North America	Middle East
				South Korea	Taiwan	China	ASEAN	India	Japan			
2002	Production	57.5	20.3	3.7	1.4	5.3	3.4	1.3	5.3	14.3	15.8	1.5
	Demand	57.9	20.7	3.6	1.7	5.6	3.6	1.4	5.0	14.7	15.5	1.4
	Balance	-0.4	-0.4	0.1	-0.2	-0.3	-0.2	-0.2	0.3	-0.4	0.3	0.2
2008	Production	72.1	25.3	4.0	2.3	7.8	3.8	1.4	5.9	15.8	19.9	3.2
	Demand	73.0	25.7	3.8	2.0	8.3	4.4	1.4	5.6	16.1	19.6	3.0
	Balance	-1.0	-0.4	0.2	0.3	-0.5	-0.6	0.0	0.3	-0.3	0.3	0.2

Note: The forecasts for production and demand in each country are based on current and very reliable

plans for increases in new production equipment and so there may not be perfect agreement between the global totals for production capacity and demand (Production capacity forecasts were conservative and so supply is less than demand)

2. Global supply and demand for aromatics and aromatic derivatives

(1) Global supply and demand for aromatics

Global demand for benzene, toluene and xylene in 2002 came to 33.6 million tons (6.7% increases on-Year), 15 million tons (2.1% increase on-year) and 23.3 million tons (3.4% increase on-year), respectively .In terms of average annual growth rates for demand during the 2002–2008 period, demand for benzene is expected to increase 3.8%, toluene 4.1% and xylene 6.3%. Global production capacity of the 2002–2008 period is expected to increase at an annual average rate of 1.6% for benzene, 4.5% for toluene and 2.6% for xylene. Excess demand for toluene and xylene in the Asian region is expected to keep growing.

TABLE 50

Global demand, production capacity and demand - supply balance for benzene Global benzene demand

(Unit: million tons)

	Global Total	Asian Total	South Korea	Taiwan	China	ASEAN	India	Japan	Western Europe	North America	Middle East
Demand 2002	33.6	12.6	2.5	1.3	2.3	1.8	0.6	4.1	7.4	9.1	1.2
2008	42.1	16.4	3.0	1.7	3.8	2.4	1.0	4.6	8.4	10.3	2.8
Increase 02-08	8.5	3.8	0.4	0.5	1.4	0.6	0.4	0.5	0.9	1.2	1.7
Growth rate 02-08	3.8%	4.5%	2.7%	5.2%	8.2%	8.5%	9.0%	1.8%	1.9%	2.0%	16.0%

TABLE 51

Global benzene production capacity

(Unit: million tons, %)

	Global Total	Asian Total	South Korea	Taiwan	China	ASEAN	India	Japan	Western Europe	North America	Middle East
Capacity 2002	43.6	14.2	2.7	1.1	2.4	1.8	0.8	5.4	9.3	11.0	1.9
2008	48.1	16.7	3.2	1.1	4.1	2.2	0.8	5.4	9.6	10.8	3.5
Increase 02-08	4.5	2.6	0.5	0.0	1.7	0.4	0.0	0.0	0.2	-0.3	1.6
Growth rate 02-08	1.6%	2.8%	2.9%	0.5%	9.3%	5.9%	0.0%	0.0%	0.4%	-0.4%	10.3%

Note: The figures in these forecasts are based solely on very reliable plans for increases in new roduction equipment, and so it is very likely that the actual growth in production capacity will top these estimates.

TABLE 52

Global benzene demand- supply balance

(Unit: million tons)

	Asian Total							Western Europe	North America	Middle East
		South Korea	Taiwan	China	ASEAN	India	Japan			
2002	-0.5	0.3	-0.4	-0.2	-0.3	0.0	0.2	-0.0	-1.2	0.0
2008	-0.7	0.4	-0.7	0.1	-0.4	-0.3	0.1	0.0	-0.8	-0.4

Note: The forecasts for production and demand in each country are based on current and very reliable plans for increases in new production equipment and so there may not be perfect agreement between the global totals for production capacity and demand.

(2) Global supply and demand for paraxylene and PTA

The global demand for paraxylene in 2002 came to 18.7 million tons (9.2% increase on year) and the global demand for PTA came to 25.4 million tons (9.1% increase on year). Demand from the Asian region accounted for roughly 70% of the total.

This high rate of growth in global demand is expected to continue. For the 2002–2008 period global demand for paraxylene is expected to grow at an average annual rate of 6.8% and demand for PTA is expected to increase at an average annual rate of 8.3%.

Excess demand for paraxylene and PTA in the Asian region is expected to keep expanding.

4. Movements of the petrochemical industries in major countries and regions around the world

(1)Asia

A high level of economic growth is expected for this region over the mid-term. In particular,China's GDP is expected to grow at a high rate of 8% thanks to solid domestic demand .As a result,China's demand for petrochemical products is expected to expand. Considering the plans for large-scale increases in production facilities, Chinese imports are expected to increase on the back of robust demand.

1) Japan

Domestic demand for petrochemical products is expected to decrease slightly as many users of such products move their operations overseas, while at the same time imports of such products from other Asian countries continue to expand.

2) South Korea

South Korea was targeting an economic growth rate of 7% in 2003, but a downward revision was unavoidable due to the drop in the global economy. A growth rate of 5.3% is expected for 2004. Korea's export ratio for petrochemical products is expected to be roughly halved from the current 45% to between 20%–30% in 2005. The total amount of petrochemical products exported in 2003 came to 9.4 billion dollars. 49% of these exports, worth roughly 4.6 billion dollars, went to China (including Hong Kong). These exports consist mainly of general purpose products. However, there has been an aggressive push to start building bases in China for South Korea's LG Chemical, Kolon Industries and other corporations, and so a gradual reduction in exports is expected.

3) Taiwan

Taiwan likely saw 3.2% economic growth in 2003. An economic growth rate of around 4.2% is projected for 2004 due to improving private sector demand and public investment that is aiming for 5% economicgrowth in Taiwan's "Challenge 2008" comprehensive 6-year national development plan. Formosa Plastics Group (FPG) has launched the third phase of its capacity expansion at its facility in Mailiao, Yunlin County totaling 3.6 billion dollars. Plans are to complete naphtha cracker facilities with annual production of 1.2 million tons by 2005. These facilities will have annual ethylene production capacity of 2.8 million tons, making this the largest petrochemical base in Asia.

4) China

Economic growth in China in 2003 was slowed somewhat by the SARS outbreak, but still managed to beat the government's target of 7% and recorded its highest rate of growth since 1997. This trend is expected to continue up until around the time of the 2008 Beijing Olympics and the 2010 Shanghai Expo. New large-scale ethylene production facilities expected to be up and running between 2005–2006 includethe Yangzi BASF (annual ethylene production of 600,000 tons), Shanghai SECCO (900,000 tons) and SHELL Shanghai (800,000 tons). In addition to these projects, EXXON MOBIL has two projects planned for Fujian and Guangzhou, and Shanghai SECCO will build in Shanghai by 2010 a 10 million ton refinery and a one million ton ethylene complex. There are also plans for expanding existing ethylene complexes,such as those of Maoming petrochemical Company and Qilu petrochemical Company, by a total of one million tons by 2007.

(2)Western Europe

Overall economic growth for the 15 EU countries is expected to have come to 0.5% in 2003. GDP for the15 EU countries is expected to be around 2% this fiscal year thanks to a recovery in the global economy centered on a stronger U.S. economy, which should be accompanied by a mild recovery in external demand. The petrochemical industry has been undergoing a process of restructuring that started in the 1990's.

However, there have been no major developments in this regard since SABIC bought the petrochemical division of Holland's DSM in 2002. Currently there are no plans to build new large-scale ethylene production faculties in Europe. However,there are plans to increase overall "de-bottlenecking" capacity to 1.5 million tons between 2002 and 2008 as the various companies try to keep pace with rising demand

(3) USA

The U.S. economy continued to improve in 2003, highlighted by a 3.1% growth in GDP. GDP is forecast to grow 4% in 2004, 3% in 2005 and enjoy average annual growth of 2.7% until 2008 The U.S. petrochemical industry struggled somewhat during the first half of 2003 due to a jump in prices for raw materials such as natural gas, but a recovery was seen in the second half. Profits have also been recovering thanks to the strong demand seen toward the end of the year. Overall profitability in 2004 will still be heavily influenced by higher energy prices and instability in the Middle East. On the bright side, the market appears to be getting tighter due to dropping capacity and so the industry will likely be able to charge higher prices.

(4) Middle East

The petrochemical industry in the Middle East is striving to become much less dependent on oil production, make more effective use of resources and diversify revenue sources. To this end, governments in the Middle East have been working to introduce capital, technological skills and business management expertise from foreign firms.

Early in 2001 three large-scale ethylene plants that have a total capacity of 2.30 million tons began operating in Saudi Arabia. There are plans in place to build new plants in Abu Dhabi, Qatar and Iran. Plans to build large petrochemical plants between 2005 and 2010 are also being considered.

3.3.2 Indian scenario

Petrochemicals industry is crucial member of the Indian economy since it caters to the needs of major industries like power, telecom, cables, plastics, textiles etc. The report provides insight into various aspects of the Indian industry along with some relevant details about global industry. Low per capita consumption offers good potential to players planning to foray into the Indian petrochemical industry. For instance, the per capita consumption of polymers, synthetic fibres, synthetic rubber and plastics in India is very low - at 2.5 Kilograms, 1.6 Kilograms, 0.2 Kilograms, 3.0 Kilograms respectively (whereas the global consumption is 17.3 Kilograms 3.9 Kilograms, 2.1 Kilograms, 17.0 Kilograms respectively). And to top this, the growth rate of the Indian industry during last four years has been around 15 percent whereas it was 4 percent in the global industry during the above period. This substantiates the huge potential that Indian petrochemicals market offers for future entrants.

The Indian petrochemicals industry is small by international standards, with ethylene capacity accounting for only 2.2% of global. The Indian polymers industry is also small, accounting for only around 2.5% of the global production. India ranked 13th in the world as on January 1, 2005 in terms of ethylene capacity. The capacity had registered increases during early 2000following the commissioning of crackers of Haldia Petrochemicals Limited (HPL) and Indian Petrochemicals Corporation Limited (IPCL).

TABLE 53

World Ethylene Capacity: India's Rank and Share

Country	Nameplate Ethylene Capacity		Rank
	'000 tonnes per annum	%	
United States	28.323.00	26.9	1
Japan	7.507.00	6.4	2
Saudi Arabia	5.845.00	5.3	3
Canada	5.407.00	4.9	4
Germany	5.516.00	4.9	5
South Korea	5.450.00	4.6	6
China	5.338.00	4.2	7
The Netherlands	3.915.00	3.4	8
France	3.373.00	3.1	9
Russia	3.670.00	3.1	10
Brazil	2.835.00	2.6	11
United Kingdom	2.855.00	2.6	12
India	2.463.00	2.2	13

Capacity as on January 1, 2005

High-Growth Industry

Although, by global standards, Indian polymers (the key petrochemical product) demand is small, it is amongst the fastest growing countries in the world. In the past, because of higher GDP growth than the world GDP growth and higher presence of the traditional materials (therefore, more potential for substitution by polymers), India has shown a significantly higher growth rate in polymer consumption in the last five years. The growth rate in Indian polymer consumption is even higher than China and other key Asian Economies.

TABLE 54

Polymer Consumption Growth Rates 1990 - 2003:India versus World

Polymer	India	World	Ratio
LDPE	0.6	1.3	0.5
LLDPE	32.1	8.9	3.6
HDPE	12.0	5.6	2.2
PP	17.0	8.0	2.1
PVC	9.1	3.5	2.6
PS	11.1	2.9	3.8

Players

The Indian basic petrochemicals manufacturers are integrated from basic petrochemical to polymers, manmade fibres, fibre intermediates and downstream petrochemical production. Non integrated players are present in production of polyvinyl chloride, polystyrene, manmade fibres and products such as phenol, linear alkyl benzene, phthalic anhydride etc.

In India, refinery petrochemical integration is limited and historically, the public sector oil refining companies have sold their petroleum feedstocks to other companies which have been adding value and converting feedstock to useful petrochemical products. Further, a significant portion of feedstock has remained unextracted and has been sold alongwith other fuel products. However, RIL's Jamnagar refinery extracts significant petrochemicals from its petroleum products.

The Indian polymers market is dominated by local players, with the foreign stakeholding in Indian polymer plants restricted to Haldia Petrochemicals Limited (HPL), BASF Styrenics India Private Limited (BSIL), and LG Polymers Limited. HPL is a joint sector company in which Chatterjee Petrochem, Mauritius, has a 43% stake along with the West Bengal Industrial Development Corporation. As for BSIL, it is a 100% subsidiary of BASF AG, a multinational chemicals company and the world's second largest PS producer, while LG Polymers is a wholly-owned subsidiary of the LG Group, South Korea.

The production of polyethylene and polypropylene in India is accounted for almost in their entirety by companies with integrated petrochemical complexes. Such companies are Reliance Industries Limited (RIL), Indian Petrochemicals Corporation Limited (IPCL), Haldia Petrochemicals Limited (HPL), and Gas Authority of India Limited (GAIL).

Dominant Position of RIL: RIL, along with IPCL (a former state-owned company subsequently acquired by RIL), has a share of over 60% of the Indian polymer market for all forms of polyethylene (PE): LDPE, LLDPE, HDPE, PP and PVC. While RIL has a large petrochemical complex, which is also the largest naphtha cracker in Asia, IPCL relies on three small to medium-sized petrochemicalcomplexes based largely on natural gas (two medium-sized crackers using natural gas and one small-sized cracker using naphtha). RIL with a large share of the Indian polyester market also has a significant position in the global market for PTA and paraxylene (raw material for PTA). In line with the other segments of the polyester chain, RIL's facilities are world scale, while the other plants are smaller. While IPCL has MEG capacities at two locations with one being gas based and the other naphtha based, RIL has a large MEG facility at naphtha based Hazira petrochemical complex. MEG, the other polyester intermediate is dominated by RIL (including IPCL) who has around 90% of capacity share. The other MEG capacities are based on agricultural feedstock and are owned by India Glycols and SM Dyechem. Reliance Industries Limited owns more than 95% of the Indian paraxylene capacity.

RIL produces paraxylene through its two plants located at Hazira and Jamnagar. While the Petrochemicalplant at Hazira is an ethylene cracker based on naphtha and produces around 250,000 tpa of paraxylene, the Jamnagar plant is a reformate based aromatics plant producing 1.385 MMT of paraxylene and uses 2.8 MMT of reformate from the adjoining refinery owned by it.

As for GAIL, it operates a medium-sized natural gas based petrochemicals complex at Auraiya in Uttar Pradesh, while HPL operates a medium-sized petrochemical complex based on naphtha in Haldia located in Eastern India . To counter RIL's dominating status, GAIL and HPL have signed a strategic alliance to market their products jointly. Under the alliance, which was signed on December 31, 2002 two companies plan to increase synergy in marketing operations of the petrochemical Products through: Long-Term Polypropylene Offtake Agreement, Product Swap Agreement which is expected to save logistic costs and improve the delivery mechanism with associated benefits, and the Memorandum of Understanding identifying potential areas of Cooperation: Grade Optimisation, Joint Procurement of Chemicals, Sale of Butene-1 by GAIL to HPL, IT and Knowledge sharing in the new Polymer Product development, Joint Venture in setting of Styrene Butadiene Rubber plant, sale of propylene, solvents, etc.

Among the PVC players not possessing captive sources of ethylene, Finolex Industries Limited, a relatively new player in the business, is the market leader. The other players are primarily chlor-alkali producers (although they buy ethylene dichloride or vinyl chloride monomer from external sources for PVC production) and have old depreciated plants.

The PS industry in India is dominated by Supreme Petrochemicals Limited (SPL) which has a capacity share of around 55%. The other major players in the industry are LG Polymers (capacity share of 16%) and BASF Styrenics India Limited (BSIL) (24%). With India having no major capacity (under operation) for manufacture of styrene, all polystyrene manufacturers in the country import styrene from the international markets. The predominant sources of styrene for India are South Korea and Saudi Arabia, with shares of 50% and 20%, respectively, in India's styrene imports. Over 90% of Indian imports of styrene are made from nearby countries.

However, the two foreign companies import styrene from their parent companies. LG Polymers sources styrene mostly from its parent company, LG Chem Investment Limited, South Korea (which is surplus in styrene). Further, BASF AG the parent company of BSIL, is the second largest world-wide producer of styrene (as also polystyrene).

The fast rising production of polyester has provided for world scale plants in intermediates industry to be built. Setting up of the indigenous facilities for production of raw materials for polyester received a boost with commissioning of Patalganga Complex by RIL and further plant commissioning by RIL at Hazira and Jamnagar. Till 2000, the PTA/DMT capacity was lower than the local demand and the country was a net importer. However, with the commissioning of MCC PTA India Corp. Pvt. Limited's (a subsidiary of Mitsubishi Chemicals Company, Japan) PTA plant, an over-capacity scenario had ushered in, in the Indian industry. BRPL, RIL and IPCL's operations are integrated with the manufacture of paraxylene. BRPL and RIL have their own refineries located adjacent to their petrochemical plants.

Till the commissioning of Jamnagar aromatics plant, India was importing paraxylene significantly from mainly South East Asia and USA. However, with the commissioning of RIL's unit in 1999, the country has become a net exporter.

In downstream chemicals other than polymers and fibre intermediates, different companies have dominating presence depending on the product. In methanol, fertiliser companies dominate the market. In case of phenol and its derivatives, Hindustan Organic Chemicals Limited (HOCL) and Herdillia

Schenectady Limited account for a major share in domestic production. While India is deficit in phenol, it has surplus in its key raw materialbenzene. In linear alkyl benzene, the basic petrochemical companies have a strong presence alongwith some standalone linear alkyl benzene (Tamil Nadu PetroProducts Limited) and detergent producers (Nirma Limited). Indian Oil Corporation Limited (IOCL) is also implementing a linear alkyl benzene plant in order to add value to its production of benzene and n-paraffins that are being produced at its refinery.

The following tables and figures give a glimpse of the current petrochemical capacities in the country.

TABLE 55
Major Indian Ethylene Capacities

April1, 2004

Plant	Ethylene Capacity	Feedstock Mix	Supplier Arrangement
IPCL, Baroda	130,000	Naphtha	Purchased from IOC/group companies as also imported
IPCL, Nagothane	400,000	Ethane Propane mix	Purchased from ONGC
IPCL, Gandhar	300,000	Ethane Propane mix	Natural gas purchased from GAIL and separated in-house and return stream sold back. The gas is received from both adjoining Gandhar field as also Hazira
RIL, Hazira	750,000	Naphtha	Purchased from group refinery also located in Gujarat
Total RIL + IPCL	1580,000		
GAIL, Auraiya	300,000	Ethane Propane mix	Separated from in-house natural gas (purchased in bulk from ONGC)
HPL, Haldia	520,000	Naphtha	The company sources naphtha from adjoining Indian Oil Corporation Limited's Haldia refinery and imports in equal share (i.e., 50% each)

TABLE 56

Indian PTA/DMT Capacities

Company	*Product*	Location	Capacity	Remarks
RIL	PTA	Hazira, Patalganga	1,280,000	Largest plants in the country; Paraxylene sourced from Jamnagar plant adjoining to group's 27 MMTPA Jamnagar refinery
IPCL	DMT	Baroda.	30,000	The oldest DMT plant (fully depreciated) in the country. Integrated with paraxylene production.
Bombay Dyeing	DMT	Patalganga	165,000	Largest DMT plant. Low cost facility as second hand equipment.
BRPL	DMT	Bongaigaon	45,000	Integrated with production of paraxylene as also polyester fibre
SVC Superchem	PTA	Mathura	120,000	Second hand equipment, facing difficulties in commissioning the plant successfully
MCC PTA India Limited	PTA	Haldia	425,000	New plant. The parent company is a leading Japanese chemicals company and has significant presence in chemicals and fibre intermediates business.
Garware Polyester Limited	DMT	Aurangabad	60,000	New DMT plant. The company is a consumer of DMT and manufactures polyester film, but its consumption is not enough to consume 60,000 tonnes of DMT.

TABLE 57

Indian MEG Capacities

	Location	Year of Commissioning	Capacity (tonnes per annum)	Feedstock for production of ethylene
India Glycols Limited	Nainital	1989	25,000	Molasses
IPCL	Baroda	1973	70,000	Naphtha
NOCIL	Thane	1978	10,000	Naphtha
RIL	Hazira	1992	356,000	Naphtha
SM Dyechem	Pune	1993	50,000	Molasses
IPCL, Gandhar	Gandhar	1999	100,000	Natural Gas

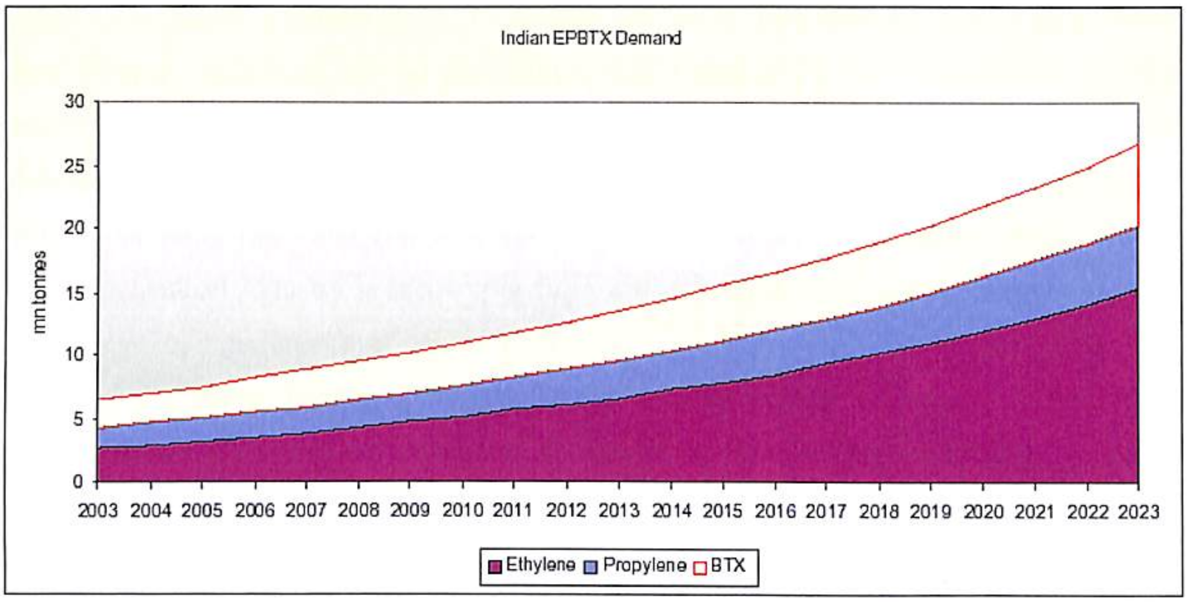
TABLE 58

Paraxylene Capacity of India's Aromatics Plants

Location	Company	Capacity	Supplier Arrangement
Baroda	IPCL	48,500	From pyrolysis gasoline and reformate from the adjoining Koyali Refinery
Hazira	RIL	250,000	From pyrolysis gasoline produced in the cracker
Bongaigaon	BRPL	29,000	From its own refinery
Jamnagar	RIL	1,335,000	Through its adjoining refinery

FIGURE 19

Cyclicality in Global Petrochemical Markets and its Impact on Indian Petrochemical Producers



Globally, the petrochemicals industry exhibits significant cyclicality. This cyclicality is caused by economic cycles and the tendency to attract over-investment during the high profitability scenario which, because of the long gestation period and capacity additions in lumps, subsequently creates an oversupply position causing the margins to decline significantly.

Cyclicality in Petrochemical Industry

Till 1993, the Indian petrochemicals industry was insulated against global cycles by high tariffs. But post-1993, the Indian industry has been exposed to global trends through the lowering of tariff barriers. Consequently, Indian petrochemicals manufacturers now find their profitability subject to the same cyclicality as their global counterparts.

Current Upturn in the Petrochemical Cycle

Globally, the demand for plastics has correlated well with the world gross domestic product (GDP).The growth in the demand for commodity plastics annualised over the period 1993-1997 was around 6.9%. The highest growth rate was recorded by linear low density poly-ethylene, or LLDPE (the newest commodity plastic). Polypropylene (PP) showed the highest volume growth with the increasing use of cost-effective new technologies (patented in the early 1980s). The growth rate, however, showed a significant slowdown during 1998 following the slowdown in the Asian economic growth. The polymer industry reported high growth rates again during 1999 and 2000. However, economic slowdown in the US, and consequently, worldwide, resulted in the demand for polymers growing at a slow pace in 2001.

The high profitability scenario in 1995-96 had led many investors to initiate new Petrochemical projects. Further, faced with low oil prices prevailing during 1998, the economies of the Middle East (critically dependent on oil exports) decided to invest significantly in exporting value-added petrochemicals. This coupled with slowdown in demand during 1998 and 2001 resulted in a significant decline in operating rates and consequently, margins in the global polymer markets. Currently, the global petrochemical industry is recovering from a trough, with most petrochemicals improving upon from their level of significant over-capacity.

With the world economy picking up and the pace of capacity expansions being slow, the operating rates of thepetrochemical companies have increased significantly resulting in increase in petrochemical margins. Thus, ethylene margins over naphtha have increased significantly from US$ 382 per tonne during January to March 2004 to US$ 460 per tonne during April to June 2004 and now to US$ 616 per tonne. In comparison to the previous year, thus, the ethylene margins over naphtha were significantly higher.

TABLE 59

International Margins (South East Asian) for Basic Petrochemicals over Naphtha

US$ per metric tonne	Oct – Dec 2003	Jan – Mar 2004	Apr – June 2004	July – Sep 2004	Oct – Dec 2004	Jan – Mar 2005
Ethylene Margins	229	382	460	530	653	616
Propylene Margins	265	327	389	450	565	515
Benzene Margins*	178	174	283	455	480	526

* *margins fob ex korea (a major benzene exporter)*

Feedstock

It is possible to produce petrochemicals from a variety of basic raw materials. The cost of raw material is the single largest cost in production of variety of petrochemicals. In India , following the global rends, petrochemicals are produced mainly from the petroleum feedstock. In past, and in some of the smaller plants, the agricultural feedstock mainly molasses are used for production of ethylene. The feedstock pattern varies from one country to another. In the US and the Middle East, ethane (derived from natural gas) is the prime feedstock for the production of commodity plastics, while in Japan, Western Europe and even in emerging Asia, the feedstock is predominantly naphtha. The use of a particular feedstock is governed by its availability in a region and the economics of obtaining it.

The Indian petrochemicals industry has an even share of naphtha and ethane-propane (gas) based plants. Among the crackers under operation, while naphtha accounts for around 56.5% of the ethylene capacity, ethane-propane (natural gas) accounts for the rest 43.5%. The following table presents the feedstock mix and supplier arrangement at various integrated petrochemical complexes in the country.

Till recently, the distribution of petroleum products and natural gas was controlled by the various ministries under the Government of India . The regulations regarding natural gas distribution had led to only State-owned companies possessing gas crackers. However, in mid-2002, the major State-owned petrochemicals company, namely IPCL, was acquired by RIL, a private sector petrochemicals company.

Natural Gas

The gas market in India is predominantly controlled by the State-owned companies. There are separate companies for gas production and distribution. Currently, gas pricing is based largely on the recommendations of T. L. Shankar Committee. The consumer price of gas is linked to the international price of a basket of internationally traded fuel oils. This linkage has been progressively increased in the proposed manner since the initiation of the current pricing mechanism. Till recently, the Government had fixed a price band of Rs. 2,150 per thousand cubic meters (tcm) as the lower limit and Rs. 2,850 per tcm as the ceiling. In May 2005, the Government approved increase in prices depending on sector in which gas is being consumed. While for power and fertilisers, the price is Rs 3200/tcm (thousand cubic metres), the gas prices for petrochemicals and other industries has been made market determined and the current level is around US$3.86/MMBtu.

Naphtha

Till 1999-2000, the Indian refining sector was dominated by the state-owned companies. However, with the commissioning of refinery by Reliance Petroleum Limited (RPL, now merged with RIL), significant production of petroleum products has started from the private sector also.

- Indian refining capacity, which was around 69 mmt as on April 1, 1999, has increased substantially to around 127 mmt as on March 31, 2005 on account of capacity additions by new as well as the existing players.

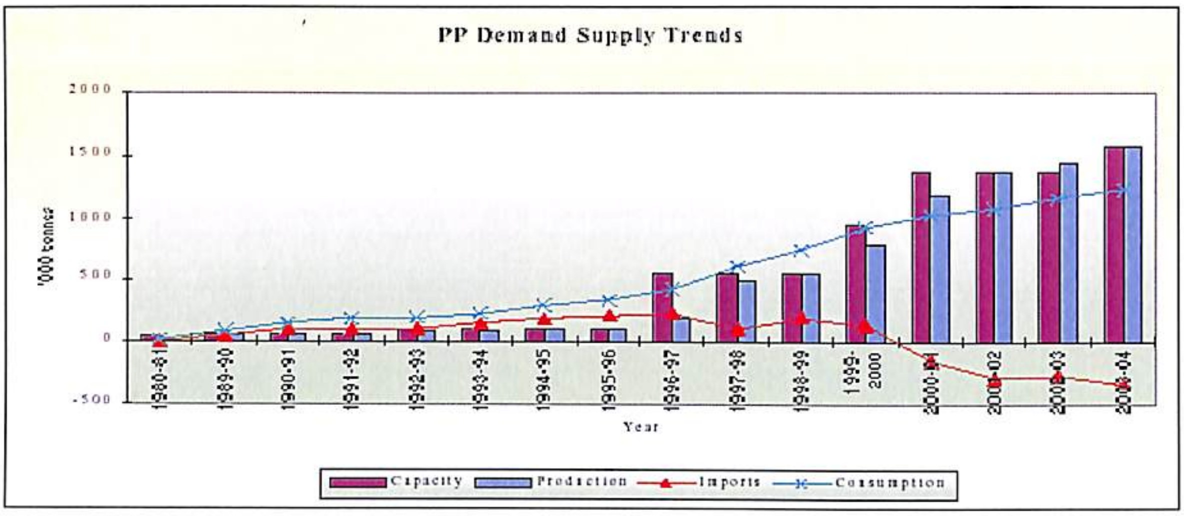
- In the past, till September 1997, the prices of naphtha were administered and controlled by government bodies, and varied with the calorific value of the feedstock. Naphtha was also supplied to fertiliser manufacturers at a subsidised rate. Since September 1997, in an effort to further decontrol naphtha, the domestic prices of naphtha were made the same for both fertiliser and non-fertiliser consumption. From April 1998, naphtha prices have been decontrolled and made market determined.
- The domestic prices of naphtha are based on landed costs (for fertiliser sector, they are linked to export parity prices) with a revision every fortnight. Accordingly, these prices have fluctuated in line with volatile international crude prices (which determine the international naphtha prices). Currently, the prices vary according to the location and the price is matched to the landed cost from the nearest port. Further, the fertiliser companies are charged on the basis of export parity prices (rather than import parity). Also, the fertiliser companies are charged only half of the marketing costs and margins till that point.
- Further, the companies sourcing naphtha from the local markets have to pay sales tax which was at 20% in some states (equivalent to Rs. 2,000 per ton at current prices) prior to implementation of VAT. The domestic prices closely follow the trends in landed costs and international prices. With rising naphtha prices in the international market, the domestic prices have also followed the trend and increased in line with international naphtha prices. Out of the three integrated petrochemical complexes (under operation) based on naphtha, the two owned by the Reliance group, consume naphtha supplied by group refinery located at Jamnagar. The refinery enjoys sales tax exemption on products sold in the State of Gujarat. Therefore, the two plants (also located in Gujarat) enjoy sales tax exemption on naphtha purchased by them

TRENDS IN PRODUCTION CONSUMPTION CAPACITY AND UTILIZATION

Comprising of polyethylenes and polypropylene, polyolefins constitute 70% of the total polymer capacity in India and 76% of total polymer production in India in 2004. As PE and PP play an important role in financial viability and profitability of a cracker, they play a crucial role in sustaining investments in crackers.

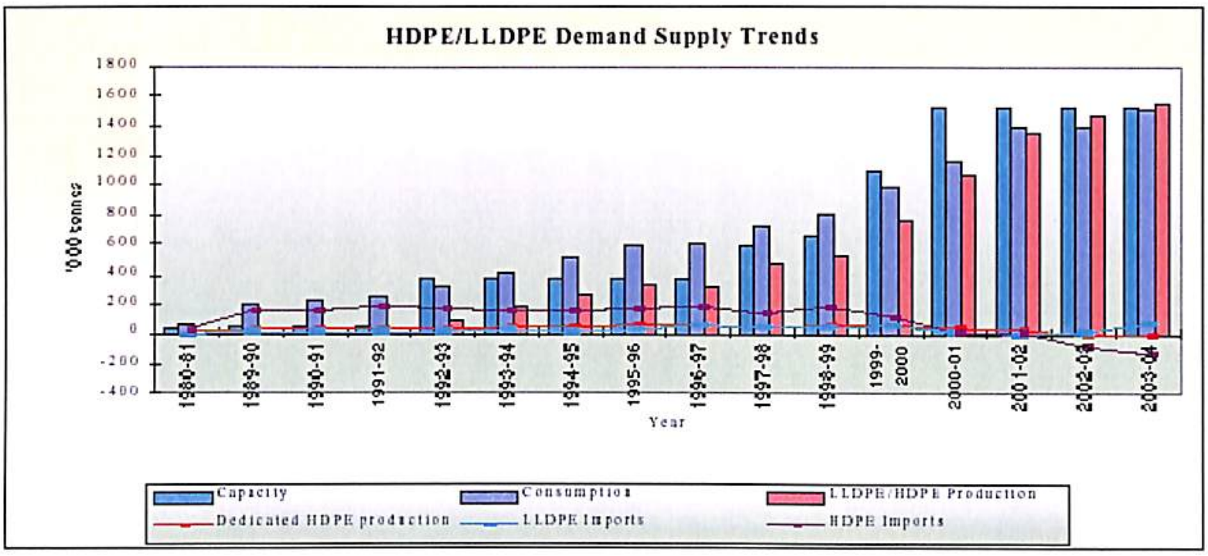
Capacity, production and imports of individual polyolefins during 2004 .Production of all the polyolefins individually are either less than the domestic production capacity or close to it with the exception of PP where production had exceeded the installed capacity with around 90 kT imports.

FIGURE 20



The year 2004 witnessed strong demand for polyolefins (PE and PP) – the 2 key cracker derivatives reflected in the high levels of capacity utilization. Industry experts predict that the firming up of demand for polyolefins is likely to continue till the current petrochemical upcycle reaches its peak in 2006-07. Table 2.2 compares the demand growth rates for the individual polyolefins till 2004 and projections for 2005 and 2006. As shown in the table, while LLDPE demand witnessed the fastest growth in 2003 and 2004, in 2005 and 2006 it is the growth in PP demand which is expected to grow fastest at the rate of 12% per annum. As depicted in table 2.2, after clocking a marginal growth of 1% in 2004, in 2005 demand for polyolefins are expected to grow at a rate of 9% in both the current year as well as in 2006. In 2005 and 2006, PP is likely to grow at the highest rate of 12% among all polyolefins followed by LLDPE with 10% growth in demand while LDPE demand is expected to register marginal growth of 3%.

FIGURE 12

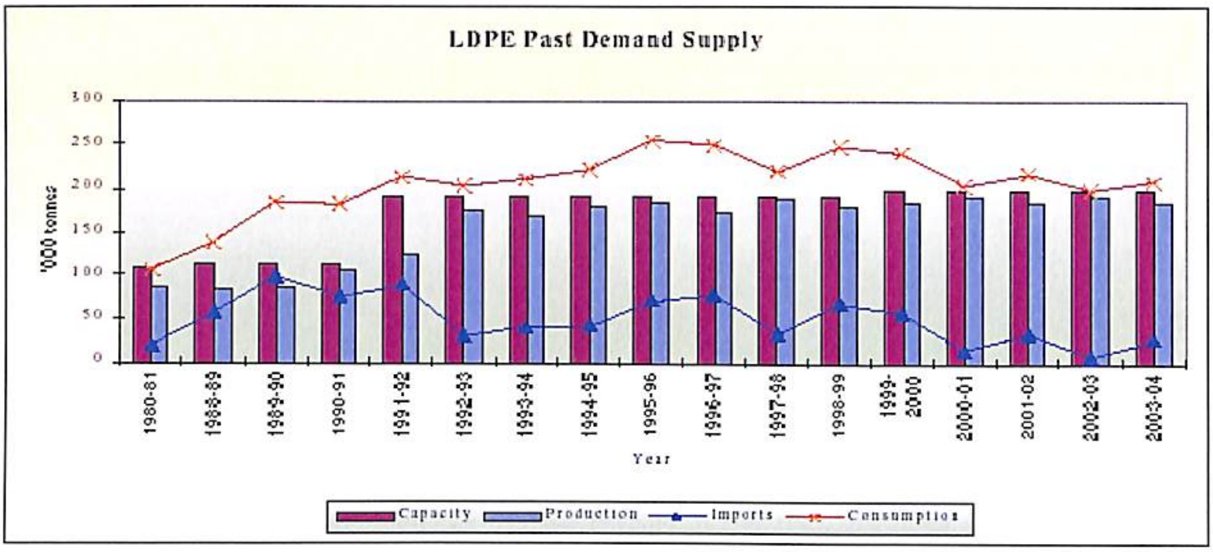


In 2004, PE and PP capacities increased by 5% and 6% respectively and the combined Polyolefins capacity increased by 6%. For PE the projected capacity increase in 2005 and 2006 is 2% & 13% respectively. In case of PP, the capacity would increase in 2005 by 15% and remain stagnant in 2006. The Polyolefins capacity is projected to increase in 2005 and 2006 by 8% and 7% respectively.

In 2004, the imports of PE and PP declined by 5% and 12%, while exports registered an increase of 28% and 20% respectively. The total polyolefin imports declined by 7%, whereas exports increased by 22%. The net trade in the year increased by 50%.

Due largely to domestic capacity additions, PE imports in 2005 and 2006 would decline by 22% and 50% respectively. The exports in 2005 are projected to decline by 30% but in 2006 they are expected to increase by 16%. Like PE, PP imports are also projected to decline by 17% and 27% in 2005 and 2006 respectively while their exports are projected to decline by 6% and 16% in 2005 and 2006 respectively. In 2005 and 2006, total imports of polyolefins are projected to decline by 21% and 43% and exports are project to decline by 15% and 7% respectively. The net trade in 2005 would decline by 12% and in the following year it is expected to increase by 10%

FIGURE 22

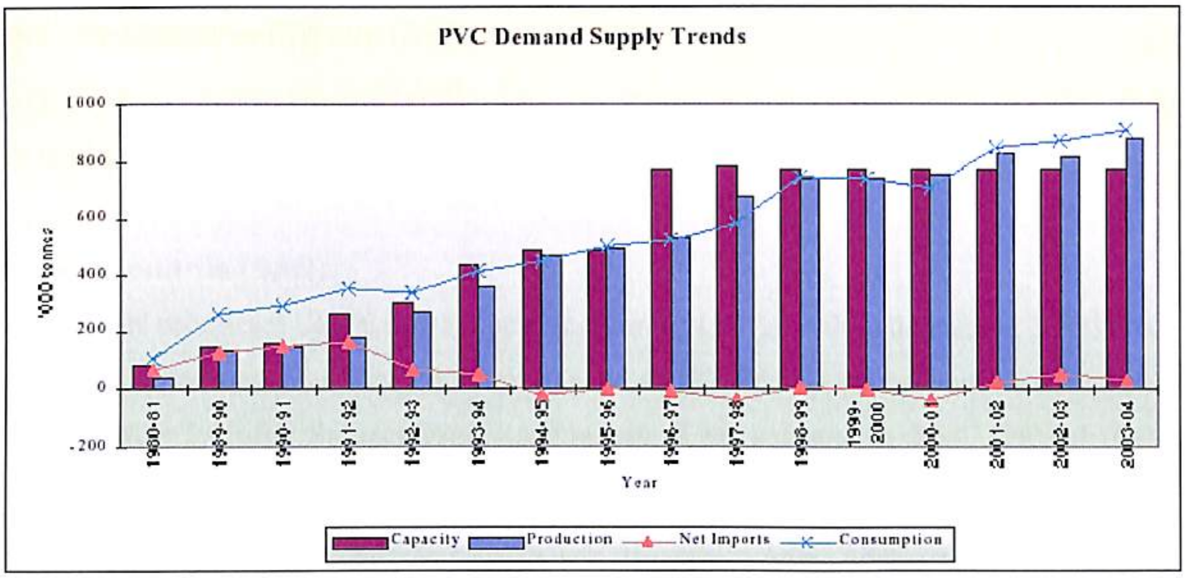


With PVC demand contracting by 1% as shown in table 2.3, the performance of the vinyls segment had been lackluster in 2004. However, PVC capacity increased by 125 kT in 2004 and is expected to go up by another 130 kT in 2005 to raise the domestic PVC capacity to 1063 kT.'

In 2005 and 2006, demand for PVC is likely to grow by 10% after registering negative growth in 2004. PVC imports during 2004 declined from 106 kT in 2003 to 92 kT and are forecast to go down further to 70 kT in 2005 before increasing to around 140 kT in 2006. Aggregate demand for PVC in India is expected to go up to 1060 kT in 2005 and further to 1170 kT in the year after.

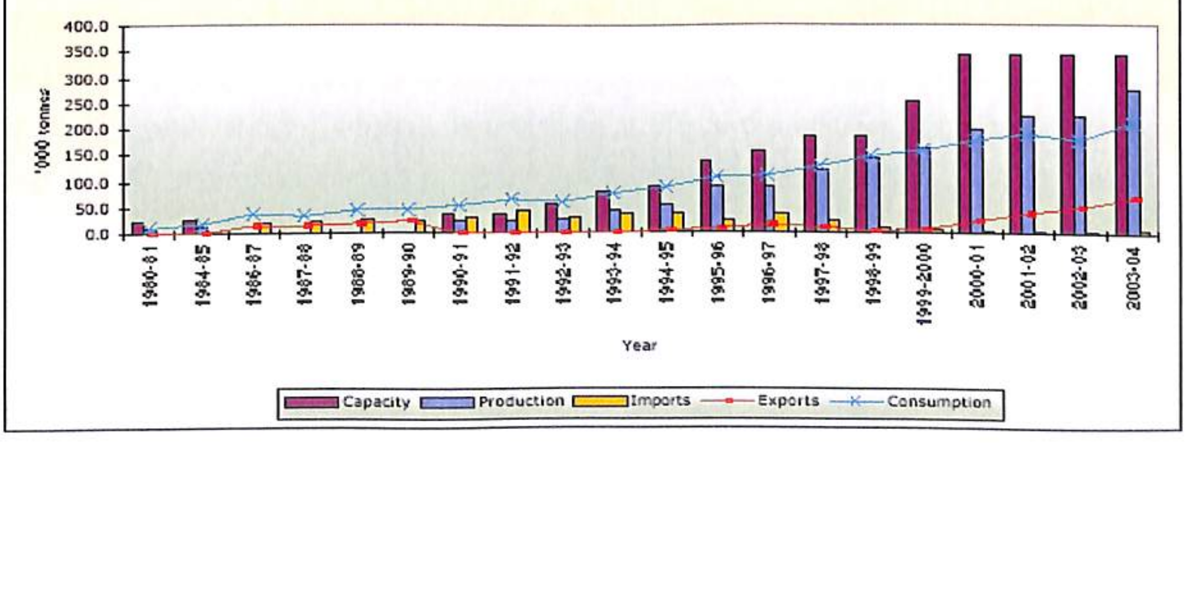
In the Union Budget 2005-06, the Government has announced irrigation, infrastructure development, Information Technology and housing as thrust areas and increased activity in these areas is expected to boost PVC demand in India.

FIGURE 23



In 2004, demand for PS increased marginally by 1% to reach 230 kT as shown in table 2.4. While PS imports in to India had gone down to 11 kT in 2004 from 14 kT in 2003, PS exports from India increased from 65 kT in 2003 to 87 kT in 2004 and is likely to increase further to 105 kT in 2005. Imports of PS into India in 2005 are likely to go up to 20 kT. The capacity is expected to remain stagnant at 354 KT till 2006. Demand for PS is projected to go up by 9% to 250 kT in 2005 and further by 12% in 2006 to reach 280 kT.

FIGURE 24



Consumption = Production + Imports – Exports and does not take into account buildup of stocks on account of unavailability of data.
During FY2005. domestic demand for polymers increased at a slow rate of 3%.

Acrylonitrile-Butadine-Styrene (ABS)

Demand for ABS is expected to grow at the same rate of 6% witnessed during 2003 and 2004. Industry capacity is likely to remain unaltered at 60 kT in 2005 and 2006.

Styrene-acrylonitrile (SAN)

Demand for SAN contracted by 1% in 2004 after registering 13% growth in demand in 2003. Production capacity for SAN has stayed unchanged since 2002 at 40 kT and imports account for roughly 10% of demand as in table 2.6.After the lackluster performance of the segment in 2004, demand for SAN is forecasted to grow at 6% per annum in both 2005 and 2006 taking demand to 41 kT in 2005 and further to 43 kT in 2006.

OLEFINS

Demand for Ethylene and Propylene increased by 6% and 7% respectively in 2004 as shown in chart 2.2. The recovery in demand, which began in 2003 continued in 2004, albeit at a slower rate with no new capacity being added in 2004.

. As shown in chart 2.3, demand for Ethylene and Propylene in 2004 was 2614 kT and 1852 kT respectively, close to the total installed capacity in the country of 2636 kT for Ethylene and 1826 kT for Propylene. As almost the entire domestic production was used up to cater to the domestic demand for derivatives production, there was very little trade.

In 2005, it is expected that demand for Ethylene and Propylene would continue to grow but the pace of demand growth is expected to moderate further to 6% and 5% respectively. Also, demand growth for Ethylene is expected higher compared to Propylene reversing the trend in the last 2 years. The capacity increase in 2005 and 2006 for ethylene is projected at 5% & 6% and for propylene is 7% and 16% respectively.

2.10 For Butadiene, a 10% growth in demand helped to narrow the gap between capacity and demand with reduction in the exportable surplus. The volume of Butadiene exports, which was 16 kT in 2004, is expected to go down to 10 kT in 2005 before Butadiene demand catches up with capacity and the exportable surplus is eliminated in 2006.

In 2004, the combined production of all the 5 fibre intermediates viz. A C N, Caprolactum, DMT, PTA and MEG reached 2815 kT of which PTA and MEG constituted 61% and 25% respectively with DMT, A C N and Caprolactum together accounting for the remaining 14% as table 2.8 shows

MEG and A C N constituted 45% and 37% of the total 236 kT fibre intermediates imported in to India in 2004. Of the 144 kT of fibre intermediates exported from India in 2004, the share of PTA was 58% followed by MEG with 35% share in total exports.

2.33 However, among the 5 fibre intermediates produced in India in 2004, India's import dependency was highest for A C N where the quantum of imports was more than double of the 37 kT produced domestically.

Outlook for 2005 for the fibre intermediates sector projects demand for individual fibre intermediates to grow at the same rate as in 2004 with the exception of DMT and PTA, which are forecasted to grow at 12% and 9% in 2005. DMT demand which grew at a very high rate of 25% in 2004, is likely to decelerate significantly to 12% in 2005 and is expected to continue through 2006 as shown in chart 2.5. Over the next 2 years, demand for Caprolactum is expected to grow the fastest at 19% per annum

FIGURE 25

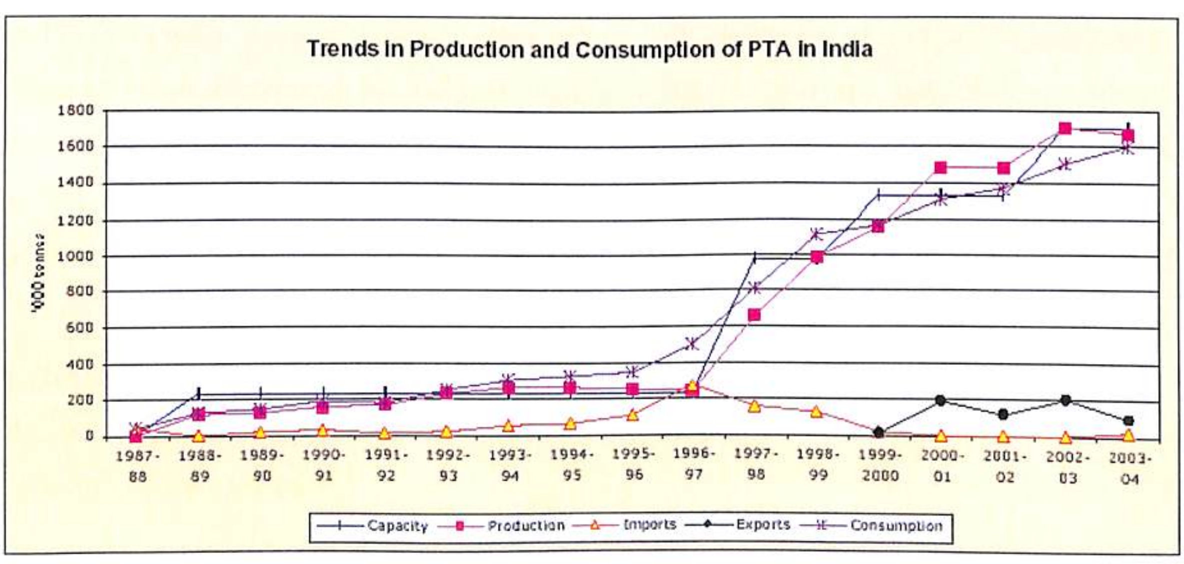
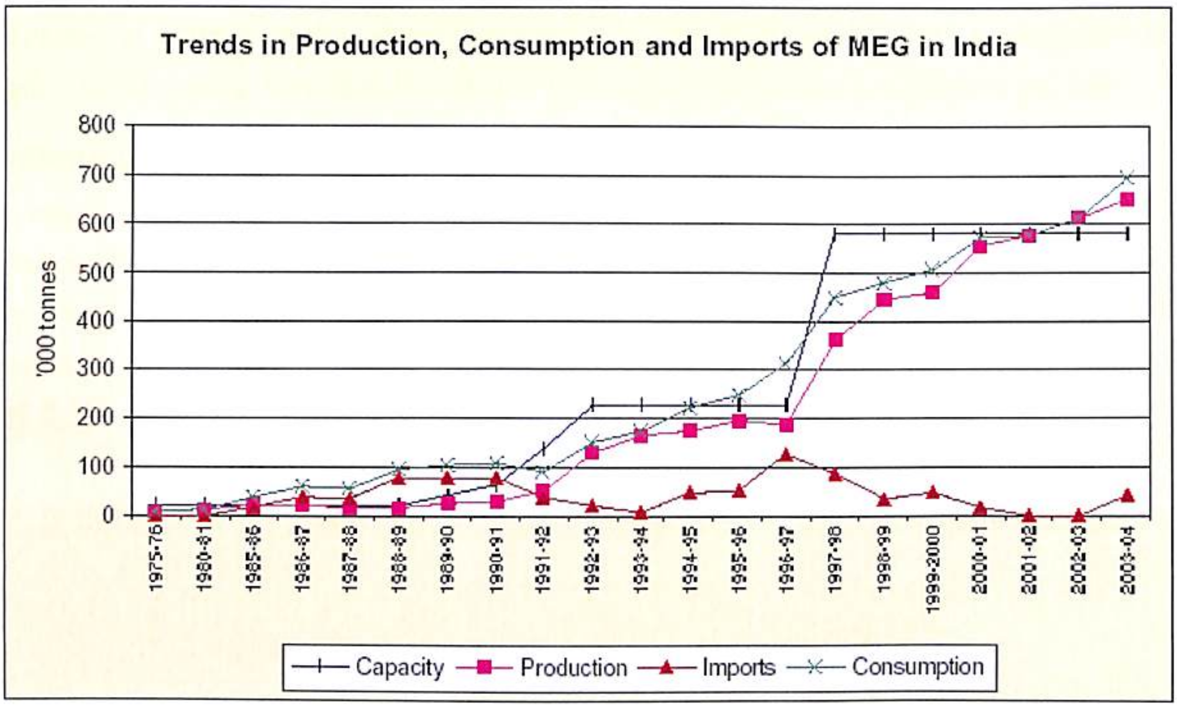


FIGURE 26

OTHER KEY PETROCHEMICALS – BENZENE, TOLUENE, MX & OX



Compared to 2003 when 3 out of the 4 key other petrochemicals witnessed contraction in demand, there was modest increase in demand for Toluene, MX and OX in 2004 and only Benzene witnessed a contraction in demand by 1%.However, production increased from 587 kT in 2003 to 654 kT in 2004 for Benzene. As a result the domestic manufacturers had to export more to offset the contraction in domestic Benzene demand and Benzene exports from India in 2004 went up by 64 kT compared to 2003.

In 2004, Benzene exports more than doubled from 56 kT in 2003 to 120 kT in 2004 constituting 64% of the total exports of key other petrochemicals of 188 kT. were exported from India, Benzene with a share of 64% constituted the bulk of it

2.42 While the volume of Benzene imported into India in 2004 was negligible, imports of OX increased significantly from 14 kT in 2003 to 42 kT in 2004 and imports of Toluene declined from 35 kT in 2003 to 24 kT in 2004.

2.43 In 2005, all aromatics including Benzene, demand for which contracted in both 2003 and 2004, are expected to witness modest positive growth. It is projected that in 2005 demand for individual aromatics would grow at rates in the range of 5-10% with MX registering the highest growth of 10%

New Ethylene Crackers

Many companies have announced plans to set up grassroots petrochemical crackers. However, not much work has happened on these projects. The following table provides the list of these

projects. Further, the Indian petrochemical companies are also planning joint ventures in the Middle East region, especially Iran.

TABLE 61

Project Plans of Grassroots Ethylene Crackers

Company	Location	Capacity ('000 tpa)	Remarks
IOC	Panipat	800	Naphtha based cracker. Naphtha to be sourced from IOC refineries. Has tied up with ABB Lummus for technology. Cost estimated to be US$ 1.5 billion. With a capacity of 800,000 MT/year of ethylene production, the Cracker complex will have associated units viz. hydrogenation, butadiene extraction, benzene extraction etc. besides downstream polymer units like swing unit (LLDPE/HDPE), a dedicated HDPE unit, Polypropylene unit and MEG unit. Scheduled date of Commissioning is second quarter of 2007
ONGC	Mangalore Special Economic Zone	More than 1000	Feedstock to be LNG. Cost of project estimated to be US$ 2 billion
RIL	Jamnagar (Gujarat) East Coast	750	Under Planning.
Reliance Assam Gas Cracker	Guwahati, Assam	200	Gas based. Implementation delayed by several years
GAIL	Kerala	500	Cost of Project estimated to be US$1.7 billion
NOCIL	Maharashtra	700	Under Planning
Kerala SIDC	Kerala	300	Under Planning
KSIIDC	Mangalore	300	Under Planning
MPSIDC	Sagar, Madhya Pradesh	300	Under Planning
PSIDC	Chandigarh, Punjab	300	Under Planning
BPCL	Undecided	300	Under Planning

Careful Planning of Medium and Long Term Trends: Choice of Feedstock, Product Mix and Capacities, Integration and Timing

The choice of feedstock, level of integration, capacity sizes and timing of the project are critical for the overall success and profitability of a petrochemical company. The decisions regarding these choices are to be made at the planning stage of the project on the basis of medium- and long-term industry trends. Accurate forecasting of these trends is vital for the success of a petrochemicals company.

Choice of Feedstock

Use of low-cost feedstock for the production of basic petrochemicals provides the player with an inherent cost advantage in the international markets and in the local markets as well. In the Middle East, with the opportunity cost of the associated natural gas being zero, basic petrochemical producers with a significant position in the global ethylene derivatives market have a significant cost advantage. In the Indian market, gas-based crackers have enjoyed high profitability on account of the low gas prices.

While gas is an efficient feedstock for ethylene-based polymers, naphtha provides other cracker outputs in much larger proportions and is, therefore, a more efficient feedstock for the production in a scenario of higher demand for other products. The feedstock that a petrochemical plant would use is thus a function of the demand-supply estimates for each petrochemical product in a country. Needless to say, such estimates must be accurate, as they comprise the starting point for the establishment of a petrochemical capacity.

Further, likely future demand supply of feedstock is also important. Natural gas prices that were artificially low in the country have now increased (in comparison to other fuels/feedstock) thereby affecting negatively the profitability of the petrochemical plants based on gas and neutralising most of the advantages of gas based petrochemical plants in comparison to naphtha.

With large availability of cheap natural gas in the Middle East, which is likely to be utilised increasingly for petrochemicals and other export intensive uses (such as fertilisers) in future, the ethylene derivatives are expected to witness lower prices. Therefore, naphtha based plants would have to rely on increasing propylene production in order to maximise profits and revenues. The natural gas based crackers that produce mostly ethylene will be required to use cheap natural gas (so as to keep cost of ethylene derivatives within a limit).

Product Mix and Capacities

High capacities provide a player an opportunity to minimise fixed costs. In the Indian petrochemicals market, RIL with its large capacities has fixed costs accounting for only around 15% of its operating income. In contrast, IPCL (which has more plants but of small to medium capacities, albeit, recently acquired by RIL) has fixed costs accounting for around 38% of its operating income. Further, at the time of construction, a higher initial capacity allows the company to lower the capital required per tonne of capacity.

Given the advantages, every player would like to set up the largest capacities possible. However, the eventual capacity gets restricted by the extent of unmet demand in the market.

Thus it is critical that the petrochemical company concerned accurately predict the extent of this unmet demand. If the company predicts too large a market, it may result in an over-capacity in the market during the initial years once the plant comes on stream. On the contrary, if the capacity is too small, the company may not be able to achieve the desired economies of scale.

The choice of petrochemicals to be produced is vital for the overall profitability of the project.

While RIL has concentrated on polypropylene (which has a fewer number of players and the market for which has lesser over-capacity), the other integrated petrochemical players have concentrated on PE, especially HDPE, which was facing a larger oversupply situation and a fragmented market as well during the last trough.

Integration

The integration of product with the raw material provides the player with control over its raw material. With large number of suppliers of styrene and ethylene di chloride (EDC), both PVC and PS markets have lower integration levels than PE and PP as the ethylene and propylene suppliers (sellers) are few.

However, in addition to control over the raw material integration of a mother cracker with downstream units and utilities has many advantages on its own. Integration provides the opportunity for optimum investment, high capacity operation, safety, optimum energy utilisation, and other economic advantages. Since all the intermediates in an integrated petrochemical complex are produced and used captively, such complexes have lesser storage requirements for intermediate products. This leads to lower transportation costs, fewer storage hazards and minimal statutory taxes. By integrating all the utilities such as those for steam, power, de-mineralised water, process water, cooling water, refrigerant nitrogen, and process air not only is the investment requirement optimised but higher efficiency is also provided for. Integration reduces the overall energy and utilities costs, which account for around 15-20% of the variable costs in a petrochemical complex. For instance, the power costs (as a percentage of operating income) of RIL declined from 6.2% in 1996-97 to 3.8% in 1997-98, following integration of the cracker. However, the advantages of integration notwithstanding, an alternative approach is possible in the

Indian petrochemicals industry. In this approach, an Indian petrochemical company could enter into a long-term arrangement for the import of ethylene, ethylene dichloride and styrene from ethane-based plants in the highly cost competitive Middle East region instead of setting up an integrated petrochemical complex. After all, the Middle East region is not too far off from India, especially for plants on the Indian West Coast, and a strategic stake in a Middle East petrochemical facility would minimise possibilities of supply disruption. For PVC manufacturers, importing ethylene dichloride is a better option than integrating with chlorine production (as chlorine production involves very high power costs and thus, is expected to be un-competitive in India).

Timing

Worldwide, petrochemical markets are characterised by cyclicality in margins, caused by the collective implementation and operation of capacities by various players. If a player times a project in such a way that it starts operating at the upswing, possibilities of significantly enhancing shareholder value are high. But to determine the upswing, the player must be able to predict the global demand and supply trends accurately. Besides, the player would have to have adequate financial strength to implement the project.

Financial Strength

petrochemical projects are capital intensive and require large capital for establishment. The project cost for an integrated petrochemical complex is substantially higher than that for a downstream plant. The cost of an integrated complex per unit of useful product is US$1750 per tonne as against US$700 per tonne for a downstream project (that is, roughly 2.5 times). Given the high project cost, financing becomes crucial and can play a critical role in determining the profitability of the project during the course of its operation. Further, if a high amount of debt is used, the cost is high during the initial years of operation and this impacts profitability significantly.

While RIL (now IPCL as well, as it has been acquired by the Reliance group), with its access to substantial funds, relies mostly on either equity or quasi-equity, other players with their limited access to equity funds have relied on substantial debt. Thus RIL, because of its greater access to the capital markets, employs significantly higher amounts of equity and consequently, has higher profits in the initial years of operations. On the other hand, Haldia Petrochemicals Limited (HPL) is very weak financially and has been unable to achieve equity closure for a project already complete. HPL was till recently facing acute financial crisis and selling products at large discounts (even though it was making cash losses on those sales) because of limited working capital finances available to it.

Capital Cost

The cost of setting up a petrochemical project determines, to a great extent, the production cost of petrochemicals and consequently, the profitability of a polymer company.

For a polymer facility, the plant and machinery cost is the single largest contributor to the project cost (roughly 40%). The compressors and heaters are imported and their cost accounts for around 50% of the plant and machinery cost. The actual plant and machinery cost varies with the technology used. Further, significant economies can be achieved by setting up large capacities. The project cost also has a significant contribution from the interest capitalised during the course of the project. For instance, the interest component accounted for more than 15% of the original project cost of HPL. In fact, the interest component was the single largest contributor to HPL's project cost (original) after plant and machinery. However, a player with significant financial strength can manage interest costs to a lower level.

Costs apart, a critical factor in the construction of a polymer facility at competitive terms is project management skills (since construction time is of vital importance). While private polymer players in the Indian market usually employ international project management consultants, the projects of State-owned companies have a higher involvement of in-house staff or State-owned project management organisations like Engineers India Limited.

Selection of Technology

The employment of the latest and best technology helps not only in improving cost efficiencies but also in producing products meeting consumer expectations. For example, in case of polymers, since polymers of improper quality can damage the machine of a plastic processor or malfunction in the ultimate application, product quality is very important. Production of good quality polymers requires control over catalysts and processes used to manufacture them.

Indian petrochemical manufacturers are too small or reluctant (probably on account of high risk) to develop indigenous polymer production technology and, therefore, depend on their international licensors. Today, various licensors provide their technology for a fee (which also depends on the capacity being implemented). These technologies have varying features and costs attached to them.

In India, the scope of research has been limited to areas involving lesser risks and returns. While IPCL has been involved in fine-tuning the imported processes and developing indigenous catalysts (so as to lower process costs), RIL has been involved significantly in developing new applications for its polymers in Indian context (which increases demand for its polymers). The other players have started emulating RIL's strategy in a limited way.

Current Facility Management

Although the cost of production of petrochemicals depends largely on the parameters available at the design stage of the plant, there is still some scope for improvement at a later stage through better management.

Higher Utilisation

As in the case of any commodity company, running a petrochemical plant at high utilisation levels is essential. The extent of utilisation, however, is dependent on the ability to sell the produce (besides technical competence). In the over-capacity scenario characterising most petrochemicals in the recent past, the smaller and medium capacity players with lower capacities were affected the most. RIL's capacity utilisation, on the other hand, has remained virtually unaffected by the over-capacity situation in the market. Sales in an over-capacity petrochemicals market depends not only on the cost of production, but also on timely despatches and their consistency, the credit schemes offered, the reach of the distribution network, the ability to provide technological help to processors, and to invent new applications for plastics as well. Indian petrochemical companies have invested significantly in developing new applications.

Further, a petrochemical producer needs to produce various grades of a particular product. However, this may involve a downtime (the extent would depend on the technology used) which must be managed effectively.

Feedstock

Feedstock costs constitute around 30%-45% of the operating income of an integrated petrochemical producer (higher for only-downstream plants). Consequently, companies spend significant resources and time over the efficient and effective management of feedstock. There are two aspects to feedstock management: minimising the per unit costs, and maximising the process yields from the feedstock (by monitoring the process conditions and minimising the losses).

Per Unit Costs

An effective supplier arrangement, which insulates a petrochemical company against cyclicality in feedstock prices, and an equity stake in the supplier company can help a polymer player minimise

feedstock costs. Some international manufacturers have entered into long-term supply arrangements with highly cost competitive Middle East feedstock suppliers to minimise their own feedstock costs.
With the sales tax on petroleum products for general uses being high, Indian petrochemical companies have invested significantly in importing naphtha (as against buying locally even when it is in surplus in the domestic market). RIL, for instance, used to purchase naphtha from the international markets until a new refinery by an affiliate company, Reliance Petroleum Limited (RPL), was commissioned (RPL now merged with RIL, had a sales tax exemption in the State of Gujarat). On the other hand, HPL, the other major naphtha based polymer player, sources naphtha partly from the domestic markets and has thus faced reduction in profitability.

Catalysts & Chemicals

For a petrochemical plant, the second most important cost head is catalysts and chemicals. Since most of these special chemicals and catalysts are produced by small players in the global market (catalysts are sold mostly by the licensor), their prices are beyond the control of domestic players.
To minimise costs, the petrochemical players need to minimise losses and to manage the costs of catalysts (zeolite catalysts, ziegar natta catalysts) and special chemicals effectively. Many measures to effectively control the use and, therefore, the cost of these chemicals are in-built at the design stage of the petrochemical project itself. Still, the careful use of these chemicals can hardly be overemphasised. The integrated polymer players in petrochemical spend considerable resources on improving process yields and in developing new alternative catalysts for the processes in use. However, the research and development expenditure of Indian petrochemical players is significantly lower than that of the international companies.

Power & Fuel

For a petrochemical company, power and fuel costs account for 7%-10% of its cost of sales. Unreliable power supply by the State grid and rising power tariffs (for external power) have forced many Indian petrochemical companies to set up captive power plants. Besides captive plants, the judicious use of fuels (different fuels have different costs per energy units) also helps polymer companies cut down their power and fuel costs. Further, polymer companies invest significantly on energy saving measures.

Financial Restructuring

With interest costs accounting for 8%-10% of the operating income, reducing interest costs can be highly beneficial. In the current scenario of liberalising financial market, the options before companies have increased manifold. The players have the option of prepaying costlier debt with cheaper current borrowings at minimum switchover costs. Additionally, the liberalised equity markets also offer the option of cheaper equity to the companies. HPL aims to issue equity (was a part of original plan, however, depressed equity markets have curbed its plans so far) so as to reduce its interest costs.

CHAPTER4

COMPARISON OF NATURAL GAS WITH OTHER ALTERNATIVES

(1) Assumptions have been made inter alia, for the following parameters:-

i) Capital Cost,
ii) Interest during construction.
iii) Plant availability/Plant load factor for power plants and capacity utilization of fertilizer plants.
iv) Energy per Kwh/tonne of fertilizer
v) Rupee dollar exchange rate
vi) Heat rate for Power Plants

(2) The quantified figures used for this comparative statement can be changed in the Excel Sheet expending upon one's judgment. Naphtha is clearly inferior to NG for power, but coal is preferable if no environmental premium is internalized.

Assumptions

1) Fixed charges are considering current capital costs
2) LNG Price for Dahej is based on fixed contract with RasGas
3) Spot LNG price is based on current spot prices
4) Heat rate for gas/naphtha based power at 1800 Kcal/kwh
5) Heat rate for coal based power at 2450 Kcal/kwh
6) Energy consumption for Urea is 6 million Kcal/tonne
7) 1US$=Rs.44
8) VAT on LNG/gas is 12.5%, while sales tax on coal is 4 %(declared goods)

Comparative statement of Cost for Power & Fertiliser

	LNG Price $/MMBTU	Rs/1000 M3	Spot LNG Price $/MMBTU	Rs/1000 M3	Naptha $/MMBTU	Rs/Tonne	Domestic Coal $/MMBTU	Rs/tonne	Domestc Coal (1200 kms) $/MMBTU	Rs/Tonne	Imported Coal (Coastal) $/MMBTU	Rs/Tonne
Remarks	**LNG at Dahej by PLL**		**Spot price by Shell/PLL**		**Napththa Arab gulf**		**Pit head doemstic Coal**		**Domestic coal transported to 1200 kms from mine**		**Imported coal from Australia**	
Gas/LNG FOB Price	2.53	4,386	8.00	13,869	13.06	25,500	0.90	597	0.90	597	2.53	2,649
Shiiping/Transportation	0.27	468	-	-	-	-		-		-	0.84	1,456
Customs Duty	0.14	241	0.44	763	0.65	1,132	-	-	0.05	87	0.17	325
Regas Charges (only for LNG)	0.60	1,040	0.60	1,040				-		-		-
Total Price	**3.54**	**6,135**	**9.04**	**15,672**	**13.71**	**26,632**	**0.90**	**597**	**0.95**	**684**	**3.54**	**4,431**
Sales Tax/VAT (12.5%)	0.44	767	1.13	1,959	1.71	2,972	0.04	70	0.04	73	0.14	273
Pipeline/Rail Tpt & Market Margin	0.50	858	0.50	853	0.98	1,682	-	-	1.20	796	-	-
Delivered Price ($/ MMBTU)	**4.48**	**7,760**	**10.67**	**18,484**	**16.41**	**31,285**	**0.94**	**666**	**2.18**	**1,552**	**3.68**	**4,704**
Variable cost/ Kwh in Rs.	1.57		3.73		5.74		0.40		0.93		1.57	
Fixed Charges (Rs. /Kwh)	0.90		0.90		0.90		1.10		1.10		1.10	
Cost of Generation (Rs./ Kwh)	**2.47**		**4.63**		**6.64**		**1.50**		**2.03**		**2.67**	
Cost of Urea Production (Rs./ MT)	**8,980**	**15,534**	**21,616**									

Assumption
Fixed charges are considering current capital costs
LNG Price for Dahej is based on fixed contract with RasGas
Spot LNG price is based current spot prices
Heat Rate for gas/Naptha based power at 1800 Kcal/kwh
Heat Rate for Coal based power at 2450 Kcal/kwh
Energy Consumption for Urea is 6 million Kcal/tonne
1 US$ = Rs 44
VAT on LNG/Gas is 12.5%, while Sales tax on coal is 4% (Declared Goods)

CONCLUSION

It can be concluded from the above analysis that cost of generation is the least in the case of domestic coal .For domestic coal which is situated 1200 Kms away an additional transportation charge increases the delivered price to $2.18/mmbtu.Whereas; LNG under fixed contracts is cheaper than imported coal. Spot LNG pulls up the cost of generation to Rs4.63 /kwh and Naphtha is the most expensive feedstock increasing the cost to Rs.6.64/kwh.On accounting for environmental impact of burning low quality domestic coal, the use of LNG would be more cost efficient in the power and fertilizer sector.

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