CHAPTER 1
INTRODUCTION AND OBJECTIVES

Most people never think about it. It is dark, thick, come in barrels, and people consume thousands of gallons on Friday evenings. No, not Guinness, oil-black gold. Your whole life, whether you are aware of it or not, is shaped by petroleum.

The bad news is that at the time of writing the barrel price of black magic has nearly quadrupled since 1999 and that means we and our family and our workplace are about to bear the costs of an oil shock.

Well, “William Gates may have changed our desktops, but like other citizens of the western world Bill drives into work, drinks from plastic cups, wears acrylic clothing, takes endless airplane flights, receives packages by UPS, lives in a warm house, works in cool offices, and gets hot pizzas delivered by automobile. He, I and you live on a petroleum-powered planet”. (Andrew Oswald, 2001).

Energy Security in a Dangerous World

If governments stick with the policies in force as of mid-2004, the world’s energy needs will be almost 60% higher in 2030 than they are in 2004. Fossil fuels will continue to dominate the global energy mix, meeting most of the increase in overall energy use. The shares of nuclear power and renewable energy sources will remain limited (World Energy Outlook, 2004).

The Earth’s energy resources are more than adequate to meet demand until 2030 and well beyond. Less certain is how much it will cost to extract them and deliver them to consumers. Fossil-fuel resources are, of course, finite, but we are far from exhausting them. The world is not running out of oil just yet. Most estimates of proven oil reserves are high enough to
meet the cumulative world demand that is projected for the next three decades. It has been suggested that global production of conventional oil will not peak before 2030 if the necessary investments are made. Proven reserves of gas and coal are even more plentiful than those of oil. There is considerable potential for discovering more of all these fuels in the future.

But serious concerns about energy security emerge from the market trends projected here. The world’s vulnerability to supply disruptions will increase as international trade expands. Climate-destabilising carbon-dioxide emissions will continue to rise, calling into question the sustainability of the current energy system. Huge amounts of new energy infrastructure will need to be financed. And many of the world’s poorest people will still be deprived of modern energy services. These challenges call for urgent and decisive action by governments around the world. Recent geopolitical developments and surging energy prices have brought that message dramatically home. Major oil and gas importers including most OECD countries, China and India – will become ever more dependent on imports from distant, often politically unstable parts of the world. Flexibility of oil demand and supply will diminish. Oil use will become ever more concentrated in transport uses in the absence of readily available substitutes. Rising oil demand will have to be met by a small group of countries with large reserves, primarily Middle East members of OPEC and Russia. Booming trade will strengthen the mutual dependence among exporting and importing countries. But it will also exacerbate the risk that wells or pipelines could be closed or tankers blocked by piracy, terrorist attacks or accidents. Rapid worldwide growth in natural gas consumption and trade will foster similar concerns.

Converting the world’s resources into available supplies will require massive investments. In some cases, financing for new infrastructure will be hard to come by. Meeting projected demand will entail cumulative investment of some $16 trillion from 2003 to 2030, or $568 billion per year.
The electricity sector will absorb the majority of this investment. Developing countries, where production and demand are set to increase most, will require about half of global energy investment. Those countries will face the biggest challenge in raising finance, because their needs are larger relative to the size of their economies and because the investment risks are bigger. The global financial system has the capacity to fund the required investments, but it will not do so unless conditions are right.

Oil, gas, hydroelectricity, nuclear power and coal are the five constituents of conventionally used primary energy. Wind and solar are two non-conventional sources. The transition from traditional, biomass fuels to modern fuels has an important influence on the growth of demand for oil products, especially in the residential sector. During the transition phase, the growth of modern fuels is driven by income growth and also by substitution by traditional fuels. This transition has been virtually completed in many countries, which will slow its rapid growth of modern fuel use, but this transition has a long way to go in many other countries like India.

The strategy for energy development forms an integral part of the overall economic development strategy. Efficient use of resources and long-term sustainability are the two important objectives of economic planning. The concept of sustainability takes account not only of natural resource and ecological balance but also of equity and self-reliance. Energy is central to the economy of any country and its prices have a direct bearing on the economic well being of all countries across the globe. Oil and natural gas are known to account for almost 65 percent of the global primary energy basket.

The world is actually more dependent on petroleum than at any time in history. The globe went through 20 million barrels a day in 1960 and 60 million barrels in 1980. In 2001, consumption exceeded 70 million barrels every twenty-four hours. World demand for crude oil is expected to grow.
from 78 million barrels per day in 2002 to 103 million barrels per day in 2015 and to just over 119 million barrels per day in 2025. Much of the growth in oil consumption is projected for the emerging Asian nations, where strong economic growth results in a robust increase in oil demand. Emerging Asia (including China and India) accounts for 45 percent of the total world increase in oil use over the forecast period in the IEO (2005).

The projected increase in world oil demand would require an increment to world production capability of more than 42 million barrels per day relative to the 2002 crude oil production capacity of 80.0 million barrels per day. Producers in the Organization of Petroleum Exporting Countries (OPEC) are expected to be the major source of production increases. In addition, non-OPEC supply is expected to remain highly competitive, with major increments to supply coming from offshore resources, especially in the Caspian Basin, Latin America, and deepwater West Africa. The estimates of incremental production are based on current proved reserves and a country-by-country assessment of ultimately recoverable petroleum. In the IEO(2005) oil price cases, the substantial investment capital required to produce the incremental volumes is assumed to exist, and the investors are expected to receive at least a 10-percent return on investment.

The additional capacity is also likely to come from non-OPEC producers viz- the likes of Russia (the world's second-largest producer, at 9.4 million barrels per day) and Norway.

**Declining growth in production rates**

According to Russian Industry and Energy Minister Viktor Khristenko, oil production growth is estimated at 2.4% in 2005, down from 10% in 2004. It's likely to drop below 2% in 2006 and even turn negative shortly thereafter.

The Norwegians are in even worse shape. The Norwegian Petroleum Directorate estimated that production itself fell to some 2.5 million barrels per day.
per day in 2005. That's down 11% from 2004 and 20% below its 2000 peak. It seems that Norway’s North Sea fields are rapidly depleting.

Mexico is in the same boat. Its largest field, Cantarell, which provides 60% of its total production, has gone into irreversible decline in the year 2006. Its rate of decline should accelerate to an annual 15% over the next few years. OPEC member Indonesia is even more of a basket case, recently shifting from a net exporter to a net importer Frankenhoff Will (2006).

The Big Business like ExxonMobil, Chevron, and Total SA, reported an average 3% decline in production in the third quarter of 2005 Frankenhoff Will (2006).

It is true; we produce more national output for every unit of oil. This often repeated fact misses the point. Western society throws away the potential advantage of greater energy efficiency by consuming far more goods than our parent’s generation did. Our lifestyles burn oil like there is no tomorrow.

Is your next car going to be a small foreign car or a large SUV? Your decision depends in part on what you think about gasoline availability. If you are very unsure about where gas prices are headed, you might be inclined to postpone a new purchase until you have a better idea of where market stands.

Energy prices and availability may be quite relevant for a host of other durable goods purchases, including housing. How long a commute to work are you willing to put up with? How energy-efficient should your appliances, windows, and insulation be? What equipment and industrial techniques should a firm build a new factory around? When energy prices and availability are as uncertain as they were in early 1974, it is rational to postpone such commitments until better information is available.
In the developed countries oil and gas constitutes a significant 63 percent to 70 percent of the primary energy consumption. The developed continents of Europe and America and countries like Japan and Korea are the maximum oil consuming countries. USA led the production until 1960, when the Middle East countries became the leaders. Thereafter, Europe, America and Japan have been vying for access to Middle East Oil. In late 2002 and early 2003, when Iraq had threatened to choke oil supplies, the western world was looking at USSR, Venezuela etc to bail them out, while preserving their own reserves. The developed countries have been and are totally dependent on oil as the energy source. But now, they are realizing the fact, that the world oil reserves are depleting and would not last too long and they would face problems in the not too distant future (Campbell, 1999).

The geologists predict that global oil production will peak around the year 2015. American domestic oil production has been falling steadily since the 1970’s. The real problem is that it is now harder to increase the world flow of oil than most realize. And the evidence shows that the rate of new discovery is comparatively unresponsive to movements in oil prices. So high prices may not help that much. Most especially, oil has a monopoly in transportation. Trains, trucks, automobiles, ship, and planes-all run on petroleum. In the United Kingdom, Transport consumes as much energy as industry and services combined. China that has five times the population of the United States, but with few cars. Remarkably, the US has 135 million vehicles and China only 4 million. The average US citizen consumes 25 times as much oil as the average Chinese citizen. Yet China is industrializing now (Andrew Oswald, 2001).

In fact, if the rest of the world replicates the per capita consumption of oil products of a user like USA, we would exhaust all the currently known oil reserves of the world in perhaps less than five years. In order to minimize consumption of oil without hindering the growth of various
sectors of the economy, some of the developed countries like USA and Canada are experimenting with non-petroleum based energy fuels, which can be used as substitutes of oil products. Brazil has experimented with ethanol, South Africa has tried coal liquids and New Zealand has experimented with synthetic gasoline, while several other countries have forayed into the use of CNG (Sperling, 1990, pp.1232-1233). Several countries in Europe and Japan have started encouraging use of public transportation system for medium and long distance travel and cycles for short distance travel. This has helped reduce pollution and improve the quality of life while conserving oil reserves. It would also be worthwhile to study the bicycle based Shanghai model. Eileen Claussen tells that Shanghai is one of the cities of China like many Indian metropolitan cities and is extremely densely populated. It has very low personal vehicle ownership, (in spite of higher income rates than prevailing in India). There Transportation plans and policies are designed to achieve broader urban objectives of population decentralization, with an eye to control traffic congestion and improving environmental quality. Maximizing use of public transport and bicycle ensures saving of resources while curbing green house gas emissions.

India, in common with many developing countries consumes energy in a variety of forms ranging from electricity obtained from nuclear fuels to agricultural waste and animal dung. The pattern of India’s energy consumption has changed over the years. From the dominance of traditional or non-commercial fuels like wood, dung and crop residues, the demand has shifted to commercial sources of energy out of which coal, oil, and natural gas are the main sources of primary energy. At the time of independence, the country had a very poor infrastructure in terms of energy production and supply. The per capita consumption of energy was abysmally low and the access to energy was very inadequate for the common people. The economy was dependent largely on the non-
commercial sources of energy for meeting the requirements of the households and on animal and human energy in case of agriculture and transport. During the 50 years that followed independence, the demand for energy, particularly for commercial energy, registered a high rate of growth contributed largely by the changes in the demographic structure brought about through rapid urbanization, need for socio economic development and the need for attaining and sustaining self reliance in different sectors of the economy. The demand for total primary commercial energy in India increased from 25.5 million tonnes of oil equivalent (MTOE) in 1953-54 to 212.9 MTOE in 1994-95, representing an increase of more than 8 times over a 40-year plan period. In per capita terms, the demand for primary commercial energy was 67 kilogram per oil equivalent (KGOE) in 1953-54. It increased to 234 KGOE in 1994-95 and is expected to increase to 648 KGOE by 2011-12. However, this is low compared to the international average of per capita energy consumption levels of 1,433 KGOE in 1994-95 and over 5,000 KGOE in the developed countries. *Institute of Defense Studies and Analyses (IDSA, 1999).*

The Indian oil and gas sector constitutes 38 percent of total conventional primary energy consumption, which is lower than the world average of 62 percent. The per capita consumption of oil and gas is 117 kg against the world average of 125 kg. There is a huge potential for demand growth in India because of higher growth rate of consumption compared to the world average and increasing share of oil and gas in primary energy consumption. The oil and gas sector gained importance on account of its multiple and cost-effective application compared to coal and hydroelectricity.

**About Indian Petroleum Industry - Historical Perspective**

The Indian petroleum industry dates back to 1890 when oil was first struck at Digboi in northeastern India. Oil exploration and production
activities were largely confined to the northeast until the 1970s when the most prolific and important Indian producing basin, Bombay High, was discovered. While the exploration and production sector remained under the state control until 1991, the Government policy now allows joint as well as private sector to participate in this sector. India’s first refinery was built at Digboi in 1901. Thereafter, more refineries were set up in the late 1950s and early 1960s with the assistance of international oil companies such as Shell, Caltex and Esso to meet India’s growing petroleum product needs.

In 1976, India nationalized the refining and marketing sector in response to the oil crisis of the 1970s and introduced regulatory controls on production, imports, distribution and pricing of crude oil and petroleum products. The Oil Coordination Committee was formed to act as a regulatory body in this regard.

Given the criticality of oil and gas in the national economy, the sector was completely regulated till 1991. With the key objective of providing basic necessities to the economically weaker sections of the society at affordable rates, the Administered Pricing Mechanism subsidized prices for products like kerosene and LPG by correspondingly charging higher prices for other products like gasoline and aviation fuel. Diesel prices were kept neutral. The Administered Pricing Mechanism ensured fixed 12% post-tax return on net worth deployed for refining, distribution and marketing of petroleum products. Also, petroleum product prices were maintained at an even level throughout the country by balancing various subsidies through a number of pool accounts.

However, in 1991, critical balance of payment position impelled the Indian government to launch general economic reforms with the objective of transforming the regulated economy into a market-driven one and attract investments from the private sector.
With the ushering of liberalization the sector was partially opened with the decontrol of lubricants, decimalization of overall products and permission to parallel marketers to sell LPG and SKO. APM was only in the marketing sector with the government ruling the prices of most petroleum products. But with the mounting oil import bill, the only solution to this problem was to attract large investments both in terms of capital and technology so as to boost production level and cater to the growing demand. To do this, all the controls in this sector had to be removed. The most significant step towards liberalization in the oil industry however was announced in November 1997 in form of a blueprint for de-regulation of the Indian oil industry.

As per the de-regulation policy, the Indian oil sector was scheduled to be completely deregulated from April 2002 in all aspects of pricing, imports and exports of crude and petroleum products. 1st April 2002 is a very significant date in the oil calendar of India as on this date, oil industry of the country has been partially deregulated.

**Total Reserves and Demand for Petroleum Products**

India has about 0.04 percent of world's proven reserves of hydrocarbons. The prognosticated geological resources of hydrocarbons in the country are estimated at 21.31 billion tonnes of which 61 percent are offshore and 39 percent on land. Out of this, the geological reserves established are however, only of the order of 5.32 billion tonnes. It is assumed that half of the prognosticated resources represents natural gas, of which only 12 percent has till now been established. As of the beginning of 1995, the balance of recoverable reserves is placed at 732 million tonnes of crude oil and 660 billion cubic meters of natural gas *Ninth Five-Year Plan (1997-2002)*. The total oil consumption in 1972-73 was 22.35 million tonnes, which rose to 60.81 million tonnes in 1993-94 to 93.91 million tonnes during 1999-2000 and thereafter rapidly rose to 111.92
million tonnes in 2005-06. Indian Petroleum and Natural Gas Statistics, Government of India (1996). This has led to a change in the pattern of commercial energy consumption, which is now characterized by a high degree of oil dependency. Oil and gas in 2001 met about 42 percent of the commercial energy consumption of over one billion people in India. Therefore the consumption of petroleum products constitutes the major share of commercial energy consumed in the country.

The ratio of oil consumption in different sectors to the total consumption of oil in the country, the oil application ratio (OAR) provides a measure of the importance of those sectors in the consumption of petroleum products.

The intensity of oil use in a sector or the oil intensity can also be described in terms of oil use ratio (OUR), defined as the ratio of oil consumption in that sector to total energy consumption. There have been substantial increases in the intensity of oil use in the transport and household sectors over the years. In other sectors, the intensity of oil use or the oil intensity has been declining Eighth Five-Year Plan (1992-97). The economy has progressively become oil intensive in view of increasing share of petroleum products in the final commercial energy use. This is due to increasing share of oil products in sectors like household and transport gaining ground over coal for efficiency, convenience and environmental reasons.

Energy per unit of GDP has been a widely used measure for considering trends in energy use. It is not, however, a good measure of the level of energy efficiency on a sectoral basis. Energy efficiency is related to how much energy is needed to satisfy demand for a given energy service. Different branches of the economy grow and evolve at different rates, causing the structure of the economy to change over time. Since each branch or activity has a different energy use per output, these changes influence the overall ratio of energy use to GDP. The determinants of the
relation between energy and output can be studied using production theory in a partial or general equilibrium framework. Distinguishing between the factors driving up energy demand from those factors making it more efficient is the key to relating past changes in energy use to future ones. Growth in energy use, however, can also be reduced by changes in economic structure, such as shifts in the manufacturing base towards producing goods that require less energy. These reductions should not be mistaken as the results of improved energy efficiency. To identify the elements that make energy use more efficient, changes in past energy use resulting from changes in the structure of economic activity need to be separated from those related to improved energy efficiency.

The energy intensity, which is energy consumption per unit of GDP, has increased in India since the early 1970s and it is one of the highest in comparison to other developed and developing countries. This is in sharp contrast to the developments in China and in OECD countries. For example, it is 3.7 times that of Japan, 1.55 times that of the United States, 1.47 times that of Asia and 1.5 times that of the world average. Thus, there is a huge scope for energy conservation in the country (Kakali Mukhopadhyay and Debesh Chakraborty, 2005).

Expected energy demand growth poses challenges for India

By 2020, India’s demand for commercial energy is expected to increase by more than 2.5 times (IEA, World Energy Outlook 2000). Underpinning this trend will be the ongoing growth in population, urbanisation, income, industrial production and transport demand. For India to tackle the economic and environmental challenge of its demand growth it is important to have a good understanding of how these and other factors shape energy use in the various sectors of the economy. Detailed and coherent information is required to identify the potential for energy efficiency improvements or to measure the progress of already implemented policies.
Over the years, the high rate of growth of energy demand could be sustained primarily through increased dependence on commercial energy sources such as coal, oil, natural gas and electricity. However, the energy supply system that has developed over the years has tended to depend more and more on non-renewable energy resources, the availability of which is severely limited. Moreover, development of some of these energy resources is beset with serious environmental implications. To some extent, subsidised prices of certain forms of energy also led to end-use inefficiencies and, therefore, an increase in the gross energy demand. All these factors have raised questions about the long-term sustainability of such an energy supply system. Moreover, with the rapid increase in demand for petroleum products, the country has become a heavy importer of oil. The present trends indicate that in the absence of adequate measures of demand management, the country may have to resort to import of other forms of energy as well and this has raised issues of long-term energy security of the country. A number of studies have been so far carried out with reference to the energy sector in India and other developing and developed countries, its intensities and other aspects. The direct and indirect fuel inputs per unit output of different sectors termed as total energy intensities or direct and indirect energy intensities emphasize that the associated energy consumption are essential part of that sector's activity and need to be considered as an integral part of operating that activity.

As govt of India has already taken efficiency measures for energy intensive sectors, further process improvements and a sectoral shift, i.e. from energy-intensive production to Services would have a bearing on the fuel mix and hence the energy consumption levels in the country. What becomes apparent is that energy-efficiency improvements are of great importance, although other improvements will be needed as well.

The most important point to reveal is that energy intensity really got reduced for some traditional energy intensive sectors but on the other hand
some new sectors have also entered in the economy. Tendency of oil intensity is on the whole fluctuating but if we estimate the 15 years performance then the rise and decline is very marginal in case of direct and total respectively. Energy Policies in India are mainly based on conservation. Energy conservation has received attention in India since the mid 70s. The impact of energy conservation efforts are felt at a very low pace, as the commercial energy consumption per capita is low in the country and efficient end use devices are costly. Recent rapid increase in energy demand, mainly in the industrial and the service sectors has created a renewed awareness about the economic advantage of energy conservation. Structural changes in the economy have led to expansion of the industrial base in the country, and subsequently the increase in demand for energy.

The pattern of consumption of petroleum products has also undergone a significant change since 1970-71. There has been robust demand growth witnessed in retail products like MS (Motor Spirit), HSD (High Speed Diesel) and industrial products like Naphtha mainly due to the auto sector boom and increased industrial activity. Also as a result of increased activity in the transport sector and price distortions arising out of Administered Price Mechanism (APM), the demand of High Speed Diesel (HSD) continues to grow at a much higher rate than other distillates. Due to increase in consumption of Liquefied petroleum Gas (LPG) and HSD the volumes of light and middle distillates have grown at a much higher rate compared to those of heavier ends which have grown by less than 3 times. The availability of light and sweet crude and the additions to the cracking capacity greatly forced the domestic refiners to change their product pattern in line with the changes in consumption pattern. (Ninth five-year plan).

The per capita consumption (per year) of primary energy vis-à-vis the hydrocarbons in India in terms of kilograms of oil equivalent, are about 285
and 113 respectively as against the corresponding world average of around 1454 and 927, China's average of 688 and 169 and Japan's average of 3962 and 2520 British Petroleum Statistics (1998). Growth of the economy would automatically lead to increase in energy consumption, as there is a direct correlation between Gross Domestic Product (GDP) and energy consumption. As a consequence of increasing oil consumption the import dependency for oil has been increasing over the years. Since 1984-85, when oil production was at its peak, India was importing only 30 percent of its crude supplies. Since then, though production has been increasing it could not keep pace with rising demand. In absence of any major discovery in the recent years, crude oil production has been marginally declining leading to increasing level of crude oil imports due to the growing demand.

Therefore, while production of crude was 33.02 million metric tonnes (mmt) in 1990-91, it has been more or less stagnant since then, with production at 33.87 million metric tonnes (mmt) in 1996-97. As a result, India's self sufficiency in petroleum products has declined from 60 percent in 1985-86 to about 34 percent in 1999 Institute of Defense Studies and Analyses (IDSA) (1999). Imports of crude oil exceeded domestic production for the first time in 1992-93 when they constituted 52 percent of total demand. This again took place in 1993-94 and then again in 1996-97, when imports constituted just over 50 percent of total demand. The net Petroleum Oil Lubricants (POL) imports in 1970-71 were of Rs. 1.3 billion, which rose to Rs. 97.7 billion in 1990-91, to Rs. 162.5 billion in 1994-95 and then to Rs. 320.9 billion in 1996-97. The import bill for the year 2000 was Rs. 528 billion and the figure is estimated to be around Rs 840 billion in 2002-03. The trends in the relative share of four oil products like LPG, Superior Kerosene Oil (SKO), MS and Diesel in POL consumption during the last three decades has increased from 54.9 percent in 1970-71 to 70.4 percent in 1996-97 Ninth Five-Year Plan (1997-2002). If this trend
continues in future as well, it will give rise to severe Balance of Payments (BOP) problems since all these products except MS, in addition to crude oil are imported at the margin. Large amounts of oil and Natural Gas (NG) therefore have to be imported for maintaining the current rate of economic growth. Even if domestic production picks up, India will continue to remain and become increasingly dependent on imports of both oil and natural gas for the foreseeable future.

The increasing dependence on oil imports along with serious repercussions on BOP is also likely to have acute political strings attached to it, which can have far reaching effects and will therefore need careful consideration. Thus the analysis of consumption pattern of oil and demand forecast and the estimation of elasticities become very important.

Geopolitical uncertainty in oil-producing countries

In Iraq, the U.S. government estimated oil production in 2006 at an average 1.9 million barrels per day. That's down more than 36% from pre-war levels. Insurgents made an estimated 282 attacks on the oil infrastructure between April 2003 and October 2005.

Nigeria led Africa's oil production with an average 2.3 million barrels per day in 2005, but it also faces constant internal turmoil. Rebel attacks on two Royal Dutch Shell installations have cut 10% of its export capacity.

Down in South America, Venezuela combines its own production shortfalls with the market's perception that President Hugo Chavez is just unpredictable enough to use oil as a weapon -- especially against the U.S.

Meanwhile, fundamentalist-run Iran is the world's fourth-largest producer of oil at 4.2 million barrels per day, sitting on more than 10% of the world's remaining reserves. It's currently in a standoff with much of the developed world over its nuclear ambitions (Frankenhoff Will, 2006).
The economic situation has changed not only for India, but also, for all developing countries which have economies dependent on large quantities of imported oil. Our foreign exchange bill for the import of oil over the years has been rising. Due to geo political problems and uncertainties, global oil price is highly volatile in nature. In most of the empirical studies conducted so far, the impact of oil price hike on the economies of different countries has been evaluated taking oil as the major commercial energy source. These studies have tried to establish the linkage between oil price and economic growth of oil importing countries. It was believed that the emergence of stagflation in 1974-75 was caused due to the first oil embargo. However, later studies suggested that recessions in the oil importing countries were less due to the direct effect of higher prices and more due to the consequence of the economic policies adopted to alleviate the price shock. In order to de-link the external oil price shocks from the Indian economy, Government of India (GOI) had introduced the system of the Administered Price Mechanism (APM) in 1976 (CII, 2002, pp.17-19).

Internationally although there is a general consensus regarding the inflationary and recessionary impact of oil prices, there has been considerable debate on the extent (magnitude) of impact of oil price shocks on overall macroeconomic indicators. Theoretical research generally concludes that oil price shocks lead to substantial increase in wages and prices and decrease in real output. An IMF study in the year 2000 indicates that for the industrial countries as a whole, a US $ 5.0 per barrel increase in oil prices reduces Gross Domestic Product (GDP) by 0.3 percentage points and leads to an increase in inflation in the short run. In the Indian context, the possible impact of petroleum price hikes, which were administered, often generated debate among the public. The postponement of adjustment in administered prices in the past delayed the build up of inflation pressures in the short run, but subsequently it got
translated into invariably bigger shocks. Any hike in such prices, apart from a direct impact, has an indirect impact on the prices of those commodities, which use them as inputs and can lead to a wage price spiral as evidenced during the oil shocks of the 1970s (Bhattacharya and Bhattacharya, 2001, pp.4735-4741). The episodes of increasing energy prices have been reflected in rising inflation during the two oil price shocks of 1974 and 1980, as well as the 1990-91-gulf war. (Confederation of Indian Industry (CII), 2002, PP.1-8). If we look at the data, since the Second World War, whenever the barrel price of crude oil has trebled, the world economy has trembled. Oil shot up in price in 1973, 1979 and 1990, recessions started right afterwards. The recent surge in oil prices is infact alarming high. There are good reasons why oil shocks hurt. When raw materials become more expensive, costs rise, profits drop; firms begin to go out of business; people lose their jobs. The price of oil matters also because of its importance in plastics, medicines, chemicals, clothing, pesticides, paint and thousand of other things we take for granted. The price of oil shapes all other energy prices, including gas and coal bills. Oil prices also govern electricity prices. The ripples from oil price shocks spread wide. The average Brent crude oil price during the year 2000 was around US$ 28.5 per barrel, higher than the price even during the gulf war of 1990. Even in the year 2001, the average price of Brent crude was about US$ 26 per barrel. Average crude oil price went up by 16.1 percent in 2003 and by 30.4 percent in 2004. In the mid 2006 oil prices reached over $70 per barrel and in late 2007, oil prices crossed $97 per barrel. Such an unrelenting high oil price scenario can apparently taking its toll on economies across the globe, and more severely on the developing countries. A prolonged period of high oil prices beyond US$ 20 per barrel may be detrimental to the consuming countries, particularly import-dependent countries like India.
In the international scene the two previous oil shocks of 70’s brought out the inherent instability in the supply and price of oil. The positive response of the developed economies to this challenge was reflected in the trends in the share of oil vis-à-vis other sources in their energy balance. It may be noted that by and large a moderate degree of saving in the consumption of energy has been registered between 1979 and 1983. The main source of this energy saving was obviously cuts in the consumption of oil. As a result the share of oil in total energy demand dropped significantly in many countries like USA, West Germany, Canada, UK, Italy, France, Japan etc after 1979. One of the classic examples of reduction in consumption of oil and consequently its imports is that of Japan. The share of imported oil within the oil supply in Japan hovered around 90 percent or above, most of the time. Against this background, Japan’s success in reducing its dependence on oil and imported oil in particular is a remarkable achievement. Therefore one of the major reasons for Japan’s success in coping with the high cost energy environment since 1979 has been the remarkable reduction in oil use without sacrificing economic growth. *Panikar (1991, pp.479-481).*

As against the foregoing, apparently there has been no evidence of any deliberate attempt in India to cut down oil consumption since the outbreak of the oil shocks in the 1970’s. It is true that the annual rate of increase in imports of oil has been cut to half; however the absolute volume of imports has increased substantially and steadily. Therefore the growth and stability of our economy is dependent on crude oil prices, which is a major arm-twisting lever in the hands of oil cartels and can play a major role in GDP growth and progress of our country. Uncertainty in world oil prices makes the economy more vulnerable.

There have been many recent developments in theoretical and empirical understanding of the macroeconomic consequences of oil price shocks.
Evaluating the impact of domestic and external shocks on the growth of developing economies is of utmost importance, as the consequences of these shocks push millions of people into abject poverty and deprivation. It is in this context an attempt has been made to analyse the impact of oil shocks on different macro economic variables of the Indian economy.

Loosely defined, an economic shock is an unexpected exogenous disturbance that has a significant impact on the economic system. Although there may be some shocks that have a positive impact (for example technological breakthroughs), the term is largely used for phenomena that have an adverse impact on the economy.

A conceptual distinction may be made between two sources of shocks. Exogenous volatility derives from sources that---at least in the short term---are outside the control of both households and policymakers. For small open economies, these include commodity price shocks influencing the terms of trade, changes in world interest rates, climate changes, and natural disasters. Endogenous volatility sources include unstable macro policies, political instability, and, to some extent, financial crisis brought about by domestic market imperfections.

As is often the case, the clear theoretical distinction does not always map easily into the empirics. Many shocks are hybrids. Thus capital flow reversals often have both an external exogenous component, such as changes in world interest rates, and a domestic endogenous component, such as perceived fragility due to maturity or currency mismatch. In like vein, productivity shocks, an important source of volatility, typically reflect both exogenous and endogenous factors. The empirical evidence suggests that input shocks play a significant role.
According to the neoclassical literature, these shocks cause unpredictable changes in aggregate demand and short run aggregate supply and hence induces fluctuations in the short run growth rate.

INCIDENCE AND IMPACT OF DOMESTIC AND EXTERNAL SHOCKS ON THE INDIAN ECONOMY

It may be worthwhile to note at this juncture, that the Indian economy has not experienced the extreme volatility in economic behaviour that has been witnessed in other emerging economies, especially in Latin America, Africa and the formerly Soviet bloc of countries. During the last fifty years, negative GDP growth occurred in only three years with the most acute being in 1979 (about minus five percent). The inflation rate has also remained fairly stable, typically below double digit figures and a negative rate of inflation was witnessed only twice during the fifties. A major reason for this kind of stable behaviour could be the state control over production, consumption and prices till the early nineties. Another reason could be the low dependence on foreign trade and investment. Even after a decade of liberalization, India is one of the least globalized economies of the world. With the advent of freer markets and globalization, the economy has now become more sensitive to internal and external shocks.

OIL PRICES AND REVENUES: AN ECONOMIC ANALYSIS

The price of oil is of critical importance to today’s world economy, given that oil is the largest internationally traded good, both in volume and value terms (creating what some analysts have called a “hydrocarbon economy”). In addition, the prices of energy intensive goods and services are linked to energy prices, of which oil makes up the single most important share. Finally, the price of oil is linked to some extent to the
price of other fuels (even through oil is not fully substitutable for natural gas, coal, and electricity, particularly in the transportation sector). For these reasons, abrupt changes in the price of oil have wide ranging ramifications for both oil producing and consuming countries. The fluctuations in world oil prices from late 1997 through June 2005 certainly qualify as abrupt and significant changes.

Generally speaking sharp decreases in oil prices help net oil importing nations and hurt net oil exporters. For net oil importers, lower oil prices act similarly to a tax cut, increasing consumer disposable income. This often leads to a loose monetary policy, and hence lowers interest rates with lower inflation and, usually after a few months, stronger economic growth. On the other hand, sharply higher oil prices have been identified as a major cause in many of the post World War II recessions in the United States (i.e. 1973-1975; 1980; 1981-1982; 1990-1991; 2001). Although all this may sound like a relatively straightforward relationship, the economics of oil price changes are actually somewhat more complicated.

Another complicating factor in considering the impact of oil price fluctuations on net oil importing countries is that certain states, or regions, within such a country may be affected differently from other states or regions within that country.

The magnitude of any economic impact of an oil price change depends on several mediating factors, including the level and duration (both actual and perceived) of the change, the prevailing demand and supply elasticities for oil, and the overall share of oil in the country’s economy. This is the reason we are estimating oil demand elasticities in our study. The implications are quite different, for instance, between oil price “shock” (upwards or downwards) which ends quickly or which lasts a long time. Shifts in energy intensity, for instance, come about through changes in economic structure (e.g., towards or away from energy
intensive industries), changeover of capital stock (i.e. houses, cars) or adoption of new technologies (e.g., more or less fuel efficient capital goods) which can take years, and which may only occur if people believe that the oil price change will last a long time.

Another issue is consumer expectations. If consumers are “surprised” (for instance, they believe an oil price change will be short lived when in fact it is long lived), this can result in a sub-optimal (either too-quick or too-slow) adaptation to the price signal. Demand elasticities (the degree of consumer response to price change) are further complicated by their asymmetrical nature – in other words, elasticities are different for an oil price increase than for a comparable decrease. In fact, most economic evidence points to the conclusion that a sudden, sharp oil price increase (or shock) has a negative impact on the economies of net oil importing nations. The impact of a similar oil price decrease (downward shock), on the contrary, has been found not to be as large.

HOW HIGHER OIL PRICES AFFECT THE GLOBAL ECONOMY

Oil prices remain an important determinant of global economic performance. Overall, an oil price increase leads to a transfer of income from importing to exporting countries through a shift in the terms of trade. The magnitude of the direct effect of a given price increase depends on the share of the cost of oil in national income, the degree of dependence on imported oil and the ability of end users to reduce their consumption and switch away from oil. It also depends on the extent to which gas prices rise in response to an oil price increase, the gas intensity of the economy and the impact of higher prices on other forms of energy that compete with or, in the case of electricity, are generated from oil and gas. Naturally, the bigger the oil price increase and the longer higher prices are sustained, the bigger the macroeconomic impact. For net oil exporting countries, a price increases directly increase real national income through
higher export earnings, though part of this gain would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners.

Adjustment effects, which result from real wage, price and structural rigidities in the economy, add to the direct income effect. Higher oil prices lead to inflation, increased input costs, reduced non oil demand and lower investment in net oil importing countries. Tax revenues fall and the budget deficit increases, due to rigidities in government expenditure, which drives interest rates up. Because of resistance to real declines in wages, an oil price increase typically leads to upward pressure on nominal wage levels. Wage pressures together with reduced demand lead to higher unemployment, at least in the short term. These effects are greater the more sudden and the more pronounced the price increase and are magnified by the impact of higher prices on consumer and business confidence.

An oil price increase also changes the balance of trade between countries and exchange rates. Net oil importing countries normally experience deterioration in their balance of payments, putting downward pressure on exchange rates. As a result, imports become more expensive and exports less valuable, leading to a drop in real national income.

The economic and energy policy response to a combination of higher inflation, higher unemployment, lower exchange rates and lower real output also affects the overall impact on the economy over the longer term.

Similarly, the boost to economic growth in oil exporting countries provided by higher oil prices in the past has always been less than the loss of economic growth in importing countries, such that the net effect has always been negative. The growth of the world economy has always fallen sharply in the wake of each major run up in oil prices, including that
of 1999-2000. This is mainly because the propensity to consume of net importing countries that lose from higher prices is generally higher than that of the exporting countries. Demand in the latter countries tends to rise only gradually in response to higher prices and export earnings, so that net global demand tends to fall in the short term.

QUANTIFYING THE IMPACT ON DEVELOPING COUNTRIES AND TRANSITION ECONOMIES

The adverse economic impact of higher oil prices on oil importing developing countries is generally more pronounced than for OECD countries. The economic impact on the poorest and most indebted countries is most severe.

The vulnerability of oil importing developing countries to higher oil prices is also exacerbated by their limited ability to switch quickly to alternative fuels, the prices of which may increase more slowly than those of oil products. And an increase in the oil import bill also tends to destabilise the trade balance and drive up inflation more in developing countries, where institutions responsible for economic management and investor confidence are more fragile. The deterioration in developing countries terms of trade is often magnified by sharp currency depreciations, as capital inflows slump. Higher oil prices and the subsequent depreciation of their currencies against US dollar also raise the cost of servicing external debt. This problem is most pronounced in the poorest developing countries, especially those already running large current account deficits.

Fiscal imbalances in oil importing countries caused by lower income would be exacerbated in those developing countries, like India and Indonesia that continue to provide direct subsidies on oil products to protect poor households and domestic industry. The burden of subsidies
tends to grow as international prices rise, adding to the pressure on government budgets and increasing political and social tensions.

The general economic background to the current run up in prices is significantly different to previous oil price shocks, all of which coincided with an economic boom when economies were already overheating. Prices are now rising in a situation of tentative economic revival, excess capacity and low inflation. Firms are less able to pass through higher energy input costs in higher prices of goods and services because of strong competition in wholesale and retail markets. As a result, higher oil prices have so far eroded profits more than they have pushed up inflation.

Yet the economic threat posed by higher oil prices remains real. Fears of OPEC supply cuts, political tensions in Venezuela and tight stocks have recently driven up international crude oil and product prices even further. Current market conditions are more unstable than normal, in part because of geopolitical uncertainties and because tight product markets – notably for gasoline in the United States – are reinforcing upward pressures on crude prices. The hike of future prices during the past several months implies that recent oil price rises could be sustained. If that is the case, the macroeconomic consequences for importing countries could be painful, especially in view of the severe budget deficit problems being experienced in all OECD regions and stubbornly high levels of unemployment in many countries. Fiscal imbalances would worsen, pressure to raise interest rates would grow and the current revival in business and consumer confidence would be cut short, threatening the durability of the current cyclical economic upturn.

The world is currently facing the fourth major oil shock in the last three decades, the previous three being in 1973-75 (the Yom Kippur Arab-Israeli-war), 1979-80 (Iranian revolution and ensuring Iran – Iraq war) and 1990-91 (Iraq's invasion of Kuwait and the Gulf war).
Thus Asian countries are walking a tightrope between keeping inflation under wraps while not derailing overall growth. Indeed, stabilisation policy more generally involves balance of various objectives and making informed guesses so as to anticipate future events. The persistence of a large number of global structural imbalances and geopolitical uncertainties in the Mid East makes this a real possibility. In view of this, as well as other possible global wildcards (hard landing the China, property bubble burst in industrialised countries etc.), the foregoing analysis may not have too long a shelf life!

IMPLICATIONS FOR INDIA

India is one of the largest consumers of crude, importing nearly 70% of the crude requirements. The country’s dependence on imported oil makes it all the more vulnerable to oil price shocks. Thus the ripple effect of increasing oil prices can be felt throughout the economy, especially in case of high oil intensive economies like India. The magnitude of these effects depends to a large extent on the size of the net oil imports, consumption pattern of oil and oil products and the intensity of oil usage in different sectors of the economy. According to IEA computations, India is one of the high oil intensive economies. So the need of the hour is to promote energy efficiency and develop alternate energy sources like nuclear power, hydel power and wind power along with progressive substitution of fuels like petrol and diesel in automobiles with natural gas.

The real oil crisis is yet to come; though it is round the corner. Policy measures announced by the government so far, do not reflect an appreciation of the crucial message implicit in the current crisis, namely oil is not a stable and sustainable source of energy.

The government continues to subsidize the prices of kerosene and LPG creating an oil pool deficit of almost Rs 14,500 crores (at a crude price of US$25 per barrel). It also continues to monitor the price of Diesel, Motor
Spirit and Aviation Turbine Fuel through adjustment of duties on the same. After total deregulation in the future, the volatility in diesel prices (especially) would turn out to be a sensitive issue for the government. It is thus important to have precise estimate on price elasticities of demand for various petro products for smooth market operations.

Another important aspect inter-related to the development in the oil sector, is the environmental degradation. We know that all the development efforts have some environmental cost, but we never account for the cost of environmental degradation in our national accounts. Diverse experts have made diverse recommendations on accounting such costs. Again both measurement difficulties and the problem of pinpointing the precise ‘cost’- to the nation in this case- have led to total neglect of this ‘cost’, which has, of late been rising. Report from (Ministry of Environment and Forests) estimates that the annual cost of environmental degradation in India in the past few years is averaging about 4.5percent of Gross Domestic Product. Oil production and utilization involves a disturbance to the state of environment Tata Energy Research Institute (TERI) (2001). At present the degradation to the environment is limited primarily to the capital cities on account of addition of almost 2 million cars each year.

It is a fact that pursuing oil based economy can bring prosperity to the better off but the opportunity cost to the poor can be substantial. They can invariably be victims of the environmental damage, as they are forced to live closest to factories spewing hazardous chemicals, waste dumps, busy roads loaded with carbon monoxide and nitrogen oxide gases or effluent laden nalas and rivers. Disturbingly, most people who suffer the health impacts of vehicular and chemical pollution do not own motor vehicles. Government policies focus on infrastructure to support motor vehicular transport, while the poor pedestrians and bicyclists are ignored. Unlike other countries like Japan and China, Singapore, India is not emphasizing on a well-developed efficient public transportation system in
order to save its resources, while also curbing greenhouse gas emissions. According to Ghosh (1992, PP. 1299-1301) “We are endeavouring to globalise the Indian economy in a great hurry and we want India to compete with the rest of the world on an equal footing, when nearly half the population is illiterate, and more than 40 percent of the population lives below the poverty line”. The huge investments in import of crude and refined products and the cost of setting up and expanding the refineries have not really touched the life of the common man in the proportion of investments made. The common man does not have to wait endlessly at the government ration shop to receive his quota of kerosene, but his household expenses has been hit hard by the fact that the fuel cost of the common household has more than doubled.

Rapid urbanization in India has been encouraged. Unfortunately, it is of a highly concentrated nature with the growth of mega cities and urban conglomerates. This is highly capital and energy intensive - both of which we are short of. People are commuting long distances to work, requiring expensive energy and transportation. For instance, Delhi requires mass rapid transport, which will cost upward of Rs. 10,000 crores - twice the sum needed to give clean drinking water to almost half the nation. While the former will benefit only 10 million individuals, the latter will cater to 500 million. Economists admit that a high rate of consumption of transport services between a man's home and his place of work signifies a misfortune and not a high standard of living. The concentrated urbanization, which is highly energy intensive, has made our economy become more and more high cost, which is adversely affecting the poor in the economy. The oil boom seems to be at the cost of the investments that are needed to be made on improvement in health, education and creating jobs for the poor. Considering the present demand pattern there is no possibility of cut in imports. Although a number of export oriented refineries are coming up in different locations, but the experts feel that these export-oriented refineries
may take some more years to bear fruit (Aditya Sen, 1995, pp.7-9). Even if the exports increase they are likely to benefit only a limited section of people because of the heavily skewed income distribution in our economy. The rising pressures for conspicuous consumption can turn destructive, reinforcing exclusion, poverty and inequality. Unless we review our policy it may lead to a human rights issue.

While the developed countries are entangled in a web of their own creation, India is at a threshold where it can avoid the pitfalls faced by developed countries. Confronted by depleting oil reserves, the Western Hemisphere could still sustain themselves; but, if we follow in their footsteps, it could shatter our economy. Inviting foreign direct investment to spur growth and import oil for continuing economic growth, will multiply demand and dependence on oil, which is going to become dearer and scarcer.

Earlier economists believed that with increased consumption, the utility level increases, but now they have developed a need based utility function, where utility depends upon need fulfillment rather than consumption and expenditure. We should evaluate the minimum expenditure to attain a given level of utility so that the opportunity cost involved is less or nil. Thus according to Buddhist economists, consumption is merely a means to a man’s well being. The aim should be to obtain maximum of well being with minimum level of consumption. In short we should try to maximize human satisfaction and sustain a way of life, which seeks to attain the optimal pattern of consumption because every commodity has an optimal point where it gives maximum satisfaction or utility. Once we shift from that point the utility level goes down. The present growth in the oil demand seems to indicate that we are likely to exceed the optimal consumption point as we are pursuing the consumption model of the developed western countries (Schumacher, 1981, pp.29, 52-53).
The question, which looms large today, is whether the emerging consumption pattern of oil in India is sustainable for the foreseeable future. Keeping in view the estimated reserves of 20 billion barrels of oil, (out of which about 27 percent has been discovered), the balance can only last for the next 20 years.

OBJECTIVES

The main objectives of our proposed study are:

1. To analyze how the consumption pattern of various oil products is changing in different regions of India. To estimate the future oil & oil products demand we first need to calculate the growth rates of consumption of oil and individual oil products. In the present study we examine the growth rates and structural changes, which occurred in consumption of petroleum products in the entire nation and 19 major states during the implementation of various plans before and after liberalization.

2. In the partial equilibrium framework to estimate:

The various determinants of oil product demand in general and how this is influenced by price and GDP, by evaluating the price and income elasticities.

3. In the general equilibrium framework to forecast the likely impact of oil market shocks on:

a) Different sectors of the economy (namely agriculture, industrial, construction, services etc) and economy as a whole. The major emphasis being on important macro economic indicators viz. wages, prices, output, and employment.

b) BOP of our country and also to forecast the possibility of export led growth to solve the likely BOP problem.

4. To suggest:
a) A suitable consumption pattern of oil to have a sustainable and a relatively pollution free growth.

b) A suitable policy to deal with disasters arising out of oil shocks (price and quantity). The idea is planners shall be ready with an alternative to deal with such crisis so as to reduce the suffering, adjustment cost etc.

CHAPTER SCHEME

In addition to the introductory chapter, there are six more chapters in which the results of our investigation of growth of oil demand, determinants of oil product demand and the impact of oil price shocks on the economy of India are reported and discussed.

In chapter II, the details of methodology and data applied in the study are discussed.

In chapter III, the available literature on the determinants of oil demand and the impact of oil shocks is briefly reviewed, in order to provide the necessary backup to the present study and to define its main objectives.

In chapter IV, growth rates and structural changes, which occurred in consumption of petroleum products in the entire nation and 19 major states before and after liberalization have been estimated. The results and discussion in this chapter shows the changing consumption pattern of various oil products. On the basis of estimated equation the chapter has also forecasted the total consumption of petroleum products in 2020.

In chapter V, important phenomena affecting oil demand is discussed in detail. An econometric analysis of demand for total oil and seven oil products in nation and in states has been presented. The chapter highlights the relationships and changes over time for income, population and oil demand and has examined the price and income elasticities of total oil and seven oil products as most important explanatory variables affecting oil
demand. After estimating the price and income elasticities of total oil and oil product demand framework, econometric modeling is done for analyzing the factors that influence domestic demand for petroleum products.

In chapter VI, the trends in global oil prices and the impact of oil prices on macroeconomic variables and different sectors of the Indian economy has been assessed. The results and discussion highlights that as international oil markets become tight, global prices would rise, and so would domestic retail prices. How do these changes in domestic prices of petroleum products influence the overall price level and hence the whole range of economic performance?

And finally, chapter VII contains summary and conclusions of our study.