CHAPTER I

FUELING DEVELOPMENT

1.1 Introduction

As we reflect upon the unfolding drama of human civilization, the role being played by energy source and their uses baffles our mind, leaving us in awful wonder. The ability of human mind in taming the gift of nature is one single achievement man ever made in his continuing pursuit of greater comfort, enhanced security from desire and the satisfaction of wants through increasingly elaborate artifacts. Animals were eventually domesticated and human muscular effort at first applied to hunting and scavenging were later channeled into cultivation and artisanship[1]. The discovery of fire illuminated human mind to use the kinetic fire to explore the universe beyond the horizons.

1.2 History of Commercial Energy

History reveals three primary energy sources: wood, coal and petroleum products. The use of wood as a fuel for space heating can be traced back to pre historic era but its employment as a fuel for manufacturing or industrial purposes probably dates back to less than 50,000 years[2]. People in Asia minor and northern Europe used heat energy from wood in the preparation of weapons and ornaments. Coal began to be employed in large scale in Europe only after the elimination of large scale forest cover. Coal was first mined on large

scale in the British Isles in the period of Queen Elizabeth I (1556-1603) The use of coal spread gradually across Europe and slowly into Asia and the coastal areas of Far East. The Southern hemisphere was also affected by the availability of exported coal Meanwhile by 1780's the industrial revolution infused a new spasm in the civilization of society and coal energy was intensively used to produce artifacts. Coal, which at first supplemented wood supplies, now came to supplant them as demands for steam power increased rapidly in the industrializing areas.

The oil era began in 1860, when crude oil was first marketed on a large scale. The lubricants derived from petroleum were appropriately suitable to the needs of high speed machinery, and many advances in mechanical engineering would have been impossible without the lubricants derived from crude oil. Eventually oil began to compete more effectively with coal when its value as a boiler fuel recognized and its cost became competitive with that of coal[3]. However, it was not until the development of combustion engine that crude oil was recognized as a major source of energy.

Perhaps no two inventions transformed society more fundamentally than electric power circuitry and the internal combustion engine. Automobiles gave the population an enhanced mobility and this mobility in turn made for an increasing flexibility in the location of industry and of population itself, increasing the efficiency of resource use and allocation.

Our world economy depends very much upon petroleum; petroleum in fact has shaped the modern world. It has dictated production technologies and methods. It has facilitated the emergence of worldwide transportation network It has allowed cities to grow and expand and determined the spatial landscape of regions. Even after the three oil shocks in about two decades, it still remains the principle source of commercial energy consumption.

1.3 World Energy Scene

From the inception of commercial energy production and consumption, economic development has been associated world over with increased use of energy and the consequent increase in productivity. As the population increases coupled with increased standard of living, the demand for energy is bound to surge in the future. The world's population stands at 6.5 billion.[4] Since 1950, in less than half our expected life time, the number of inhabitants has doubled. Current population growth is 1.7 percent per year. Population trends since 1650 indicate that by 2020 there will be nearly 8 billions humans and the world population will have more than tripled between 1950 and 2020.[5] Population growth as seen above and the better communication in terms of inter regional transportation, together with new economic and political freedom in former Soviet Union, Africa, Middle East, and Latin America have led to exponential growth of world creamer society during the past decade. Consumerism is growing in the nuke and corner of the globe. As long as oil prices remain within a trading range of approximately $ 12-22/bbl, world demand for petroleum will continue to rise despite economic recession in the developed countries.

Table 1.1 : World Primary Energy Consumption

Resource	1983	1992	2000	2005	2010
Petroleum(million b/d)	58.7	66.7	77.4	82.4	86 5
Natural gas, (tcf)	54.4	74.7	87.3	100.6	114.0
Coal, (billion short tons)	4.4	5.0	5.7	6.1	6.6
Nuclear,(trillion kw-hr)	1.0	2.0	2.2	2.3	2.3
Hydro, (trillion kw-hr)	1.9	2.2	--	--	--

Source : Energy Information Administration, Base Case Projections.

World annual primary energy consumption is 343.9 quadrillion BTU. In 1983-92 world energy consumption rose by 22 percent. The EIA base case projection for worldwide energy consumption in the year 2010, assuming a moderate growth scenario is 476 quadrillion BTU.[6] Oil and natural gas provided 61 percent of the total primary energy consumed in 1992. Coal provided 20 percent, nuclear power about 6 percent and hydroelectric power nearly 7 percent. Natural gas consumption is projected to increase by 53 percent to 114 trillion cubic feet in 2010 from 74.7 tcf in 1991. As pipe line infrastructure is developed, natural gas became the fastest growing major energy resource. The demand for electricity has grown phenomenally. During 1983-92, world net electricity consumption increased by 35 percent. The average rate of growth during this time was 3.4 percent per year. Electricity demand is increasing at twice the 1.7 percent rate of population growth. This is a direct result of rural electrification and industrialization in the developing economies.

Table 1.2 : Per Capita Energy Consumption in 1992

Country	Quadrillion BTU/year	Population (millions)	MMBTU/capita
U.S	82.19	260.8	315.1
Russia	32.72	147 8	221.4
Japan	19.01	124.4	153.3
China	29.22	1,192.0	24 5
India	8.51	911.0	9.3
Brazil	6.07	155.3	39 1
World	349.90	5,420.0	64 56

Source : Energy Information Administration 1995, U.S.Census

In order to understand future world demand for energy, i.e., how energy consumption is distributed around the world, the above in formation would be of use. The 26 million Americans constituting 4.5 percent of the world population consume nearly 25 percent of the world energy production, 25 percent of entire oil output and natural gas, 18 percent of coal and 31 percent of all nuclear power. The average American consumes 315 MMBTU per year, twice what Japanese utilize, 13 times greater than the average Chinese use and an incredible 34 times the per capita energy consumed in India. If the developing world is to reach the share of developed nations, it becomes beyond ones comprehension to imagine the energy requirement of the world in the near century.

Table 1.3 : Consumption of Petroleum in 1992

Country	Consumption million b/d	Population millions	Bbl/year capita
U.S	17.03	260.8	23.8
Japan	5.45	123.0	15.9
Russia	4.30	147.8	10.6
China	2.63	1,192.0	0.8
India	1.25	911.6	0 5
Brazil	1.41	155.3	3.3
World	66.70	5,420.0	4.5

Source : Energy Information Administration 1995, U.S. Census

If the average per capita consumption of petroleum in China and India was to rise from the current 0.7 bbl/year to only 5 bbl per year, then an additional billion bbl of annual production of oil products or an increase of about 41 percent over current world production would be required.

Changes in Economic policies are motivated more often by events rather than by planning. In 1973, the embargo imposed by the Arab oil exporting countries on shipments to US and the Netherlands, together with subsequent tripling of oil prices gave initial motivation to address the energy issue.[7] The further increase in oil prices following the fall of Shah of Iran in 1979 created the needed pressure to act. The collapse of oil prices in 1986 and the short, sharp spurt in prices following Iraq's invasion of Kuwait promoted interest in energy issues yet once more. Since energy economic analysis is a relatively new field, most

energy policy makers have limited experience with models for energy decision making. As Greenberger (1977) notes, "The need for sound energy decisions has never been more pressing than now. Energy modellers have great deal to offer, but they need better signals from decision makers on the nature of the problems, on the constraints and what is and what is not critical. Decision makers need better understanding of the models, their assumptions, strengths, and limitations, and on why they produce the result they do. The need for bridges is great on both sides of the gulf, and the responsibility for creating these bridges is a shared responsibility".[8]

The government of India recognizes energy-economic policy as being critical issue. Owing to the intrinsically complex nature of the energy problem and the interlinks that energy sector has with many other macro issues such as demographic trends, investment, impacts, balance of trade, pricing and financing etc., there arise a real need to study this sector critically and in-depth.

Against this background an attempt is made in this study to understand the energy scene in India. The use of various energy fuels, and their mix, their changing demand, government policy in production distribution, consumption and imports, energy intensities and their changes over time are discussed with succeeding chapters. Various techniques used to forecast the energy demands and the forecasts for different time periods are presented.

1.4 The Present Study

Commercial energy is one of the fundamental infrastructural input, its availability sets the effective constraint in the achievable rate of growth of economy. It is also highly capital intensive. Massive investments in energy sector has been made i.e , from an initial 10 14 percent of the total plan out lay in the second plan to 30.6 percent in Eighth plan. These did not however, really help in improving energy availability because demand always outstripped supply. Imports of crude oil and oil products continue to absorb a sizable share of India's foreign exchange earnings. Nonetheless, persistent power shortages remain a hindrance to growth. In fact, India has followed an energy intensive path of development, with commercial energy consumption growing faster than GDP by a factor of 1.2 to 1.5. It is one of the most important sectors included in infrastructure along with transport, communication, etc. Efficient infrastructure is a prerequisite for economic development and uninterrupted commercial energy sources such as coal, oil and natural gas, and electricity are vital for the progress of the society. These are the energy sources that are considered for the present study. The consumption of commercial energy is to be evaluated in relation to economic growth and development. To analyze the issues underlying the use of energy, energy intensities, energy forecasting the present study follows the scheme given below.

* A general description of Indian economy with explicit reference to energy sector's relationship to other sectors of the economy

* Justification of energy model for economic analysis and decision making

* A comprehensive review studies done in India by the government of India. Other research institutions and individual scholars to investigate and forecast the future energy requirements

* Available methodologies are evaluated and justification is made as to why input-output analysis is considered to be one among the best tool to analyze energy economy interaction.

* Use of Leontief Input-output Model to evaluate varied coefficients and multipliers and their relation within the context of changing industrial structure.

* Estimation of final demand using the base year (1989-90) and to arrive at the required gross output to fulfill the final demand forehand for different growth scenarios. An integration of input-output matrix with Linear programming.

* An analysis of issues identified and policy alternatives based on the results obtained.

1.5 Data Sources

This study will make use of secondary data only. These include:

1. Input-Output tables for the years 1984-85 and 1989-90 prepared by the Planning Division, Planning Commission, Government of India.
2. Economic Survey, Various issues.
3. Reports of different energy studies undertaken by the Government of India.
4. Annual Publications from the relevant ministries.
5. Energy Indicators published by the Asian Development Bank.
6. World Bank and Other Reports, United Nations.
7. Tata Energy Research Institute (TERI) Publications on Energy and Related Studies, New Delhi.

8. Central Statistical Organization (CSO), Annual Survey of Industries, Basic Statistics and Other Publications

9. Planning Commission, Input-Output Tables on Floppy Diskette for the years 1989-90 and 1992-93.

10. CSO, Input-Output Table on Floppy Diskette for the year 1983-84.

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