CHAPTER VII

SUMMARY AND CONCLUSION

This chapter summarizes the main findings of this study. After presenting a brief explanation regarding the findings, the limitation that are inherent in the methodology followed are explored. Justifications is offered as to why this methodology is chosen to study the energy scene in India.

7.1 Analysis of Policy Alternatives

In this study, Leontief's interindustry model is used to probe into the structure of Indian economy in relation to its energy problems and prospects. The interindustry model further extended to incorporate Linear programming with the objective of maximizing the value added or GDP. Since the technology from input-output matrix and constraints from energy sources set limit to the achievable GDP. At the aggregate level Leontief's interindustry model is used to investigate the trade off between gross output and energy use On the sectoral level, energy/income final demand coefficients have been used within an input-output context to estimate the sectoral income and energy use. The information derived from these model's result represent various scenarios to address certain energy economic problems such as, achieving a specified economic growth rate with minimum consumption of energy, the relationship between energy demand and supply and economic growth/development, decreasing the elasticity of energy, considerations for restructuring the industries, and estimating the economic impact on the Indian economy under assumed disruption of energy supply. On the national level gross output under conservative policy is estimated to be Rs. 15726950 Million in the year 2005, with the total consumption of commercial energy sources equal to 202.23 (mtoe). Under moderate policy in 2005 the gross output increases to Rs. 21996526 Million and the commercial energy consumption 287.27 (MTOE) Under the Aggressive policy the gross output increases to Rs.26022287 Million for 2005 with the consumption of commercial energy resources amounting to 340.33 (MTOE)

The scenario for 2010 under the conservative policy regime, gross output is Rs.20078940 Million and the commercial energy likely to be required to achieve this gross output is 259.57 (MTOE). Under a moderate growth policy the gross output grows to Rs. 31485436 Million and the commercial energy consumed is 489.77 (MTOE) and under an aggressive policy regime, the gross output is Rs. 39322604 Million and the required energy consumption to achieve this growth in output is 524.27 (MTOE).

On the sectoral level petroleum products, fertilizers, iron and steel minor metals and minerals top the energy income final demand coefficients under 2005 aggressive and 2010 normal scenarios. These sectors should not follow aggressive expansion in the year 2010.

Achieving a specified economic growth rate with minimum energy use could be realized with aggressive policy in 2005 and normal or moderate course of action in 2010.

The energy income intensity for the over all economy is the lowest under aggressive policy in 2005 and normal policy in 2010. Development of those sectors with relatively low energy/income final demand coefficients such as agriculture, electronics other transport equipment and services sector should be encouraged in all scenarios. On the other hand, expansion of sectors with high energy/income final demand coefficients curtailed or high energy intensive industries viz., iron and steel, textiles, sugar, chemicals, fertilizers, aluminum, cement and paper account for more than half of energy consumed in all scenarios should be discouraged consequently accounting for commercial form of energy, the income elasticity of demand continue to be low at 1.5. The high energy intensiveness is caused not only by misuse of energy resources but largely by choice also of energy intensive technologies of many production processes in these industries. The thrust towards setting up of basic metal industries, though well intended during the second five year plan, there is urgent need to reevaluate such well intended intention in the energy economy context. Will it be cheaper to import these products where they are produced with energy efficient technology ? Can the present mode of production technology of these industries made efficient? Because improvement in energy use, efficiency in a production process means conservation of energy in the process, which as an end result will lead to substantial savings capital intensive investment in energy supply and potential savings in fuel.

Industrial restructuring should consider interindustry relationship, industrial blocks, and the forward and backward linkages among sectors. Some sectors such as iron and steel, coal and tar products, surface transport, should maintain a desirable production level due to their strong linkages with other sectors

7.2 Demand Side Energy Management

A major concern of the government should be to minimize the production and equipment loss if energy disruption occur. The loss is considerable in industries like electricity, plastic and plastic products iron and steel are significantly affected. Under such conditions contingency plans are necessary. Closely related to the external energy disruption, internal power supply should be guaranteed. Unreliable power supply results in both short and long term loss to the economy. Service interruption may escalate cost related to product spoilage and damage to machinery and equipment. Under condition of uncontrolled load shedding and transmission and distribution outages (sudden service interruption without prior notice) these cost can be very high.

7.2.1 Reduction in Transmission and Distribution Losses

Transmission and distribution losses (T&D) of major states in India varied from 16.4 percent to 25.8 percent with an all India average of 21.8 percent. Improvement in efficiency of electricity use in Indian industry HT (High Tension) through demand side management result in savings in the use of scarce resources. In 1994-95 the country lost an estimated revenue of Rs.50,000 million due to T&D losses. Investment in T&D system have been much lower than the prescribed 40 percent allocation of the total power sector allocation It was 24 9 percent during 1993-94 which partly account for the high T&D losses It can be estimated that a one percentage point reduction in national all T&D losses would be equivalent to an addition of 800 MW of capacity.

7.2.2 Plant Load Factor

The existing availability of operating available factor (OAF) and the actual generation plant load factor (PLF) are high and could be reduced. The existing availability of OAF of 77.2% indicates an unavailable power supply of 22.8 percent which a developing country like India can ill afford. The main concern is the gap between OAF and PLF. This is nearly 15-16 percent comprising energy not utilized due to system load variation, breakdown, etc. and the partial unavailability arising out of the constraints in the operating equipment and auxiliaries. This unavailability is higher in older plants. One main reason for complete shut down and partial unavailability of generating units are coal related problems, since Indian coal contains high ash and sulfur content.

7.2.3 Energy Pricing

In India, prices of all forms of commercial energy are administered by state agencies. Such administered prices rarely reflect the 'true price' that society actually pays. Perhaps the only exemption are the prices of petroleum products, which though administered yet to large extent correspond to social price and even higher, because considerable portion of total petroleum products purchased from international market with huge foreign exchange outflow that could otherwise have been spent more beneficially for the society For electricity and coal, their administered prices lag much behind social prices and are multi-tiered and lowly priced

All power supply utilities have two types of tariff depending on the type of supply, i e., High Tension (HT) and Low Tension (LT) tariff. The energy based tariff for power supply of power to LT consumers in domestic, commercial, irrigation and small industry category consists of flat rate of stepped/block energy charges per kwh consumed prevalent in LT non-power category and small industries and irrigation category. It also has in some cases an other structure comprising fixed charges based on connected load in KW or BHP and energy charges are on the basis of actual consumption. Tariff charges for agricultural customers, irrigation and low income domestic consumers is heavily subsidized as per government policy, in some cases upto to certain BHP, electricity is provided free of charge. If at all any charges are levied on agriculture, it is only Rs.0.328/KWh, where as for low tension industries it is Rs. 1.55/KWh. Such tariff structure lead to heavy loss to State Electricity Boards (SEB). This is being reflected in their inability to maintain service and modernize leading to further loss in T&D power supply system. It is therefore clear that a rational energy pricing policy is very important for the purpose of long term energy planning.

In summary to ensure energy security as well as sustainable economic growth it would be necessary to initiate suitable policy measure from supply side management which would lead to:

(i) enhancement of efforts for extended recovery of oil in the offshore fields, acceleration of exploration effort within the county and from outside.

(ii) creation of incremental refining capacities and marketing infrastructure

(iii) augmentation of port facilities and pipe line capacities

(iv) promotion of foreign and domestic investment in the hydrocarbon sector

(v) promotion of growth in service and other sectors which would consume least energy and yet increase gross output

(vi) enhancement export in real terms in a sustained manner in the long run. For any organization to be internationally competitive, domestic price of energy should be in like with international prices

(vii) Continuous upgradation of energy efficient technologies that could be achieved by removing undesirable restrictions on international trade.

This should not however detract attention from applying pricing and other demand side management measures which include:

(i) Reduce the energy intensity over a period of time

(ii) Introduce energy efficient technology to achieve maximum energy productivity with minimum consumption of energy

(iii) Efforts should be made to reduce energy GDP ratio over a period of time such as to bring down the ratio to less than one

(iv) Introduce energy conservation measure which while increasing the income generated reducing the environmental degradation

(v) Put in place an energy pricing policy that would generate sufficient internal resources for the economy and encourage conservation and substitution of petroleum products by other fuels

(vi) Industrial restructuring should consider the forward linkages, backward linkages and the industrial blocks.

7.3 Limitation of this study

There are two major limitations in this study : one of scope and the other of the model mechanism itself. The scope of this study limited to the first level of energy economics and policy (see section 2.1) and is tied to the one objective of maximizing GDP with the given technological constraint available in the year 1989-90 and the energy disposable energy resources. There are varied factors which would directly and indirectly contribute to the growth of GDP, but are treated beyond the scope of this study. For example, when planning economic development, commercial energy must be considered one part of total available resources. A developing country like India, where the non-commercial energy sources play a vital role providing the energy needs of nearly sixty percent of the population living in rural areas. Equally important are the other natural resources like water resources, soil resources and the resources that directly contribute to the energy needs to the nation, like wind energy, tidal energy, biogas and biomas energy Consideration also should be given to the capital accumulation, savings foreign trade and foreign exchange, all play a vital role in the growth of the economy. Energy, as mentioned earlier, is one part of the system, the whole picture must be examined to in order to asses the energy economic policy. It is hoped that this study could be extended to include three or more objectives along this line in the future. Other than GDP many concerns such as employment, equity, security are also relevant. It is more and more realized that energy economic policy cannot be studied in isolation without the considering the impact of increased fossil fuel use on the environment. Because increased use of fossil fuel may necessarily increase the income of the nation, that is only one side of the coin, the flip side is the economic cost of environmental degradation and the future liability that be imposed on the future generation with dirty environment.

As to the limitations of the model mechanism, there are atleast two types.

(1) Inherent in the input-output analysis and cannot be removed. It includes: (i) Market equilibrium in the real world, the market is seldom in equilibrium (ii) Perfect competition - the economy may be close to but not in perfect competition. Market failures, other externalizes and imperfect information characterize any economy.

(2) The constant return to scale inherent in Linear production system. To relax this assumption, more constraint functions may be included in the model. These constraints represent various `recipes' for different production stage of the same product.

(3) Single technology production. In conventional input-output model, each sector uses only one technology to produce a single output. As a result no substitution of inputs or outputs is possible. In the real economy, producers substitute inputs as prices change This behavior could be captured in this model by shifts to alternate activities to

produce sounds in response to changes in shadow prices. The energy intensive industries could be considered for further analysis in these lines.

Homogenous commodity. The output within a given sector is assumed to be homogenous and completely substitutable. But in the real market, energy good has different grades, shapes and sizes. The obvious remedy is to disagregate commodities

Uniform prices across sectors: The assumption of perfect competition implies that all buyers are price takers and pay the same price for a given commodity. This is not true. For example, in India, residents of southern region may not pay the same price for the same type of energy as the residents of western region. Because special contract, approximate to the energy source, quantity discount, etc. still exist, the effect of non uniform prices is similar to that of non-homogenous commodities. Even if one uses physical units of to measure the direct and indirect energy sources in the input-output framework, the problem still exist for all non energy sectors.

Static analysis. This study assumes the structure of the economy remains unchanged from the base year 1989-90 to the forecast years 2005 and 2010. This might be questioned because, in particular, profit maximizing entrepreneur may undertake energy conservation measures that resulted from higher energy price. Technological and energy constraints alone do not reveal the given dynamism of charge resulting from a response to changes in prices. If one wants to make the model more dynamic, a capital coefficient matrix, labor requirement matrix must be included.

The planning horizon: The line planning horizon of the model can be considered another possible limitation of this study Models dealing with resume allocation and utilization should be long run models because the formation of capital resources and the build up of the overheads and infrastructures have long gestation period to that extent, the time period of 20 years long enough to allow for such change, even though such changes are not captured in this system due to model limitation. However, energy resource is different from the above mentioned resources in terms of supply change. The oil embargo of 1973 is a case in point. Energy is largely imported, and the changes may be drastic and very fast due to oil embargoes. This type of economic growth is very different from those arising from other domestic resources. Long run model may not be able to capture this effect. Efforts will be made in the future to extent this present study from static to dynamic and to incorporate both short run and long run in the lines of Leontief Dynamic inverse.

Looking at the role of input-output table in the planning process world over, and particularly in India, this list of formidable qualification and proviso, the input-output-linear programming model is justified a useful tool. From the beginning of its inception in the planning process in India, input-output table serves the base for successive planning and will continue to remain a center piece in the future planning as well. Hence the use of input-output table of 1989-90 as a basic tool of analysis is well justified. First the input-output table itself captures an enormous wealth of details concerning the interdependent structure of the economy. The key format of the table provides an internal consistency of inputs and output within each sector and balance of production and consumption among sectors Similarly the energy flow matrix describes a clear picture of how economy utilizes different types of energy sector by sector. The different final demand components depict the role of government in providing for public welfare, enables the planners to make provisions in its trade balance to meet the final demand if the domestic resources are inadequate etc This type of interindustry analysis is virtually the only practical alternative to massive econometric model when industrial details are required.

Another significant benefit of the model is that once the model is set up, it is able to accommodate different points of view quickly and with little effort. It has a definite structure which forecasts different amounts of energy to be used by different scenarios reflected in the value of the right hand side of the model, final demand, and the energy constraints, the exogenous determinants. The consistent framework of this model allows policy makers to check the actual gap and production levels of each sector with the result of the model to see of the solutions are logical, consistent and valid.

In conclusion, the I-O - LP model is useful for tracing the relationship between economic goal and resource uses, for assessing the relative impact of fuel and energy shortages in the present economy, and for examining the implications of industrial restructuring in the future years. In addition, with the importation matrix M included in this model, it is capable of investigating the consequences of charging trade policy by composing artificial diagonal elements in Matrix M. By modification to a dynamic model, it can be used to analyze future impact of present investment and development policy decisions in the energy field. This model is flexible and adaptable enough to explore various issues involved in energy planning and, above all, though its use decision makers can easily trace the functioning of the mechanism.