CHAPTER-VIII
FINDINGS, SUGGESTIONS AND CONCLUSION

8.1 Major Findings of the Research

This study has analyzed the economic aspects of petroleum during the pre-reform (1970-1990) and reform (1990-2010) periods. Following are the major and important findings of the study.

8.1.1 Consumption of Petroleum

• Total consumption of India’s primary energy sources such as coal, crude, natural gas, lignite, electricity increased rapidly with an annual average growth rate of 5.6 per cent in the study period. However, growth in the total consumption of primary energy sources namely coal, natural gas, lignite, and electricity has shown a decrease during the reform period as compared to pre-reform period.

• Growth in the consumption of natural gas had been impressive with 9.9 per cent between 1970 and 1990 and declined to 6.5 per cent in the next two decades.

• The growth rate of crude oil has been estimated at 5.6 per cent in the reform period which is marginally higher than in the pre-reform period. (5.1%).

• Estimated trend in the growth rate of consumption of total petroleum products was (including Refinery Fuel) 5.4 per cent during 1970-2010.
Consumption of total light distillates (LPG, Motor Gasoline and Naphtha) has influenced much the growth of total consumption of petroleum products with 7.3 per cent during 1970-2010.

Consumption of total middle distillates such as kerosene, high speed diesel oil, aviation fuel and light diesel oil have grown with average annual trend growth rate of 5.3 per cent during 1970-2010.

Consumption of total heavy ends namely fuel oil, lubricants, petroleum coke and low sulphur heavy oil has grown with average annual trend growth rate of 3.6 per cent during 1970-2010.

Average annual trend growth rate of total consumption of petroleum products is marginally less during the reform period (5.2%) than in the pre-reform period (5.5%).

Decline in the growth during reform period is accounted by the fall in the growth rate of middle distillates; growth rate has declined to 3.3 during this period from 6.7 per cent in the pre-reform period.

Growth in LPG has been estimated as 11.8 per cent for the study period and it was higher during 1970-1990 with 12.8 per cent in relation to 9.5 per cent in the next two decades.

Domestic sector consumption of LPG exhibited a spectacular growth of 12 per cent and commercial sector grew with average annual trend growth rate of 5.8 per cent between 1978 and 2009.

The overall average annual trend growth rate of naphtha for the study period was 6.4, having registered growth rate of 6 per cent during pre-reform period and 9.1 per cent during the reform period.
Total end use consumption of naphtha has been estimated to grow with an annual trend growth of 6.8 per cent for the period 1978-2009.

Average annual trend growth of consumption of naphtha by petro chemicals industry has been estimated at 4.2 and 1 per cent for fertilizer consumption during 1978-2009.

Decline in the consumption of naphtha by the fertilizers industry is significant in the last decade as fertilizers and power plants have shifted from naphtha to natural gas for energy efficiency.

Motor gasoline has grown exceptionally during the reform period with 6.8 per cent, than in the pre-reform period of 4.4 percent. Growth for the entire period of study has been estimated at 6.1 per cent.

Increased sales of automobiles, particularly two wheelers have led to the increase in the consumption of motor gasoline. The sale of two – wheelers sales comprises 76 per cent of the total automobile sales in 2009/10.

Trend growth rate for consumption of kerosene has been estimated at 5.4 per cent during the pre-reform period, whereas its growth during the reform period is not significant.

Decline in the consumption of kerosene during the reform period is the result of policy decision of the Government in reducing the allocation of kerosene.

Consumption of ATF has been robust during the reform period (5.5%) than in the pre-reform period (4.8%).

Consumption of high speed diesel oil recorded an annual trend growth rate of 4.2 per cent as compared to the growth rate of 8.5 per cent in the pre-reform period.
The major consumers of high speed diesel oil have been transport and plantation sectors, which has grown at an average annual trend growth rate of 3.4 per cent and 20.2 per cent respectively during 1980-2010.

In transport, the growth rate of road transport has been 4.7 per cent during 1980-81 to 2008-09.

Consumption of high speed diesel by power utilities has also recorded a growth rate of 14.4 per cent and 4.8 per cent by industry during 1980-2010.

Consumption of HSDO by major industries such as mining, engineering, iron steel and textiles have been reduced and new industries has increased its share during 1980-2009.

An average annual negative growth rate has been recorded in the consumption of light diesel oil (-4.3 %) during the reform period as against the positive growth of 0.6 per cent in the pre-reform period.

Consumption of products of heavy ends exhibited a relatively high growth during the period of reform and its shares in total have also improved over the years.

Fuel oil grew with an average annual trend growth rate of 3.1 per cent during the pre-reform period against 1.9 per cent in the reform period.

Average annual trend growth rate of consumption of lubricants has doubled during the reform period (6.1% ) than in the pre-reform period (3.2 %).

Bitumen has grown positively with an average annual trend growth rate of 3.4 per cent during the pre –reform period and with the growth of 5.8 per cent during the reform period.
Chapter VIII

Findings, Suggestions & Conclusion

Petroleum coke has grown with an average annual trend growth rate of 22.9 per cent during 1990-2010 compared to 4 per cent during 1970-1990.

The spatial pattern of consumption indicated that the largest consumption centres in the western zone comprised the states of Gujarat, Maharashtra, Goa, Madhya Pradesh and Chhattisgarh. Major share has been maintained by the states of Gujarat and Maharashtra.

Average consumption of petroleum products of western region was 8124.31 ktoe and it has been consistent throughout the study period.

8.1.2 Production, Consumption and Imports of Petroleum

Individual growth rate of production of primary fuels were; coal 4.97 per cent, crude 3.99 per cent, natural gas 8.7 per cent, lignite 5.6 per cent and electricity 3.8 per cent. Total production of primary sources grew at an average annual trend growth of 5.08 per cent during 1970-2010.

Stagnated production of crude oil during the reform period accounted for 2.9 per cent growth rate, less than the growth of 4.8 per cent during the pre-reform period.

Natural gas has recorded an average annual growth of 4.9 per cent in the reform period as compared to 12.32 per cent in the pre-reform period.

Relatively constant production of coal and natural gas between 1990 and 2000 and flat production of crude throughout the reform period were the reasons for slow growth in total production of primary energy sources of energy in India during the reform period.
Total consumption of primary sources of energy outstripped total production in the study period.

Shortage in the fuels namely coal, crude and electricity has led to the imbalance in total production and consumption of primary sources.

Average annual consumption of coal has been 5.3 per cent, crude 5.6 per cent, and electricity 6.5 per cent during 1970-2010. The corresponding figures for production in the same period have been 4.97 per cent, 3.99 per cent and 3.78 per cent respectively.

Against the pre-reform period of India, growth rate of both production and consumption experienced a decline in the reform period.

Average annual trend growth rate of production of crude oil was high during the pre-reform period with 10.1 per cent than 0.6 per cent during the reform period.

The share of private production in total production was 20 per cent in 2009-10.

Growth in the production of petroleum products has been estimated at 5.8 per cent for the period 1970-2010.

Trend growth rate for total petroleum products has been relatively high during the reform period (7.1%) as compared to (5.7%) in the pre-reform period.

The overall trend growth rate of light distillates, middle distillates and heavy ends of petroleum products were 8.8 per cent, 5.9 per cent and 4.1 per cent respectively.

Production of light distillates has registered a high growth of 8.8 per cent during the reform period as against 6.9 per cent in the pre-reform period.

Production of middle distillates has grown annually with 6.2 per cent during the pre-reform period and 6.9 per cent during the reform period.
Trend growth rate in the production of heavy ends has been estimated at 4.5 per cent during the pre-reform and 4.8 per cent during the reform period.

The overall average annual trend growth of production of LPG has been estimated at 9.7 per cent, having grown with 9.5 per cent during 1970 - 1990 and with 11.4 per cent during 1990-2010.

Naphtha production grew with an average annual growth rate of 6.5 per cent in the four decades. Its growth rate was 8.7 per cent during 1970-1990 and 7.7 per cent during 1990-2010.

Production of motor gasoline has registered an average trend growth of 9.1 per cent during the reform period against 4 per cent during the pre-reform period. The overall growth rate of motor gasoline production was 6.8 per cent.

Middle distillates average annual trend growth rate of 5.8 per cent in production has been influenced by growth in high speed diesel oil (7%) and Aviation turbine fuel (5.7%) during 1970-2010.

Estimated average annual trend growth rate of HSDO has shown a marginal decrease during the reform period (7.7%) than in the pre-reform period (8%).

ATF has shown high growth rate of 9.7 per cent during the reform period in relation to 4.3 per cent in the pre-reform period.

Kerosene production has registered an average annual trend growth 4 per cent, having grown with 4.1 per cent during the pre-reform period and 3.6 per cent in the reform period.

The production of light diesel oil has shown growth rate of 1.6 per cent during the pre-reform period and became negative during the reform period.
✧ Production of fuel oil has grown with an average annual trend growth of 3.7 in the last four decades. Its growth of 4.9 per cent during the pre-reform period was relatively high as compared to the growth of 3.4 per cent in the reform period.

✧ Production of lubricants has registered average trend growth rate of 2.8 per cent for the period 1970-2010. It growth was estimated at 4.2 per cent between 1970 and 1990 and 3.3 per cent between 1990 and 2010.

✧ Production of petroleum coke was accounted for 3.4 per cent during pre-reform period and 20.6 per cent in the reform period.

✧ Estimated average annual trend growth of 4.4 in the production of bitumen during 1970-2010 has been influenced by the growth in the reform period. Its growth rate was 2.6 per cent during the pre-reform period and 5.6 per cent during the reform period.

✧ Total production of petroleum products shown an increase during the reform period as compared to the pre-reform period, where as total consumption shown decrease during the reform period compared to pre-reform period.

✧ Relatively high growth in production of LPG and diesel has been responsible for increase in the total production during the reform period.

✧ Decline in consumption of kerosene and high speed diesel oil has been the reason for decline in the total consumption during the reform period.

✧ Consumption of petroleum products has undergone structural changes in the forty years. Domination of middle distillates in total consumption has reduced during the reform period and light distillates and heavy ends increased its share.
Imbalance in the production and consumption of petroleum products during the pre-reform period has led to huge imports of petroleum products and surplus production during the reform period encouraged exports in the reform period.

The overall average annual trend growth rate for gross imports of crude oil was 6.6 per cent and 5.6 per cent for petroleum products during 1970-2010.

Liberalization in the downstream sector has been successful in reducing the imports of petroleum products; its growth rate has decreased to 1.6 per cent during the reform period as compared to 5.6 per cent in the pre-reform period.

Deregulation in the downstream and consequent increase in the refining capacity has pushed up the import demand for crude during the reform period. Its growth rate was 10.9 per cent during the reform period as against 1.9 per cent in the pre-reform period.

Oil vulnerability has ranged between 1 and 4 per cent of GDP during the pre-reform period and 2 and 5 per cent during the reform period.

The increasing production has positioned India as a net exporter of petroleum products since 2001-02 and share of petroleum products in total exports increased to 15 per cent.

LPG and diesel were the major imports during the reform period, where as diesel, ATF and naphtha was chief exports of petroleum products.

8.1.3 Petroleum Prices and its Consumption

Price of domestically produced crude oil in India has always been set much below the import price during the period of Administered Pricing Mechanism (APM).
The ratio between import price and indigenous price of crude has declined between 1975 and 1997.

The movements of crude oil prices were fairly independent of the behaviour of international price.

During the decontrolled prices, price of LPG, kerosene, petrol and diesel did not moved in tandem with international price and they were adjusted through changes in taxes, duties and subsidies.

8.1.4 Consumption of Oil and GDP

India’s GDP grew at average speed of 3.9 per cent during 1970-1990 compared to 6 per cent during the reform period.

The coefficient of elasticity of oil consumption to economic growth was high during 1970-1990 i.e., 1.42 relating to average coefficient of 0.66 during 1990-2010.

Since the growth rate of India’s oil consumption was lower than GDP after 1990, the oil intensity i.e., amount of oil consumption per crore GDP has declined during the reform period.

Declined oil intensity during the reform period exhibits improved efficiency in oil consumption.

Granger causality test has revealed neither oil consumption influence GDP nor GDP causes oil consumption in India.
8.1.5 Testing of Hypotheses

The first hypothesis states that there is no significant difference in the average consumption of LPG naphtha and diesel by the major sectors during pre-reform and reform periods gives evidence for the following:

✧ There is significant difference in the average consumption of LPG by domestic and commercial sectors during the pre-reform and reform periods

✧ There is significant difference in the average consumption of naphtha by petrochemicals and fertilizers industries during the pre-reform and reform periods.

✧ There is significant difference in the average consumption of diesel by transport (other than road and rail), plantation, power utilities and industries (mining, iron and steel, engineering and other industries) during the pre-reform and reform periods. However, there is no significant difference international he average consumption of diesel by road transport, rail transport and textile industry during the pre-reform and reform periods.

✧ Second hypothesis states that there is no significant difference in the average consumption of petroleum products among the east, west, north and south regions. Result shows evidence that there is significant difference in the average consumption of petroleum products among the regions.

✧ Third hypothesis of there is no significant difference the ratio of gross imports of petroleum to domestic consumption during the pre-reform and reform periods was tested with t test. Results confirmed that there is no significant difference in the ratio of gross imports of crude oil to domestic
consumption during the two periods. However, there is no significant difference international he ratio of gross imports of petroleum products to domestic consumption during the pre-reform and reform periods.

8.2 Suggestions and Policy Implications

✧ Rapid consumption of petroleum products by the different sectors indicates that these petroleum products are important for the different economic activities and thereby economic development. So, Government has to constantly maintain the efforts to facilitate the consumption until the infrastructure for substitutes and renewable energy production founded on more reliable technology for production and servicing.

✧ The process of liberalization in the upstream sector has been successful to the extent in bringing down the unexplored areas, attracted foreign investments in India. Thus, process of opening of sector to the private and foreign players to be continued in exploration of oil. However, there have been problems in the commercialization of new oil fields. Therefore, this study presents following suggestions and policy implication to accelerate exploration and production of crude oil.

- Conducive environment could be created for investors in terms of policies, regulations in getting easy clearances from the ministries particularly Ministry of Defence.
- Improvisiation of expertise could be enhanced in oilfield services such as manufacturing of deepwater rigs and drilling equipments.
Oil field services could be promoted particularly deep water rigs, drilling equipment for easy commercialization of oil fields.

- Construction of platforms, pipelines, collecting stations and other surface facilities to transport oils from wells to delivery points could be helpful.

- Foreign participation has declined over the NELP rounds. Therefore speeding up the open acreage policy forming national data repository would help in tap the investment from oil majors in the world.

- Consumption at regions level has shown total consumption has been high in the region which has developed states in terms of GDP. Therefore, efforts could be made to increase exploration and consumption in the regions which has low consumption of petroleum products to have uniform development in the region and thereby nation.

- Reforms initiated in the downstream sector could be continued as it has brought surplus in refining capacity and positioned India as a net exporter in petroleum products. However, certain areas in refining sectors may need action for the future growth.

  a) Production of petroleum products could be sourced by the domestic crude, as imports have posed serious pressure on Balance of Payments.

  b) Efforts could be taken to build strategic reserves both domestic and abroad in order to reduce supply disruptions in the downstream sector.

  c) Investments could be called in the downstream infrastructure in the form of pipelines and other facilities for refiners for faster transport.
To enhance competitiveness in the products, research activities could be initiated in all possible manner to improve the quality of petroleum products. This could help expand export market in other countries. This would be helpful in reducing the environmental impact of petroleum products.

Efforts could to be made to strengthen the energy diplomacy with oil producers and consumers of petroleum products in the world.

Refining capacity is now surplus and further additions in the refineries have also planned by the companies. Thus long term strategies could be planned to expand the export market in other countries for petroleum products.

Specific courses that are required in refining sector may be offered in the universities and research institutes to get skilled human resources. Awareness could be created on the availability of career opportunities in the oil sector in the educational institutions.

In the total consumption of petroleum products, there has been shift from middle distillates to light distillates, but production of light distillates has not increased according to the demand. This has changed imports in favor of light distillates and they formed major component in the import bill. Hence, proper planning is essential in the production in accordance with the changes in consumption.

Demand management could be planned for highly demanded petroleum products namely LPG, HSDO and petrol.

There is a need for increasing the production of all primary fuels particularly electricity because high speed diesel has been used as a substitute for electricity
when there is shortage. So proper planning could be made to enhance the production of electricity through other means.

✧ Transport sector has been the major consumer of petrol and diesel. Therefore, alternatives for petrol and diesel vehicles may be considered to reduce the consumption. In this regard, the following strategies are discussed:

- efforts could be initiated to encourage the use of electric bikes and scooters to create petrol free cities; and
- investment may be required for the new and improved technology options to minimize emission hazards and environmental impacts in the transport vehicles.

✧ Prices of sensitive fuels are not linked with market prices even in the decontrolled era. This has hindered the competitiveness and discouraged the investments in the research activities to produce quality products. Competitive energy market could be established in order to allocate these resources into the most productive uses in the economy. Artificially low prices have led to in economic use of petroleum products. In this regard, effective policy tools could be implemented to link the prices with market. On the other hand, subsidies could be provided for poor Indian to access energy market.

✧ Given the low per capita consumption of energy, and the present stage of economic growth, obviously there is no scope for reducing the overall consumption of energy. However, some energy could be saved through appropriate measures like conservation, avoidance of wastage and improvement
in energy efficiency. The case for resorting to alternative, renewable sources of energy such as hydropower, solar energy ethanol etc., is equally valid.

8.3 Conclusion

During the last four decades, petroleum consumption has undergone drastic changes in India. Products of middle distillates, dominating before 1990 has lost its position and light distillates have emerged as major one. As country grows, demand for cleaner fuel like LPG shows increasing trend. On the other hand, there are no such changes in the production; similar structure has been maintained during the reform period. This has resulted in large imports of light distillates, particularly LPG. Consumption of petroleum products by the major sectors has significantly increased during the reform period.

Policies to expand production of petroleum products were successful with output rising strongly with respect to pre-reform period. Upstream sector have also seen increased foreign participation but there are difficulties in the commercialization of newly discovered oil fields which have kept the production constant during the reform period. Though export of petroleum products increased, Balance of Payments got affected by the volatility in the international oil prices.

In the decontrolled era, prices of petroleum products are linked to market prices, but it has not been followed. Prices were adjusted continuously through subsidies and modulation in taxes. So demand for petroleum products in India has been substantially influenced by the Government’s pricing scheme. Consumption of kerosene declined as Government reduced its distribution and consumption of LPG increased because of the Government promotion for LPG as a cleaner fuel.
Subsidy given for diesel encouraged its consumption in relation to petrol; similarly, LPG has been favored because of its support in price. But, petrol which is fuel for two wheeler, used by the middle income group priced high and car used by the affluent group has been subsidized. Artificial low prices have widened long term supply-demand imbalances by discouraging refiners and marketers to expand capacity. Also, it has virtually forced the private players out of the market. Government has protected the consumer from the volatility of oil prices recognizing the importance of these products in the development of economy. Though price adjustments provided stability in the short run, this would give instabilities to the oil companies and fiscal soundness of the Government in the long run.

8.4 Avenues for Further Research

This research has assembled and analyzed available data on oil energy during pre-reform and reform phases in India. An effort has been made to analyze the three related areas:

1) Trends in, consumption, production and imports,
2) Petroleum prices under administered and market determined pricing mechanism and its consumption, and
3) Consumption of oil and economic growth. From this study, several areas of future research have been identified as follows:

- This study has identified plantation as the major consumer of petroleum products next to transport. So further study could be made in consumption of subsectors in plantation for detailed analysis of consumption.
- It has been found that consumption of petroleum products by traditional industries has reduced and new industries increased their share. It is therefore useful to conduct a comparative study on consumption by the new industries.

- Consumption and production of petroleum in all states need further research on region-wise exploration, production and consumption of petroleum.

- Total consumption of petroleum products by different states of India has been analyzed. Hence, it would be appropriate to investigate further the product-wise consumption of various products of petroleum by the states.

- A study can also be undertaken on the use of oil energy in different sectors and their relationship with economic growth.

- Further studies can also be made in feasibility of substitutes for petroleum products like natural gas and compressed natural gas for protection of environment.