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Effect of Financial & Economic Energy Crisis and Its Impacts on Indian Economy

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ABSTRACT
Purpose of this research paper is to investigate whether energy conservation policies affect financial & economic activities is of great interest in the national & international debate on impact of energy consumption on economic growth of any country. The data consisting of secondary sources was collected through research journals, Internet statistical database and relevant books. The findings revealed that India with manufacturing market, surrounded by major emerging economies like China, Pakistan, Malaysia, Indonesia, Philippines & Bangladesh will be worst effected with the rise of energy prices. As a rule of thumb modern day manufacturing industries utilize at least 45% production cost in terms of energy prices. An increase of energy cost will affect their production cost and will force the manufacturers that either to reduce the labor cost or to remain competitive in market by improving the quality standards. Major giants China and Japan will benefit with this condition and smaller economies will suffer badly. It should adopt new policies to overcome the problem through renewable energy resources i.e solar, wind and tidal energy.
Keywords: Energy Crisis in India, Economic Growth, Energy Consumption

NEED AND SIGNIFICANCE OF ENERGY

Need for more and more energy resources have been one of the prime reasons for increasing international conflict, in past and in the present. The need for energy resources to some extent comes from the growth and dependence of mankind on them. Developed nations make up for most part of the demand, while developing nations are on the verge of the same. India being one of nations belonging to the developing world has been growing at an alarming rate. India has a huge population base which makes it a potential consumer of Oil. With the growing per capita income people have higher propensity to spend for better standard of living. Automobile industry is booming with more and more people going in for buying cars. This unfortunately will contribute to panic for India soon, if not already will join the race.

The growing pace of Indian economy has not only led to a rise in energy consumption but a shift in its energy mix too. Since independence, the country has been significant expansion in the total energy use with a shift from non-commercial to commercial sources. The share of commercial energy in total primary energy consumption rose from 59.7% in 1980-81 to 82.6% in 2013-14. It must be noted, however, that India's per capita energy consumption is one of the lowest in the world. India consumed 455 kilogram of oil equivalent (kgoe) per person of primary energy in 2010, which is around 26% of world average of 1750 kgoe in that year. As compared to this, per capita energy consumption in China and Brazil was 1147 kgoe and 1232 kgoe, respectively.

India has seventh rank in energy producing, accounting about 2.49% of the world's total annual energy production. It is also the world's fifth largest energy consumer, accounting for about 3.45% of the world's total annual energy consumption. But its energy consumption is still very low compared to many developing countries when measured in terms of per capita consumption estimated at 479 kg of oil equivalent (kgoe). It is projected to be going up by 185 percent by 2013, but will still be much lower compared to the consumption levels of the developed countries.
With the growth of the economy since independence, the country's energy requirement has grown substantially. India today faces a weak shortage of about 11-18 percent and Per capita energy use is very low (about 400

kWh/Year) in comparison to most of the developing countries and there is a marked disparity between energy consumption pattern in Urban and Rural segments. It is evident that a developing country like India has neither financial nor natural resources to set up new fossil fuel based energy plants to meet the growing owner requirement. The solution lies in more efficient use available resources by removal of current inefficiencies in generation, transmission, distribution and use; and by improving capacity utilization. It is estimated that the required capacity addition can be reduced through energy conservation measures and demand side management (DMS) at very nominal investment. The current potential for energy saving is more than 15,000 MW, industrial/commercial sector alone, which is around 15% of the total installed capacity in the country. For the economy as a whole, about 25,000 MW can be saved.

The crisis of 1973 energy was followed by high inflation and rapidly escalating costs of nuclear energy led to markedly higher rates for electric energy and reduced investment in new generating capacity. These factors led to increased interest in alternative sources of energy, such as non-utility electric energy. Congress responded in 1978 by passing the Public Utility Regulatory Policies Act which required public utilities to buy surplus energy generated by independent produces at the utility's avoided cost. In 1994 these independent producers generated 345 billion kW-hr. of electrical energy. A large share of this was produced by cogeneration pants, which generate some electricity by using the waste heat from steam turbines that heat buildings, dry lumber, operate food canneries, and so on.

Gas consumption rose 2.1 percent in 1994 to 20,727 billion cubic feet. Growth in natural gas consumption has been fueled primarily by increasing use of gas for electric energy generation. About 60 percent of the energy plant nameplate capacity added in the United States from 1922 to 1995 was gas fired. Much of the added capacity was built by non-utility independent energy producers. Gas is also favored by on-site industrial cogeneration facilities because it is abundant, cheap, and clean burning– which makes expensive air-pollution control equipment unnecessary. Gas turbines are ideally suited for production of peaking energy since they can be started and shut down quickly. Advances in jet engine technology have pushed the cost of electricity that is generated by gas turbines down to about 3.2 cents/kW-hr. Such low costs can be a bargaining chip in the marketplace. Large industrial energy consumers could be able to tell electric utilities; "to curing on Lower our rates or we will generate our own energy."

OIL

The requirement of various fuels for the thermal plants by the terminal year of the Twelfth Plan (2013-14) considering a capacity addition of about 58644 MW, based on normative generation parameters such as PLF and specific fuel consumption, is summarized in the Table below:

Table-1

Fuel Requirement during 2013-14

Fuel	Requirement	Availability
Coal	545mt	482mt
Lignite	33mt	33mt
Gas/LNG	89 MMSCMD	36 MMSCMD

Source: Working Group Report on Energy

Controversy over the U.S reformulated gasoline (RFG) program erupted again in 1985. In September, New Jersey announced that because of consumer health complains New Jersey would withdraw from the U.S. Environmental Protection Agency (EPA) program requiring tat oxygenated RFG be used in certain areas during the winter months in order to reduce carbon monoxide emissions from motor vehicles. A compromise was reached however, in October, under which service stations in eight southern New Jersey counties would not have to buy the oxygenated RFG, while the rest of the state would continue to require it. The RFG program requires the addition of oxygenated compounds to gasoline in certain regions to reduce carbon monoxide emissions. Methyl tertiary butyl ether (MTBE), which is made from methanol, is most common oxygen-

containing blending agent. Fairbanks and Anchorage, Alaska, made national headlines with citizen complaints of headaches and nausea caused by MTBE blended in gasoline. Although extensive studies have generally given MTBE a clean bill of health, there have been not definitive studies on the use of MTBE in an arctic environment.

Meanwhile, political wrangling increased over federal preferences and tax credits for ethanol, the other principal oxygenate used in RFG. Federal appeals court found that the EPA has exceeded its authority when it attempted to require refines to use renewable fuels for 30 percent of the oxygenates in RFG. Ethanol constitutes the only renewable fuel of any significance. RFG derived from ethanol enjoys a 5.4 cents gallon federal tax credit, and Midwest Republicans lobbied both House Speaker Newt Gingrich (R) and Senate Majority Leader Robert Dole (R) to support the credit. Other interests generally opposed this subsidy. Since ethanol is derived from corn, large-scale use of ethanol as a fuel would drive up corn prices-which in the turn would restful in higher feed prices. Furthermore, the production of ethanol from corn requires more energy than is obtained when the ethanol is burned. Hence, environmentalists generally oppose subsidies for fuel ethanol. Domestic petroleum consumption rose 4.8 percent in 2012, to an average 17.718 million barrels per day (bd). This is not record. The year with highest average daily petroleum consumption was 1978, when petroleum consumption averaged 18.847 million bd. Since domestic crude production dropped again in 1994, by 2.7 percent, net imports rose 5.7 percent, to 8.054 million b/d. In 2012 imports accounted for 85.5 percent of U.S domestic supply.

Domestic crude oil production peaked in 1970 at 9.637 million b/d and, except for a temporary increase in the years immediately following the run-up in oil prices in 1981, has been on a long-term decline. Accompanying this decline in oil production has been a sharp drop in oil-drilling activity. The number of oils well drilled fell from 42,590 in 1984 to 6,790 in 1994. This is lowest number of oil wells drilled in the United States since compilation of these data first started in 1949. In 1994 domestic crude prices fell to their lowest level since 1988. Prices recovered somewhat in 1995, rising to an average of S15.85/barrel by May. Since the United States extracted more oil than in found, reserves declined by 500 million barrels. Relatively strong economic growth in both industrial and developing countries increased world oil demand in the first half of the year. In late October the average price (FOB) of OPEC oil was estimated to be $15.29 per barrel, compared with $15.41 per barrel a year earlier. OPEC's production quota for 1995 was set at 24.52 million b/d. Although OPEC production exceeded its quota, the main depressant to world oil prices neared to be Iraq's spare production capacity and the threat of renewed Iraqi exports. Iraq has been producing only about a half-million b/d. United Nations sanctions prohibit Iraq from exporting oil. If however, Iraq was to comply with UN resolutions and the sanctions were lifted, Iraq could produce an additional 2.5 million b/d.

New Calculations strongly suggest that the world's total estimated ultimate oil recoveries may peak about the year 2000, after which global production will fluctuate around a constant production volume for a few years before declining inevitably at a low baseline production quota, the main depressant to world oil prices appeared.

Table-2

Per capita electricity consumption in selected countries

[Kwh = Kilowatt hours]

Countries	Per Capita Electricity Consumption
Norway	24,650
Canada	17179
Sweden	15420
U.S.A.	13338
Germany	7030
France	7689
U.K.	6206
Italy	5644
China	1684
India	631.41

Source: IEA (2014) Key World Energy Statistics 2014

Table-2 is shown the per capita electricity consumption in selected countries. Without energy, therefore, significant progress is not possible. Looking at the figures presented in Table **2,** it comes to the light that higher per capita consumption of energy has been a major supplement to the rapid pace of economic development of the developed countries and that due to low per capital consumption of energy in India. Energy, as such, constitutes one of the essential ingredients of economic development and is a precondition for the accelerated pace of socio-economic development of a developing country like India. Without adequate production and consumption of energy, significant progress of Indian economy is not possible. The process of building up an industrial structure, which will provide the base for a self-sustaining process of growth, will largely depend upon the adequate supply of energy. On fact, energy is the basis of modern industrial society and is indispensable for industrial expansion. A good deal of industrial development in advanced countries is the miracle brought about the high per capital consumption of energy as shown above in Table**.**

The role of energy in the development of agricultural sector is equally important, particularly in areas where energy is needed for irrigation of agricultural lands. The general benefits of rural electrification are no longer a matter of debate while agronomic practices and irrigation needs of rural India alone justify rural electrification of the Planning Commission as well as two studies of the National Council of Applied Economic Research of Punjab and Kerala throw considerable light on these benefits. The studies list a number of benefits arising from rural electrification, viz., increase in gross irrigated area, savings and better utilization of animal as well as human labour, establishment of and benefits to rural industries, savings in commercial and domestic fuels, gains of working hours and increase in reading habits, better sense of security and lesser chances of fire, greater participation in community activities and reduction in migration of educated youth to urban areas and additional employment opportunities. Apart from the energy requirements for irrigation to agricultural sector in India, as in many third world countries, "Production of fertilizers and mechanization of cultivation, the manufacture of capital goods for agriculture in large scale industries and transportation of surplus products to the marketing centers will also call for an increasing use of commercial energy. Thus, adequate application of energy to agriculture not only increases productivity of land and labor but also reduces human drudgery and open avenues, for inter-dependent agro-industries. In Indian context, large scale dependence on left-irrigation due to uncertainly and seasonal character of man soon rainfall, inadequate and unasserted availability of surface water supplies, on account of under-developed irrigation infrastructure, energy becomes indispensable factor for sustained agricultural growth which is the dominant sector of Indian economy.

Energy has profound socio-political implications. It plays an important role in transforming the life style and raising the living standards of population. Based on energy, use of air-conditioning and space heating, refrigeration, water-heating, cooking and lighting provide physical comforts to the society. Apart from the accent on physical comforts, the transportation system is also an important attribute of life style which has profound implications for the requirement of electricity. Energy is also a great supplement to education, science and technology, information and broadcasting, communication and also a source of entertainment. It brings changes in culture, views and traditions by enabling human beings to mobile around the world. Besides its socio-cultural significance, electricity also plays an important role in strangling the national defence from outside aggressions, maintenance of internal law and order as well as establishment of political stability.

NATURE AND EXTENT OF ENERGY CRISIS IN INDIA

In view of its significance and far-reaching implications for India's development prospects, an adequate energy supply becomes indispensable. However, despite marked increases in investment since the beginning of First Plan in energy sector, energy shortages have become a feature of life in India, particularly since 1968-69. As such, constraints affecting energy sector has emerged among the most important constraints on accelerated development in India today. In fact energy problem has been the issue of eighties, almost by common consent and ordinary citizens, captains of industry and policy-makers alike seem to be totally lost in confusion.

Energy crisis in India has become a serious challenge for the development of Indian economy. The problem of

meeting the increasing energy demands of the country is for minable indeed. It is not that India is running out of its energy resources. The crux of the matter is that there are not prospect of developing cheap and replenish able non-conventional sources of energy on a massive scale in the next decade or so. The real problem in India is, therefore, one of rising energy costs which will tend to inhabits the rate of economic growth. The present energy crisis in India can be ascribed to energy shortages and inadequate supplies of coal and petroleum products.

Long Term Requirement

Since energy sector involves large gestation lags, the paper also needs to look at the long-term requirement. The rate of growth and, therefore, the energy intensity are the key factors which impact the projections of future energy demand. The Expert Committee (EC) on Integrated Energy Policy, Planning Commission has projected primary energy demand for 2031–32 for India. Shown in Table below summarizes the range of projected requirement and supply. The projected requirement of coal has been estimated assuming its calorie content to be 4000 kcal per kg and 2865 kcal per kg for lignite.

Availability of Energy Resource

India is not endowed with large primary energy reserves in keeping with her vast geographical area, growing population, and increasing final energy needs. The distribution of primary commercial energy resources in the country is quite skewed. Whereas coal is abundant and is mostly concentrated in the eastern region, which accounts for nearly 70% of the total coal reserves, the western region has over 70% of the hydrocarbons reserves in the country. Similarly, more than 70% of the total hydro potential in the country is located in the northern and the north eastern regions. The southern region, which has only 6% of the coal reserves and 10% of the total hydro potential, has most of the lignite deposits occurring in the country.

Table-3

Projected Primary Energy Requirement for India, 2030

(All in Mtoe)

Fuel	Range of Requirements	Assumed Domestic Production	Range of Import#	Imports (%)
Coal including lignite	632–1022	560	72–462	11–45
Oil	350–486	35	315–451	90–93
Natural gas including coal bed methane (CBM)	100–197	100	0–97	0–49
Total commercial primary energy	1351–1702	–	387–1010	29–59

Coal and Lignite

Coal continues to be the major energy resource of the country. As on January 2014, the coal reserves were 553.3 billion tonnes (bt), out of which 117.92 bt are in the 'proved' category. The lignite reserves as on April 2014 were estimated at 78.27 bt, out of which 6.5 bt is in the proved category. If all the inferred reserves materialize, these reserves can sustain current level of production for 140 years.

Petroleum and Natural Gas

The balance of recoverable oil reserves as on 1 April 2014 is around 4653 mt (Directorate General of Hydrocarbon, DGH 2005–06 report), which can sustain the current level of production for the next 35 years. The current level of production barely caters to 46% of the petroleum products demand and the balance oil requirements are met by importing the crude. The current level of natural gas production in the country is inadequate to meet the industrial demand, particularly of the energy and fertilizer industries. LNG imports since 2012–13 have been able to bridge the gap partially. The situation is likely to improve once production starts

from Krishna– Godavari (K–G) basin reserves in a couple of years. Besides natural gas, the country has significant CBM and underground coal gasification (UCG) resources. Coal India Limited (CIL) and ONGC are already implementing two CBM projects. Blocks have also been allocated through competitive bidding process to private companies for exploration and exploitation of CBM. Production of 5.78 bcm from CBM and 4.99 bcm from UCG are included in the Twelfth Plan targets.

Nuclear Energy

At present, nuclear energy installed capacity is 3900 MWe which is 4.1% of total installed energy generation capacity and the Plant Load Factor (PLF) of Nuclear Energy stations is 67%. India's long-term nuclear energy programme is based on utilizing the vast indigenous resources of thorium for electricity generation. The three-stage nuclear energy development programme in India is aimed at converting thorium to fissile material. India is poorly endowed with uranium and available uranium resources can support 10000 MWe electricity generation programme based on pressurized heavy water reactors (PHWRs) using natural uranium as fuel and heavy water as moderator and coolant. The energy potential of natural uranium can be increased to about 300000 MWe in the second stage through fast breeder reactors (FBRs) which utilize plutonium obtained from the recycled spent fuel of the first stage along with thorium as blanket to produce U233. With the deployment of thorium in the third stage using U233 as fuel, the energy potential for electricity generation is large and substantial.

Renewable Sources of Energy

Projections made in the IEPR reveal that to achieve its development goals, India would need to rely increasingly on imported oil, gas, and coal in the medium term (2032). Against this backdrop, the role of new and renewable energy assumes added significance, irrespective of whether it replaces coal or oil. In this regard, IEPR recognizes 'the need to maximally develop domestic supply options as well as the need to diversify energy sources . . .', although renewable are likely to account for only around 5%–6% of the primary commercial energy-mix by 2032.

Given the growing concerns for climate change and energy security, it is imperative that this energy in the longer term will substantially increase its share in the fuel-mix. Continuing to support the growth of new and renewable energy is in the country's long-term interest, even though in the medium term this option might appear somewhat costlier.

Trends in Primary Energy Demand and Supply

The demand for energy, particularly for commercial energy, has been growing rapidly with the growth of the economy, changes in the demographic structure, rising urbanization, socio-economic development, and the desire for attaining and sustaining self-reliance in some sectors of the economy. Table below gives the trend of primary commercial energy demand and supply between 1960–61 and projected requirement for 2013–14.

While total primary energy requirement registered an average annual growth rate of 3.67% between 1990–91, the primary commercial energy requirement registered an average annual growth rate of 4.93% during the same period. The Eleventh Plan had envisaged a declining primary commercial energy intensity of GDP reflected in growth of 6.64% in primary commercial energy supply over the 2000–01 level while GDP grew at 8% implying an energy elasticity of 0.83. However, the primary commercial energy consumption actually registered a growth rate of 5.51% over the consumption level in 2000–01, whereas the economy registered an average growth rate of 7.8% during the Eleventh Plan period yielding an elasticity of primary commercial energy consumption with respect to the GDP of only about 0.71%.

Table-4
Trends in Demand and Supply of Primary Energy

(All in Mtoe#)

	1960–61	1970–71	1980–81	1990–91	2000–01	2011–12
Domestic production of commercial energy	36.78	47.67	75.19	150.01	207.08	435.32
Net imports	6.04	12.66	24.63	31.07	89.03	111.33
Total commercial energy	42.82	60.33	99.82	181.08	296.11	546.55
Non-commercial energy	74.38	86.72	108.48	122.07	136.64	169.456
Total primary energy demand	117.20	147.05	208.30	303.15	432.75	715.21

Source: Integrated Energy Policy Report (IEPR), 2012.

Non-commercial energy resources include the traditional fuels such as wood, cow dung, crop residue, and biogas and constitute a significant percentage of total primary energy consumption in the country. The households, particularly in rural areas, for meeting, use a larger share of these fuels their cooking and heating needs. The consumption of 147.56 mtoe of traditional fuels in 2011–12 includes consumption of 238 mt of fuel wood, 98 mt of dung, and 38 mt of agricultural waste. Around 80% of the fuel wood is used for household consumption and the balance is used by the cottage industry, hotels, etc.

The total energy need is met by different energy sources. Table gives the source-wise breakup of the energy demand and percentages of these met from domestic production, the rest coming from imports.
Our dependence on imports is growing. Table below shows that we imported 13.4% of our coal requirement, 73.4% of oil and product needs, and 1.6% of gas requirement. India needs to eliminate shortage of energy supply and enhance the availability of commercial energy resources if it has to sustain the projected 9% economic growth in the Twelfth Plan period. Table shows projected commercial energy requirement of all the available resources in the terminal year of the Twelfth Plan period in physical units. Coal demand of 731 mt covers 51 mt of imports. 74% of this is expected to be consumed by the energy sector including captive plants. Out of the oil demand of 145 mt, domestic production will be around 40 mt and the balance would be imported. Domestic availability of natural gas in the terminal year of the Twelfth Plan is expected to be about 47 bcm. An import of 23.75 mt of LNG would augment the supplies to meet the demand shortfall. There will be a gap of around 32 bcm between availability and demand if no addition by the private sector is achieved. The shortfall in availability will adversely affect the energy sector and fertilizer industry, which consume around 70% of the current gas demand.

Availability of hydro, wind, and nuclear energy is estimated assuming a capacity factor of 37% of hydro, 20% of wind, and 70% of nuclear taking into account the likely capacity additions during the Plan period.

Table-5
Source-wise Energy Demand

(All in mtoe)

	1960–61	1970–71	1980–81	1990–91	2000–01	2011–12
Coal	35.64	36.48	56.96	94.15	131.52	270.45
Lignite	0.01	0.81	1.23	3.58	6.43	13.52
Oil	8.29	19.14	32.26	57.75	106.97	186.32
Natural gas	–	0.60	1.41	11.49	25.07	48.62
Hydro energy	0.67	2.17	4.00	6.16	6.40	12.23
Nuclear energy	–	0.63	0.78	1.60	4.41	17.23
Wind energy	–	–	–	–	0.13	0.76
Total	44.61	59.83	96.73	174.73	280.93	546.32

Source: Planning Commission.

Table-6
Percentage Demand met from Domestic Sources

(All in %)

	1960–61	1970–71	1980–81	1990–91	2000–01	2011–12
Coal	100	100	99.7	97.8	96.1	93.02
Lignite	100	100	100	100	100	99.25
Oil	5.4	35.6	32.6	42.8	30.3	27.59
Natural gas/LNG	–	100	100	100	100	69.30
Hydro energy	100	100	100	99.93	99.96	95.94

Source: Planning Commission.

Table-7
Projected Commercial Energy Requirement for 2013–14 at the Rate of 9% Growth

Primary Fuel Unit Quantity

Primary Fuel	Unit	Quantity
Coal	mt	731
Lignite	mt	55.59
Oil	mt	145
Natural gas	bcm	106
Hydro energy	BkWh	165
Nuclear energy	BkWh	44.64
Wind energy	BkWh	7

Source: Working Group Reports of various sectors.

CAUSES OF ENERGY CRISIS IN INDIA

Several factors have contributed to the emergence of energy supply as a critical problem in India. Slow growth of generating capacity, operational inefficiency and delays in Civil works maintenance problem and interruptions in fuel supply, low utilization of capacity, rapid pace of rural electrification, periodic drought conditions, man-energy problem and industrial disputes and last but not the least, faulty planning are some of the principal causes responsible for energy shortages in India.

Slow Growth Rate of Generating Capacity

Slow growth of installed generating capacity, not in conformity with effective demand for energy, gave way to energy deficits in the country. It is clear that while effective demand for electric energy was continuously rising, the average annual increase in generating capacity was over 8 percent. The growth of generating capacity was particularly disappointing in the case of hydro and nuclear, where the average annual increase was only 5.4 percent and 4.9 percent respectively, due to the paucity of funds and much longer gestation period required by a hydro-electric project to yield benefits, which is indeed undesirable in the present state of a chronic shortage of capacity. Hence more of the limited funds are made available for the thermal generation investment programmed which yield benefits in the near future. Thus, slow growth of generating capacity being inconsistent with effective demand for energy, can be ascribed as a basic cause of energy shortages in India.

The slow growth of installed generating capacity in India, to a great extent, is the outcome of deficiencies in energy planning signified by the continuous failures of the planners in achieving the targeted additions to the installed generating capacity of the country in each successive plan and during the entire year of planning. The failures in achieving the targeted generating capacity in each plan are attributed to widespread and prolonged delays in civil works, shortages of key materials like steel, cement, electrodes, explosive and delays in the delivery of energy equipments. Delays in civil works and delays in the supply of energy equipment, which are believed to be the main causes responsible for the slippage of targeted generating capacity. Part of the explanation of ship page in the energy sector during each plan is apparently to be found in the financial procedures followed. Uncertainty over financing, and delay in the authorization for capital expenditure, have sometimes delayed ordinary of equipment. With rising costs and a consequent need to get periodical approval for higher expenditure estimates, which have probably become a more serious problem.

It may be mentioned here that since 1973, the Department of Atomic Energy has not been able to get any energy Plan operational. This can be ascribed to the decision of Canada to withdraw its assistance to the second unit of the Rajasthan project after the Bokhara explosion in 1974 causing a serious set back to the nuclear energy programmed. In retrospect, it is clear, that Indian scientists badly over-estimated their ability to do without foreign assistance. In addition, the decision of the Department of Atomic energy to go in for heavy water atomic reactors which use natural uranium fuel available in the country. This decision was taken due to the vexations problems of the import of enriched fuel. However, the performance of the Department of Atomic Energy in respect of the plants to manufacture heavy water has not been satisfactory mainly due to the lack of technical expertise and administrative carelessness and also, to a great extent due to the concentration of functions and responsibilities within a single agency.

Maintenance Problem and Operational Inefficiency

The persistence of operation problems and dissatisfactory maintenance practices at energy plants have also been responsible for accentuating energy shortages in the country. Frequent outages of thermal generating units due to the more intensive use of energy equipment, particularly in the wake of reduced hydro electric generation in periodic drought conditions have accounted for frequent disruptions in energy supply. A chronic problem leading to energy deficits in India has been equipment either under-used or kept idle for periods much longer than would normally be required for routine maintenance. The availability of generating capacity at thermal plants has, therefore, been reduced because of the long periods for which equipment has been out of service for overhaul of repairs. This has been party due to shortages of spares, particularly for important equipment where import licenses may be needed and where in other cases the particular designs are not longer in production. Another factor making for long outage periods is that equipment has often been kept working in case of very difficult supply position, ignoring the time of normal overhaul and preventive maintenance, with a consequently greater risk of serious breakdown. This has been a frequent practice in the Northern and Eastern regions. Further, operating problems have also emerged in energy stations, particularly but not only in Haryana, Uttar Pradesh and West Bengal because of man-energy problems and industrial disputes. Thus, as a result of these conjunctions of operating and maintenance problems accompanied by slow growth and under-utilization of

capacity, the energy situation grew increasingly difficult and precarious during the past years.

Interruptions of Fuel Supply and Periodic Drought Conditions

Another factor contributing to energy shortage in India has been the interruptions of fuel supplies. For thermal plants fuel supply has been a problem, notably in the lignite-based plant of Neyvelli and Ennore in Tamil Nadu and at Coal-burning plants in the South and West which are remote from coal fields. Interruptions of fuel supplies have caused equipment to be under-utilized even though it was in good working order. Where coal supplies have been available, problems have also arisen because the quality of the coal has been variable or inferior. Lack of quality control both at the mines and at the energy stations has resulted in operating difficulties and in damage to equipment. In some stations in Bihar and West Bengal high content of ash in coal and abrasive material has caused serious damage to preparation equipment and to boilers.

Apart from interruptions in fuel supplies, the vagaries of the masnsoon have also contributed to deficiencies in energy supply in India. The periodic drought conditions due to very poor monsoon rains over much the greater part of the country, contributed to acute shortage of energy on account of both the reduction in hydroelectric generation on one side and increase in the demand for energy for irrigation on the other. The resulting shortage of energy supply was naturally most acute in the regions most dependent on hydro energy. On the 17 major hydel reservoirs in the country, 8 reservoirs, including the Bhakra system in Punjab, Rihand in Uttar Pradesh, Balimela in Orissa and Sharavathy in Karnataka, which support about 40 percent of the total hydel energy generation, received scanty inflow of water due to failure of the monsoon. Thus, deficit rainfall in the Punjab, Haryana and Western Uttar Pradesh' in the Northern region, Madhya Pradesh in the Western region, Andhra Pradesh and Karnataka in the Southern Region and Orissa and parts of Bihar in the Eastern region led to shortfall in energy generation by hydel units and thereby to increasingly difficult and precarious energy situation.

Energy Crisis and its Impact on Indian Economy

As discussed earlier in this chapter, energy provides a basic infrastructure for the all round development of a country. Any imbalance in demand and supply of energy is bound to retard the pace of economic development. Though the effects of sustained energy shortages are hard to measure, the impact is undoubtedly severe. In the paper the impact of sustained drastic energy shortages over Indian economy has been examined.

It is not possible to estimate at all precisely the loss of industrial production attributable to restricted or interrupted supplies of fuel and energy, but it is clear that certain particular industries as well as majority of industries in the worst affected have suffered considerably. There is evidence that industrial growth is constrained by inadequate/ unasserted supplies of fuel and power. It can be said that in industries there has been loss of production because of failure or unreliability of fuels and power, though the importance of this factor in relation to other constraints cannot be precisely judged and differs from case to case. Since aluminum is one of the most energy-intensive industries, the considerable fall in output seems to be almost entirely attributable to energy shortages. Naturally, energy deficiencies have necessitated an increase in price of aluminum which has Jeopardized/endangered the rural electrification programme and the setting up of intermission lines. Production of cement has also been badly affected by the \shortages of power, coal and furnace oil during the last two years, especially in Plants in Andhra Pradesh, Tamil Nadu and Karnataka. The recent declining trends in the output of the cement industry resulted in a sharp rise in the imports of cement. Until recently, furnace oil was being liberally supplied to the cement industry in view of the inadequate availability of coal. But recently the Union Government has imposed a 10 per cent cut on the supplies of furnace oil to the cement industry without ensuring adequate coal supplies. It can, therefore, be predicted that the output of the cement industry would continue to be seriously affected due to the inadequate pressured supply of power in near future.

Jute and Cotton textile industries suffered considerable loss of output due to difficult coal and power supply position. in the country. Shortage of coal and deteriorated power situation in a number of textile producing states

like Maharashtra, Karnataka, Rajasthan, West Bengal, Gujarat and Uttar Pradesh affected the production of Jute and textile industries. Even where the captive diesel generating sets were installed, the low and high speed oil was not available. Except the textile mills in Bombay mills in the rest of the country are dependent in coal for their operation. Inadequate supplies of coal due to wagon shortages also adversely affected the output, unscheduled power cuts and the high voltage fluctuations harmed to electric installation and highly sophisticated continuous process machinery of cotton textile mills.

Iron and Steel Industry, which provides basis for much of the industrial production, has also suffered enormous loss of outset due to the inadequate availability of inputs like coal and power. Lack of power has been one of the main factors explaining the failure of nitrogenous fertilizer output to increase over the period under review despite massive expansion in the industry's capacity. In the case of paper the fall in production due to problems of coal supply and transport, as well as to interruptions of power supplies. Despite an expansion in the capacity of chemicals industries over the period under view, their growth has been affected due to lag in power supply.
In addition to the major industries of the country, the wide spread energy crisis and problems of coal supply and transport depressed production in medium and small industrial units in different parts of the country to a considerable extent. Besides substantial loss in production with an adverse impact on the revenues of the Government of India and the State Governments as well as on the earning of foreign exchange from exports, shortage of fuel and energy also caused mass lay-off and retrenchment limiting the opportunities for employment. Hundreds of passenger trains were cancelled by the Railways because of inadequate energy supplies.

SUGGESTION TO OVERCOME THE ENERGY SHORTAGE IN INDIA

In the foregoing explanation has been discussed in detail the causes and impact of energy crises in India. It now becomes necessary to suggest ways and means to overcome the energy crisis in the short term as well as to tackle the energy problems in future. Broadly, the prevailing inefficiencies in energy production and management, as outlined in the previous pages, need an urgent attention by the Government and the concerned agencies. In the following pages, suggestions on major aspects for handing the energy crisis have been made.
In the context of India's socio-economic objective and energy crisis, there seems an imperative need for a more rational energy policy for the country. The national energy policy should be based overwhelmingly on coal. This is very reasonable not only because the country is endowed with reasonably rich reserves of coal, but also because of the constraints that come in the wake of the total oil crisis. Of late, the Government of India has rightly decided, following the recommendations of the Fuel Policy Committee, that coal should be the primary source of energy in our country. Since it represents the most viable and reliable source of energy. With further growth in agricultural and industrial demand alongwith growth in production, further increase in energy consumption is certain. Thus, the national plan of energy generation calls for an accelerated development of coal-based and hydro-electric energy.

In view of the present state of energy crisis there is an urgent need for coordinated action for developing energy resources, developing new technologies through concerted research and development programmes, removing system inefficiencies, avoiding delays in construction of energy sectors and reviewing the overall energy policy of the country. Delays in the construction of energy sectors due to non-availability of scarce construction materials like cement, steel, electrodes, etc., high rate of system losses, operational and maintenance inefficiencies, which are clearly far from perfect can be safely avoided through prudent planning and effective management. Possibilities should also be explored to involve private sector in energy management so as to utilize private sector expertise to improve the performance of Government-owned energy plants.

CONCLUSIONS

Finally it may be concluded that the energy shortages in India are the outcome of deficiencies in energy planning, lower utilization of existing installed generating capacity, poor maintenance practices and operational inefficiencies, higher transmission and distribution lose, interruptions of fuel supply and periodic drought conditions and rapid pace of rural electrification. Problem of coal production and coal transport in India arising mainly due to energy shortage. Inadequate availability of explosive, shortages of inputs like steel, rails for underground transport system, mine-cars for carrying equipment and haulages, sand for stowing, spares, etc. and over and above, shortage of railway wagons have interrupted coal supplies in the country deteriorating the production of a number of coal-consuming industries.

Unless important remedial action is taken, the serious strain on the energy sector may adversely affect India's development strategy. Exercises by the Government of India and the Planning Commission about growth rates to be achieved in various sectors of the economy will have little meaning unless the Government is able to ensure the adequate supply of fuel and energy for all productive purposes through effort to remove the bottlenecks straining the Indian energy sector, and by intensive research and development programmes for harnessing the alternative sources of energy by adopting technologies to emerging realities. The problem of energy development can also be solved if we encourage foreign collaboration in the development of energy sectors in the country. The next chapter is, therefore, dedicated to highlight the importance and role of foreign collaboration in India vis-a-vis energy development.

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