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Study of Energy Sector with Special Reference to India's Perspective

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Abstract

India's energy and economic development has a cause and effect relationship. With India being a growing economy, there is external resistance for sacrificing economic growth for the sake of protecting environment in the future. A study covers concept of energy and sustainable development, India's energy demand in high growth scenario, production and consumption of energy, energy and its impact on environment of India, recommendations of energy saving and also shown that T&D losses, covering the usual technical losses and the unusual thefts, were higher in the states where law and order where inferior. Whatever political party comes in power becomes corrupt and runs the Board administration accordingly. The systemic problems with the SEBs has stemmed from the corrupt political system. Under such a situation no amount of legislation can help – Electricity Act, 2003 is no exception. A strong political will and the proper enforcement of the existing electricity rules can improve the situation properly.

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1. INTRODUCTION

A nation's infrastructure development plays a significant role in its economic growth. A fast growing economy warrants an even faster development of infrastructure. Any discussion about India's infrastructure has to briefly cover the planning carried out for the country's economic growth, since Independence. The concept of 'sustainable development's is not new to India. Through the preaching of great saints like Mahavir, Buddha, Ashoka and Gandhi, the concept of sacrifice for others became the integral part of the oriental philosophy. Energy is the prime mover for the growth of Indian economy and in order to ensure adequate energy generation to meet the demand India has to depend on the natural resources indigenously or through imports. In order to meet its energy needs the country has tried to obtain energy from various natural resources including wood, coal, natural gas, hydro, wind, solar etc. Technological innovation and industrialization has led to the over exploitation of natural resources beyond limits to satisfy the insatiable lust of greed by humans worldwide.

2. ENERGY

Energy is a critical factor in infrastructure for sustained economic development. In addition to its widely recognized role in development of different sectors of the economy, it makes a direct and significant contribution to economy in terms of revenue generation, increasing employment opportunities and enhancing the quality of life.

3. OBJECTIVES OF THE STUDY

The present paper is carried out with the following objectives.

1. To review of India's energy demand in present and future
2. Overview of the National Energy Development Strategy
3. To study the production and supply position of Energy in India.
4. To suggest suitable measure to overcoming short falls in energy.

4. METHODOLOGY OF THE STUDY

This paper is prepared on the basis of secondary sources of data, such as books, study material of professional courses, government department reports as well as websites and some extent primary observations of the researchers.

5. ENERGY AND SUSTAINABLE DEVELOPMENT

Near about 78% of the rural people and 30% of the urban population of India are still dependent on fuel wood and chips as their main fuel source. The dependence on fuel wood in rural areas implies that carbon sequestration or conservation cannot be achieved in isolation without fuel wood or integrated land use management or energy substitution policies. Analyzing two CDM projects undertaken in India, Down to Earth (2005) commented that 'sustainable development was not an important goal' to such projects.

Per capita consumption of energy in India is one of the lowest in the world. India consumed 520 kg. of oil equivalent per person of primary energy in 2003 compared to 1090 kg in China and to the world average of 1,688 kg. The consumption in the US was 7835 kg per person. The per capita electricity consumption is also very low at 435 kwh. As the level of economic development is

positively co-related to per capita energy consumption, the energy consumption figures in India are in line with its low per capita income.

India's energy and economic development has a cause and effect relationship. With India being a growing economy, there is external resistance for sacrificing economic growth for the sake of protecting environment in the future. But India needs to keep up the pace of economic growth to ensure the good of its masses. Of late it has veered towards the inclusive growth of the neglected and marginalized sections of society. India needs economic growth and development to free itself from the evil clutches of poverty and hunger. To ensure the desired rate of growth of the economy it also needs adequate energy either indigenously or by means of import. This entails that in order to maintain the required economic growth India would have to exploit the natural resources in the form of coal, hydro, gas nuclear, and wind. But the challenge is how it can harness the energy resources so as to ensure its energy needs and at the same time make it sustainable for its future generations.

India's Integrated Energy Policy Report 2008 lays stress on the energy security aspects as well diversification of its fuel mix coupled with indigenous use of resources to meet its energy challenges and its efforts to raise its level of human development."India faces formidable challenges in meeting its energy needs and in providing adequate energy of desired quality in various forms in a sustainable manner at competitive prices. India needs to sustain an 8% to 10% economic growth rate, over next 25 years, if it is to eradicate poverty and meet its human development goals". In order to deliver a sustained growth of 8% through 2031, India would at least need to grow its primary energy supply by 3 to 4 times whereas the electricity supply needs to grow at the rate of 5 to 7 times the present consumption. In real sense of the Indian context, the issue of sustainability is larger compared to OECD countries as we as a nation have to address the basic needs of teeming millions both today as well as tomorrow? Environmental taxes, green taxes, carbon taxes, and subsidies etc. needs to be levied so as to affect choices of end users.

6. INDIA'S ENERGY DEMAND IN THE HIGH GROWTH SCENARIO

In India, there is close relation between energy and sustainable economic development and environment. Energy security and sustainable development are critical issues to ensure India's economic growth and its human development objectives. With India being a growing economy, there is external resistance for sacrificing economic growth for the sake of protecting environment in the future. But India needs to keep up the pace of economic growth to ensure the good of its masses. Its initial five year plans mostly focused on the urban development as a result of which there has been no equitable distribution of wealth across the urban and rural or across the rich and the poor. The per capita energy consumption in India is one of the lowest compared to world average but nonetheless it's highly energy intensive and ranks poorly in terms of energy efficiency.

As per table No-1.1 shows that

1. The position of the India's energy demands in increasing. Average annual demand growth is 5%, 4.8% and 4.1% in coal, oil and Hydro energy respectively it is below 5% annual demand growth.
2. On the other hand Gas, Nuclear and Other renewable energy average annual growth demand rate is more than 5%. It is observed that Nuclear energy has highest demand in India. It

shows and proves that atomic energy projects are essential for fulfilling gap in the demand and supply of energy in India.

3. The demand of energy is increasing day by day due to industrialization, urbanization and use of electric instruments in agricultural sector and domestic appliances.
4. Most of the energy generation is based on coal which is again a big contributor towards the green house gas emissions.

Table-1: India's Energy Demand and proposed Growth.

	2005	2015	2030	2005-2030*	Difference from the Reference Scenario in 2030	
					Mtoe	%
Coal	208	337	700	5.0%	79.9	12.9
Oil	129	204	416	4.8%	88.3	26.9
Gas	29	61	136	6.4%	43.2	46.7
Nuclear	5	17	40	9.2%	6.9	20.7
Hydro	9	14	24	4.1%	1.4	6.3
Biomass and waste	158	167	183	0.6%	–11.6	–6.0
Other renewables	1	5	10	12.3%	1.1	13.2
Total	**537**	**804**	**1 508**	**4.2%**	**209.2**	**16.1**

* Average annual rate of growth.

Source: World Energy Outlook, 2010

The present scenario shows that the Consumption of coal increased from 129.5 million tons to 204. million tons. 70% of the consumed coal was used for generating electricity. The New and Renewable Energy Policy 2005, document indicates that, of the total emission of 1572 MMT in 2001-02, CO2 emission from energy sector was 60%. The sector-wise contributions to the total energy related carbon-dioxide emissions in 1997-98 were as follows: Power (36.51%); industry (19.47%); transport (7.84%); residential 34.92%; agriculture (0.87%), and commercial (0.97%). GDP and manufacturing sector grew at a faster rate during this period. Electricity consumption (kwh) per capita has also increased from 173 kwh in 1980 to 569 kwh in 2002.

Table-2: Production and Availability of Energy -2005-06 (MMTOE).

Sector/Source	Domestic	Net Import	Total
Fuel (commercial)			328
Coal and lignite	170.35	14.00	184.35
Oil &Products	33.38	82.62	116.00
Gas	27.65	00	27.65
Non-fuel	---	--	8.29
Hydraulic	6.67	-	-
Wind	0.29		
Nuclear	1.53		
Non- commercial			155.89
Fuel wood	115.44		
Agro wast	17.12		
Dung cake	22.62		
Bio – gas	0.71		
Grand Total	395.56 (80.28)	96.62(19.72)	492.18(100)

Source- Planning commission, 2006.

As per above table No -2 it reveals that total production and availability of energy in India was 492.18mmtoe. Out of which 395.56MMTOE (80.28%) energy avails in domestic sector. In other words it is produced in India and only 96.62MMTOE (19.72%) energy imported from other countries.

Table-3 Consumption of Energy -2005-06 (MMTOE)

Sector /Source	Power Generat	Loss/ self consum.	House hold	Agri.	Transport	Industry	Services
Coal and lignite	131.61	0.00	0.55	0.00	0.00	52.19	0.00
Oil &Products	6.96	8.24	19.37	7.76	34.02	19.75	19.90
Gas	10.02	4.38	.08	0.12	0.52	12.53	0.00
Fuel wood			92.57				22.87
Agro wast			17.12				
Dung cake			22.62				
Bio – gas			0.71				
Grand Total **(483.88)**	**148.59**	**12.62**	**153.02**	**7.88**	**34.54**	**84.47**	**42.77**

Source- Planning commission, 2006.

The Economic Survey, 2005-06, reveals that the power shortage that occur around 12% in peak and 8% on average is equivalent to Rs 15,000 crores of fore gone generation and associated GDP loss of Rs 300000 crores.

7. ENERGY AND ITS IMPACT ON ENVIRONMENT IN INDIA

1. A study was carried out at J. N University, New Delhi, to compare the energy and environmental impact of the rail and road transportation. The result of the base year 2000-01 was presented as an indication of the relative impact of the two modes. The findings were: if freight movement and passenger movement via road by combination of car and bus were considered, the rail mode was always superior in terms of energy efficiency.
2. Near about 78% of the rural people and 30% of the urban population of India are still dependent on fuel wood and chips as their main fuel source. The dependence on fuel wood in rural areas implies that carbon sequestration or conservation cannot be achieved in isolation without fuel wood or integrated land use management or energy substitution policies.
3. Rail is the superior form of transport for the movement of freight. An additional exercise was carried out to look into the effects of substitution of gas for coal at thermal power plants. Emissions attributable to the consumption of electricity by the rail come down drastically and rail became environmentally less damaging vis-a-vis emissions from road travel. The policy recommendation resulting from the study promoted transportation via rail mode over road especially in the interests of sustainable intercity transport.

8. OVERVIEW OF THE NATIONAL ENERGY DEVELOPMENT STRATEGY

For the first time in independent India, the Draft Report of the Expert Committee on Integrated Energy Policy has tried to address the energy issues of the country from a holistic prospective and tried to evolve an Energy Policy that reflects the aspiration of an independent country. Over the past six decades India has failed miserably to formulate an energy policy that integrates all available energy options. The previous two major policy statements (the Fuel Policy Committee,

1974 and the Working Group of Energy Policy, 1979) were full of policy recommendation, most of which were not implemented. There are concerns about the latest report origins as, in the case of the previous two committees, this committee was also formed at a time when the international price of crude oil was increasing. This report, like its predecessors, is a reaction to an eminent crisis. Should the crisis be resolved quickly, it is more than likely that the recommendations on self reliance, security, technology mission etc., will remain on paper only.

A plan to pipe gas from Iran to India via Pakistan has particularly worried US policymakers. The Prime Minister M. M Singh acted to allay their concerns to some extent by removing this high profile and independent-minded petroleum minister from his position in a reshuffle in January 2006. A pro-US right wing politician has replaced him. As the trans-Asia gas pipeline was central to Mr Aiyar's energy policy his sudden removal from the Ministry of Petroleum has raised suspicions within India about Mr Singh's willingness to align his economic and foreign policy more closely with US interests. Recently India, under pressure from US, has voted against Iran- its long trusted friend and major supplier of crude. All these factors reinforce the apprehension that the strong policy recommendations on energy security will be watered down in the final report, on April 2006.

According to the proposed plan, from a purely socio-economic perspective, the 'availability' objective could be achieved by arranging supplies through three streams of generation:

1. The cheapest power generating stations meet agricultural and other socially relevant demands;

2. The demand of existing consumers (poor households and agriculture) above their entitlement would be met from the pooled power of utilities.
3. The emerging large demand would be met by new private/public/captive power stations through mutually arranged commercial contracts using the transmission/sub-transmission lines of utilities bearing pre-announced wheeling charges. In effect, such consumers would pay the marginal cost of power.

Table 4: Scenario for Fuel Mix in Year 2031-32 (MMTOE)
(Assuming 8% GDP growth)

Scenario Description	Coal Dominant Case	%	Renewable Dominant Case	%
Oil	467	28%	406	29%
Natural Gas	114	7%	163	12%
Coal	1082	65%	659	42%
Hydro	5	0%	50	4%
Nuclear	3	0%	89	6%
Wind	1	0%	12	1%
Bio-diesel	-	-	12	1%
Total	1672	100%	1383	100%

Source: Planning Commission, 2005.

It is clear that coal shall remain India's most important energy source until 2031-32 and possibly beyond. India will need to take a lead in seeking clean coal technologies and, given its growing demand, new coal extraction technologies such as in-situ gasification in order to tap its vast coal reserves that are currently difficult to extract (from an economic perspective) using conventional technologies. The committee has concluded that imported coal is far more cost-competitive than imported gas for power generation especially along the western and southern coasts of India. This preference for coal over gas is likely to continue for a while.

As per above Table No-4 By 2031-32 power generations' capacity would have to increase to 778095 MW and annual cost requirement would be 2040 MMT. Meeting this vision would require that India pursues all available fuel options and forms of energy, both conventional and non-conventional, as well as new and emerging technologies and energy sources. Assuming an 8% growth rate, the Expert Committee has made ten different projections with varied energy mix combinations for the year 2031-32. In all the projections, the share of coal ranged between 65% and 42%, share of oil varied between 34% and 28%, gas had a share ranging between 12% and 7% while nuclear share could rise up to a maximum of 6%.

9. RECOMMENDATIONS FOR ENERGY SAVING

1. Energy efficiency and conservation programs and standards should be established and enforced. The Bureau of Energy Efficiency (BEE) should develop such standards for all energy intensive industries and appliance and develop modalities for a system of incentives/penalties for compliance/noncompliance.
2. The BEE should be made autonomous and independent of the Ministry of Power. It should be funded by a contribution from all energy Ministries or from a tax on fuels and electricity and an adjusted tax on fuels for generating electricity. BEE staffing should be substantially strengthened.
3. Existing national energy efficiency organizations like the Petroleum Conservation Research Association (PCRA) should be merged with BEE. This will ensure that BEE is responsible for energy efficiency for all sectors and all end uses.
4. For the purpose of civil society's involvement in the energy sector, need to organize awareness creation campaign on the role and need for new and renewable energy systems/devices in everyday life.
5. Adequate technologies and allocation of funds for energy related R&D needs to be promoted for developing indigenous solutions which are typical to India.
9. The lack of energy transportation and distribution infrastructure needs to be addressed.
10. The government should make efforts to attract private capital into infrastructure. An important step in these initiatives would help achieve the objectives of high economic growth coupled with equity on a sustainable basis.
11. The regulator needs to be empowered so as to facilitate creation of markets and setting up of effective tariffs. The pricing mechanism in the energy sector is distorted and also there is an irrational tax structure. It makes the business unsustainable.
12. The pricing and the tax structure as such needs to be rationalized to make the energy sector financially viable and sustainable. In order to improve energy security, state needs to adopt

energy efficiency measures, go for Demand Side Management in the entire value chain and reduce import dependence.

13. Village is the nucleus of economic development as far as India is concerned. Keeping in view the millions living in the villages and thriving on conventional fuels for cooking and lighting, the Ministry of Environment and Forests who is entrusted with the issues related to Sustainable Development needs to take up the challenge of meeting their objectives in a time bound manner.
14. Basic education which promotes functional literacy, livelihood skills, understanding of the saving of electricity and values of responsible citizenship is a precondition for sustainable development.
15. Four technology approaches may be adopted which are as under.
    - **a**. Coal technology: (i) recovering coal bed methane and mine mouth methane; (ii) in-situ coal gasification; (iii) carbon capture and sequestration; and (iv)integrated gasification combined cycle (IGCC)
    - **b**. Solar: A technology approach should be initiated to bring down the cost of solar photovoltaic or solar thermal by a factor of five as soon as possible.
    - **c**. Bio-fuels: (i) A bio-fuel mission to plant Jatropha or other appropriate oil plants on half a million hectare of wasteland within two years should be undertaken; (ii) biomass plantation and wood gasification,; and (iii) community biogas plants run on commercial basis.
    - **d.** In addition to this, coordinated research efforts were suggested for the development of nuclear technology including fusion power & battery and hydrogen technology
16. A recent study revealed that transporting commodities through railways saves substantial amount of fuel. In addition to cutting transportation cost and reducing dependence on crude imports, reduced fuel consumption means reduced toxic gas emissions as well. Thus significant savings of diesel is possible if railways operations can be upgraded to win back the haulage lost to road traffic.
17. Energy related R&D did not get the resources it needed. The Expert Committee strongly felt the need to focus on research on energy generation, distribution and conservation.
18. Reduce energy requirements through application of better technology to improve fuel efficiency, reliance on rail transport etc.;
19. Substitute imported energy with domestic alternatives such as the use of bio diesel etc. Coal can be converted into oil as is being done in South Africa. The technology is well developed and in use for years.
20. Diversify supply mode such as importation of gas through pipelines, importation of hydro power through Nepal/Bhutan.

10. ENVIRONMENTAL SUSTAINABILITY- INDICATOR OF CO_2 EMISSION KG/CAPITA

By global standard carbon emission per capita is relatively low in India due to low energy consumption which has led to a low GDP per capita. However, CO_2 emissions have increased marginally 1990 to 2006 for the following reasons:

1. The number of registered vehicles has increased by over 250%between 1991 and 2001-06. The corresponding figures are 21.37 million and 58.86 millions.

2. During the same period, the consumption of coal and production of petroleum products increased steeply.
3. The refinery throughput increased from 51.8 million tons to 112.6 million tons. India today is largely self-sufficient in its petroleum product production.
4. Major imports are LPG while diesel, petrol and STF are exported. As refinery throughput has increased, the environmental pollution has increased.
5. India bore an increased pollution burden by importing and processing high levels of crude oil in its refineries.
6. The technology approach to telecommunications (C-DoT) undertaken in late 1980s that changed the entire telephony system of India within a span of ten years. It is hoped that these focused and targeted technology approaches will result in drastic changes in India's fuel mix of India and perhaps assist other countries to do the same.

11. CONCLUSION

A study had shown that T&D losses, covering the usual technical losses and the unusual thefts, were higher in the states where law and order where inferior. Thus, the parties in power are corrupt and run the Board administration accordingly. The systemic problems with the SEBs has stemmed from the corrupt political system. Under such a situation no amount of legislation can help – Electricity Act, 2003 is no exception. A strong political will and the proper enforcement of the existing electricity rules can improve the situation properly.

Reforms are being introduced to bring in competition and to lower prices. Trading of power is also being introduced. But the reform experience in other countries-both in developed and developing – has established one simple fact; private operators are intent on maximizing profits and with the kind of regulatory mechanism that does not include strong public participation, consumers will have to pay higher prices.

The country through new and renewable energy sources in furtherance of the aim of Accessibility; and fuel-switching through new and renewable energy system/device development in future is the aim of conventional Energy Conservation. The New and Renewable Energy Policy, 2005 has prepared a detailed study on the indicative time frame for commercial viability of various new and renewable energy sources. As per that time frame, between 2005 and 2010 only two forms of renewable energy are expected to be commercially viable. Thus, in the long-term sustainable contribution from renewable energy sources can be expected.

REFERENCE

[1]. Arunabha, G. (2009). Competing needs: Clean coal is key, Article published in Mint Newspaper-April 28.
[2]. Arvind Jasrotia, Environmental Protection and Sustainable Development.
[3]. Bureau of Energy Efficiency, website: www.bee-india.nic.in
[4]. Dey, D. Energy and Sustainable Development in India, Paper published by HELIO International/India.
[5]. Economic Survey of India 2009-10.
[6]. GOI, Planning Commission, 8th Five Year Plan, Vol2; MNES New and Renewable Energy Policy, Draft II, 2005

[7]. Integrated Energy Policy, 2008 Report by, Planning Commission, Government of India.
[8]. Institute for the Analysis of Global Security www.iags.org/n0121043.htm
[9]. Kunja-Bihari Nayak. (2008). Sustainable Development (An Alternative Approach in Rabindranath Tagore's Vision, New Delhi: Serials Publication, pp-223
[10]. Ministry of Environment and Forests, GoI, Annual Report 2007-08.
[11]. Planning Commission, 2005, Draft Report of the Expert Committee on Integrated Energy Policy, New Delhi.
[12]. Sunderlal Bahuguna- "Sustainable Development in India: Perspectives," www.envfor.nic.in
[13]. Sajal Ghosh, Electricity Consumption and Economic Growth, Paper published by Elsevier Energy Policy 2002
[14]. TERI, Summit Bulletin, February 2006.
[15]. The Economic Times, 28.2.2006.
[16]. World Energy Outlook 2008, Published by International Energy Agency. [6] World Energy Outlook 2007, Published by International Energy Agency.
[17]. Website Central Pollution Control Board, Govt. of India.
[18]. http://www.tmcnet.com/usubmit/2006/02/27/1412052.htm