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A Review of India's Internal Energy Market: Its Present Status, Future Challenges and Mitigation

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Abstract—*Energy is an important criteria for the measurement of development of a nation. Internal energy market of a nation is a characteristic of both the productivity and demand of energy. Indian economy is currently in a developing stage where the demand of energy is increasing to be in pace with industrialization, urbanization and day to day requirements of a population which exceeds 1.2 billion in number.*

For years, the conventional energy source in India has been thermal power, primarily due to the availability of huge coal deposits, particularly in the eastern states. This is followed by hydropower which is produced from dams and has been facilitated by the great number of perennial and non-perennial rivers which are regularly flooded during the monsoon. This paper does a comparative study of energy produced from different sources, an analysis of the efficiency of the conventional energy source, i.e., fossil fuels and study of India's energy market to predict its future pattern of growth and probable challenges. This paper also offers suggestive measures to face those challenges.

This paper concludes that in order to meet the future growth in demand of energy and to overcome the present deficiency in production of the same certain measures needs to be taken. These can be achieved by increasing the efficiency of thermal power through proper policies and exploitation of the huge potential of non-conventional and renewable sources of energy available in the country.

Keywords: *Thermal power, hydro power, non-conventional energy sources, energy deficit, industrialization, urbanization, renewable energy sources, nuclear power*

1. INTRODUCTION

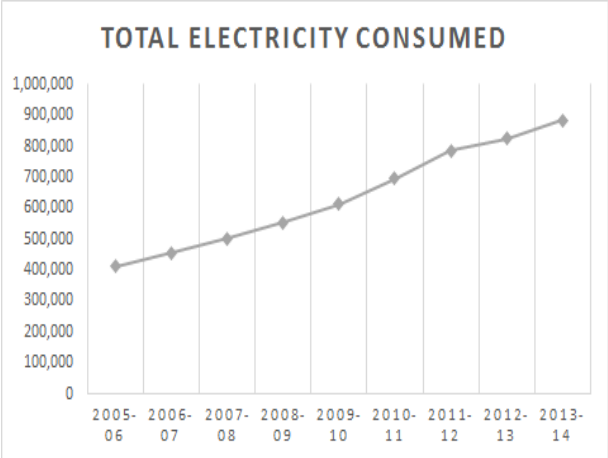
A drastic change in the pattern of growth has been long awaiting in the Indian economy, especially since liberalization in foreign policies in 1991. The present annual growth rate of the economy at around 5% of the GDP coupled with a projected growth rate 0f 8-9% per annum are significant indications to be taken cognizance of the changing economic scenario. This is a significant indication of changes in terms of increment in per capita earning, higher standard of living and rapid urbanization and industrialization. Furthermore, these changes indicates higher energy demand, primarily for vehicular fuels, industrial processes and domestic and office electricity requirements.

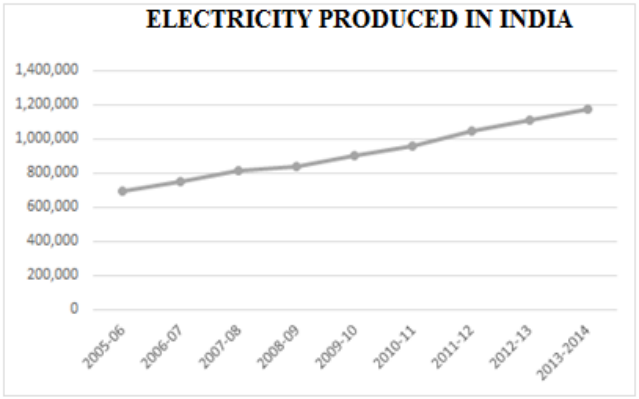
Energy crisis, in present day is a global phenomenon and India's internal energy market is not abhorred from this problem. Indian energy market is highly dependent on conventional sources of energy which are not only limited and non-renewable but also potentially environmental hazards. According to estimations in the Integrated Energy Policy Report of the Planning Commission of India, 2006, a six-fold increase in the requirement of electricity and four times increment in the requirement of crude oil is to be implied to grow at a sustained GDP till 2030. This is a clear indication of the difference in the demand and supply of energy in India's internal energy market. Thus, in order to keep pace with the growing demand of energy in India, stirred by drivers like industrialization, urbanization, higher income and aspirations of the citizens and to simultaneously ensure energy security for the future, the country must not only increase the efficiency of the conventional energy sources but also look for other non-conventional and renewable sources of energy. This is possible only through detailed study of the nation's large reserve of natural resources and research and development in engineering so as to use them judiciously and efficiently.

2. PRESENT STATUS OF INDIA'S ENERGY MARKET

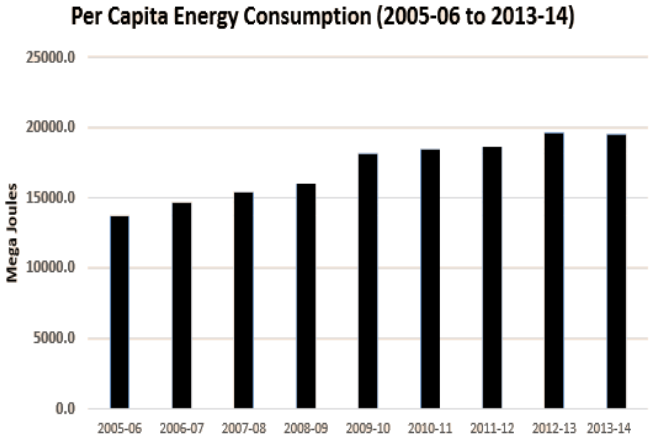
A. Demand of Energy in Indian Market

As per Energy Statistics 2015 published by the Central Statistics Office, Government of India, the electricity consumption of in 2013-14 has been 8,82,592 GWh at a CAGR of 8.84% from 2005-06.





Source: Central Electricity Authority



The ratio of the estimate of the total energy consumption during the year to the estimated mid-year population of that year is the per-capita energy consumption (PEC), which was 19522.15 Mega Joules in 2013-14. From 2005-06 to 2013-14 the compound annual growth rate (CAGR) in PEC was 4.53%.

SECTOR	CONSUMPTION
Industry	43.83%
Domestic	22.46%
Agriculture	18.03%
Commercial	8.72%
Others	7%

Sector wise Consumption of Electricity during 2013-2014

The increase in demand of electricity has been highest for industry and commercial sector with CAGRs of 10.97% and 8.82% respectively, from 2005-06 to 2013-14.

B. Production of Energy in the Indian Market

Total electricity generation in India, from utilities and non-utilities taken together for the period of 2013-14 was 11,79,256 GWh of which 8,53,683 GWh was generated from thermal, 1,34,731 GWh from hydro, 34,200 GWh from nuclear and 1,56,642 GWh from non-utilities.

The CAGR from 2005-06 to 2013-14 of electricity production has been 6.01% whereas the growth rate from 2012-13 to 2013-15 has been 6.07%.

Electricity production from different sources for 2013-14

SOURCE	ELECTRICITY PRODUCED IN GWh	CAGR 2005-06 TO 2013-14 (%)
Thermal	853,683	6.01%
Hydro	134,731	3.20%
Nuclear	34,200	7.85%
Non-Utilities	156,642	8.75%
TOTAL	1,179,256	6.01%

Source: Central Electricity Authority

The CAGR in production of electricity at 6.01% has been lower than that of demand at 8.84%, though the net electricity production is higher than the consumption, which is 74.84% of the total production.

3. CONVENTIONAL SOURCE OF ENERGY IN INDIA'S MARKET

Inferences from the study of the present status of India's internal energy market clearly indicates that thermal power is major sources of energy in India's market it can be seen that thermal energy is the main source of energy followed by hydro and nuclear.

Coal, crude oiland natural gas are the prime resources for the production of thermal energy.

A. COAL

The deposits of coal in India is primarily limited to the southern and eastern part of the country. The states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra alone accounts for more than 99% of the total coal reserves of the country. As on March 31st 2014, the estimated reserve of coal was 301.05 billion tones.

Proved	42%
Indicated	47%
Inferred	11%

There has been an increase of 0.7% in the estimated coal reserves during the year 2013-14.

B. CRUDE OIL

The estimated reserve of crude oil as on March 31st 2014 was 762.74 million tons (MT).

REGION	DEPOSIT OF CRUDE OIL (%)
Western Offshore	43%
Assam	23%
Gujrat	18%
Eastern Offshore	7%
Rajasthan	6%
Andhra Pradesh	2%
Tamil Nadu	1%

Geographical distribution of crude oil indicates that the maximum reserves are in the western off-shore followed by Assam.

C. NATURAL GAS

The estimated reserves of natural gas in India as on 31.03.2014 stood at 1427.15 billion cubic meters (BCM).

REGION	DEPOSIT OF NATURAL GAS
Eastern Offshore	37%
Western offshore	30%
Assam	10%
CBM	7%
Gujrat	5%
Tripura	3%
Tamil Nadu	3%
Andhra Pradesh	3%
Rajasthan	1%

The maximum reserves of natural gas are in the Eastern Offshore followed by the Western Offshore.

4. FUTURE CHALLENGES TO INDIA'S INTERNAL ENERGY MARKET

Numerous policy reforms over the last few decades (approx. 20 years), have transformed the energy sector of India from a predominantly government owned system towards one based on market principles, thereby offering a optimum playing field for both public and private sectors. The overview of the individual fuel sector shows that different degrees of progress were made in each of them over the last two decades.

1) The power sector achieved a greater degree of liberalization, allowing private investment along the entire value chain-generation, transmission and distribution.
2) The oil and gas sector is highly liberalized to attract private investment and to increase domestic production.
3) The renewable sector features strong private investments which are essential to materialize the potential of renewable for supplying a clean and modern energy, particularly in rural areas.
4) The nuclear sector is exclusively controlled by the central government and recently obtained access to global nuclear industry and technology.

The goal of providing energy access to the entire population led to well-meaning policies which are designed to protect the poor, but resulted in a system of untargeted producer and consumer subsidies that prevent a more thorough implementation of a well-functioning and financially sound energy sector. In combination with an industrial policy that aims to protect the indigenous manufacturing industry through import substitution, India now finds itself trapped halfway along the transition toward an open and well performing energy sector.

India's Energy sector is increasingly unable to deliver a secured supply of energy abide of growing demands and fuel imparts. In conjunction with a rising subsidiary levels and systemic failure to ensure proper revenue collection along the value chain, the financial capacity of energy sector players is significantly undermined. Lack of sufficient capacity to make timely and adequate investment gives reason to fear that India is heading towards energy crisis.Political complexity and a tradition of socialist economic practices, however hindered the complete liberalization of India's energy sector, leading to sub-optimal outcomes. In this sense, the huge blackouts that occurred in Northern India in July 2012 could be seen as a consequence within the framework of incomplete market liberalization. Indian energy policy cannot be set in isolation and needs to account for rising global interdependence, while simultaneously communicated appropriately to the public and reflected in policy debates.

5. MITIGATION

There are six main challenges that need to be addressed to create a well-functioning and financially viable energy market in India:-

1) The Core Capacity of players in India's Energy sector-mainly energy companies should be improved.
2) Pricing Mechanism in the energy sector must ensure commercial viability and send proper signals to the market.
3) India requires significant investment to meet its growing energy demand and provide access to all the citizens
4) An increase in effective implementation of energy policies is required through the improvement of

bureaucratic and administrative processes to assure a timely completion of energy projects.

5) Truly integrated and consistent energy policy is critical to guide and direct India's energy sector and ensure investment.

Strong political will is a pre-requisite to successfully cope with energy sector challenges.

To complete the transformation of India's energy sector into an open and functioning energy market, the country needs strong political leadership to convey the vivid policy messages. India needs to align its energy policies and institutions with global practices to meet the increasing need for investments and the integration of India's energy sector into the global energy market.

Besides policy changes in the energy market the country must re-engineer its sources of energy from conventional and non-renewable sources to non-conventional and renewable sources of energy.

RENEWABLE ENERGY SOURCE	ESTIMATED POTENTIAL (MW)
Wind Power	102772 MW
Small Hydro Power	19749 MW
Bio Mass Power	17538 MW
Cogeneration-Bagasse	5000 MW
Waste to Energy	2556 MW
TOTAL	147615 MW

Estimated Potential of Renewable Power in India as on 31.03.2014

Source: Ministry of New and Renewable Energy

India has a huge potential for wind power generation which is waiting to be exploited.

6. CONCLUSION

Energy crisis is a global phenomenon and India too is affected by it. The growth of Indian economy leading to urbanization, industrialization, increasing per capita income and higher standard of living is creating a huge demand for energy, especially for electricity. At present, the net consumption is around 75% percent of the total production but the CAGR of consumption has been higher than that of production. In order to meet the growing demand for energy the authorities needs to take certain steps. These primarily includes changes in policy for production, procurement and market regulations. A slow and steady transition needs to be undertaken so as to reduce dependence on conventional and non-renewable energy sources to non-conventional and renewable energy sources.

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