

A Study and Recent Trends about Sources of Energy as Strategic Commodity

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Abstract: Energy is one of the most fundamental parts of universe. Energy has come to be known as a 'strategic commodity' and any uncertainty about its supply can threaten the functioning of the entire economy, particularly in developing economies. India's substantial and sustained economic growth is placing enormous demand on its energy resources. The demand and supply imbalance in energy sources is pervasive requiring serious threats of India to augment energy supplies as India faces possible severe energy supply constraints. Energy requirement in our country is increasing at a very rapid rate. Achieving energy security in this strategic sense is of fundamental importance not only to India's economic growth but also for the human development objectives that aim at alleviation of poverty, unemployment and meeting the Millennium Development Goals (MDGs). Holistic planning for achieving these objectives requires quality energy statistics that is able to address the issues related to energy demand, energy poverty and environmental effects of energy growth. This paper presents the Energy Balance and efforts are being made to reduce the gap between different sources of energy to cater to the needs of the planners, policy makers.

Keywords: Energy security, Human development objectives, Millennium Development Goals, Energy Balance

1. Introduction

The energy policy of India is largely defined by the country's expanding energy deficit and increased focus on developing alternative sources of energy particularly nuclear, solar and wind energy. The energy consumption in India is the fourth biggest after China, USA and Russia. The total primary energy consumption from crude oil (29.45%), natural gas (7.7%), coal (54.5%), nuclear energy (1.26%), hydro electricity (5.0%), wind power, biomass electricity and solar power is 595 Mtoe in the year 2013. In the year 2013, India's net imports are nearly 144.3 million tons of crude oil, 16 Mtoe of LNG and 95 Mtoe coal totaling to 255.3 Mtoe of primary energy which is equal to 42.9% of total primary energy consumption [1]. About 70% of India's electricity generation capacity is from fossil fuels. India is largely dependent on fossil fuel imports to meet its energy demands — by 2030, India's dependence on energy imports is expected to exceed 53% of the country's total energy consumption. In 2009-10, the country imported 159.26 million tonnes of crude oil which amounts to 80% of its domestic crude oil consumption and 31% of the country's total imports are oil imports. The growth of electricity generation in India has been hindered by domestic coal shortages and as a consequence, India's coal imports for electricity generation increased by 18% in 2010.

Due to rapid economic expansion, India has one of the world's fastest growing energy markets and is expected to be the second-largest contributor to the increase in global energy demand by 2035, accounting for 18% of the rise in global energy consumption. Given India's growing energy demands and limited domestic fossil fuel reserves, the country has ambitious plans to expand its renewable and most worked out nuclear power programme. India has the world's fifth largest wind power market and also plans to add about 100,000 MW of solar power capacity by 2020. India also envisages increasing the contribution of nuclear power to overall electricity generation capacity from 4.2% to 9% within 25 years. The country has five nuclear reactors under

construction (third highest in the world) and plans to construct 18 additional nuclear reactors (second highest in the world) by 2025.

2. Literature Review

The installed capacity of utility power plants is 267,637 MW as on 31 March 2015 and the gross electricity generated by utilities is 1106 [GWh](#) (1106 billion kWh) which includes auxiliary power consumption of power generating stations [2]. The installed capacity of captive power plants in industries (1 MW and above) is 47,082 MW as on 31 March 2015 and generated 166.426 billion kWh in the financial year 2014-15. In addition, there are nearly 75,000 MW aggregate capacity diesel generator sets with unit's sizes between 100 KVA and 1000 KVA. All India per capita consumption of Electricity is nearly 1010 kWh during the financial year 2014-15

Table 1.1: Total installed Power generation Capacity (end of March 2015)

Source	Utilities Capacity (MW)	%	Captive Power Capacity (MW)	%
Coal	164,635.88	61.51	27,588.00	58.6
Hydroelectricity	41,267.43	15.42	83	0.17
Renewable energy source	31,692.14	11.84	Included in Oil	-
Natural Gas	23,062.15	8.61	5,215.00	11.08
Nuclear	5,780.00	2.16	-	-
Oil	1,199.75	0.44	14,196.00	30.17
Total	267,637.35		47,082.00	

Table 1.2: State wise installed power capacity

Sector	Utility Power Capacity (MW)	Percentage
State Sector	96,963.20	36.23
Central Sector	72,521.16	27.1
Private Sector	98152.99	36.67
Total	267,637.35	

3. Problem Definition

By above literature, it is necessary to think about that type of energy which should be renewable, nonconventional and useful for the commodity. These sources support sustainable growth and long lasting. It should be pollution free, nontoxic and easily available; it should be low maintained, scalable and reliable.

4. Methodology /Approach

Oil and gas

India imports nearly 75% of its 4.3 million barrels per day crude oil needs but exports nearly 1.35 million barrels per day of refined petroleum products which is nearly 30% of its total production of refined oil products. India has built surplus world class refining capacity using imported crude oil for exporting refined petroleum products. The net imports of crude oil is lesser by one fourth after accounting exports and imports of refined petroleum products [3].

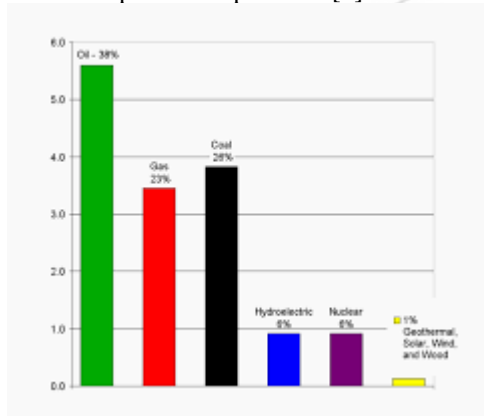


Figure 1: Types of Energy

Coal

India has the world's 4th largest coal reserves. In India, coal is the bulk of primary energy contributor with 54.5% share out of the total 595 Mtoe in the year 2013 India is the third top coal producer in 2013 with 7.6% production share of coal (including lignite) in the world. Top five hard and brown coal producing countries in 2013 (2012) are (million tons): China 3,680 (3,645), United States 893 (922), India 605 (607), Australia 478 (453) and Indonesia 421 (386). However, India ranks fifth in global coal production at 228 Mtoe (5.9%) in the year 2013 when its inferior quality coal tonnage is converted into tons of oil equivalent.¹ Coal-fired power plants account for 59% of India's installed electricity capacity. After electricity production, coal is also used for cement production in substantial quantity. In the year 2013, India imported nearly 95 Mtoe of steam coal and coking coal which is 29% of total consumption to meet the demand in electricity, cement and steel production [4].

Bio-fuels

Gasification of bio mass, yields wood gas or syngas which can be converted into substitute natural gas by Methanation. Nearly 750 million tons of non edible (by cattle) biomass is available annually in India which can be put to higher value addition use and substitute imported crude oil, coal, LNG, urea fertilizer, nuclear fuels, etc. It is estimated that renewable and carbon neutral biomass resources of India can

replace present consumption of all fossil fuels when used productively [5].

Hydrogen energy

Hydrogen Energy programme started in India after joining the IPHE (International Partnership for Hydrogen Economy) in the year 2003. There are nineteen other countries including Australia, USA, UK, Japan, etc. This global partnership helps India to set up commercial use of Hydrogen gas as an energy source. This will be implemented through Public Private Partnership.

Nuclear power

India boasts a quickly advancing and active nuclear power programme. It is expected to have 20 GW of nuclear capacity by 2020, though they currently stand as the 9th in the world in terms of nuclear capacity. An achilles heel of the Indian nuclear power programme, however, is the fact that they are not signatories of the Nuclear Non-Proliferation Treaty. This has many times in their history prevented them from obtaining nuclear technology vital to expanding their use of nuclear industry. Another consequence of this is that much of their programme has been domestically developed, much like their nuclear weapons programme [6]

Hydro electricity

India is endowed with economically exploitable and viable hydro potential assessed to be about 84,000 MW at 60% capacity factor. In addition, 6,780 MW in terms of installed capacity from Small, Mini, and Micro Hydel schemes have been assessed. Also, 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified for catering to peak electricity demand and water pumping for irrigation needs. It is the most widely used form of renewable energy. On global scenario, India is ranking 5th in terms of exploitable hydro- electric potential.

Wind power

India has the fifth largest installed wind power capacity in the world. As of 31 March 2015, the installed capacity of wind power was 23,444 MW an increase of 2312 MW over the previous year Wind power accounts nearly 8.5% of India's total installed power generation capacity and generated 28.314 billion kWh in the fiscal year 2014-15 which is nearly 2.6% of total electricity generation. The capacity utilization factor is nearly 15 % in the fiscal year 2014-15.

Solar energy

India's solar energy is about 5,000 T kWh per year (i.e. ~ 600 TW), far more than its current total primary energy consumption. Long-term solar potential could be unparalleled in the world because it has the ideal combination of both high solar isolation and a big potential consumer base density [7].

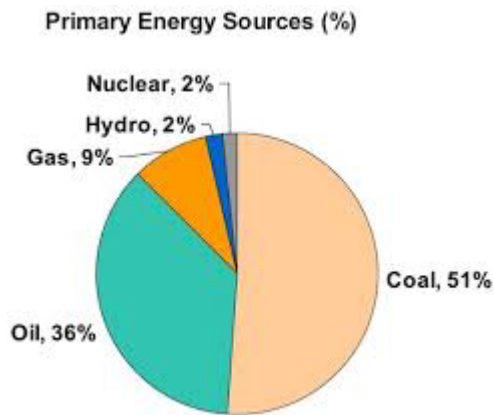


Figure 2: Primary Energy Sources

Table 3: Rural electrification statuses

Rural Electrification rates	N.O of states and UTs	Remarks [20]
100%	16	
99%	4	(electrification %, un-electrified villages): Maharashtra (99.9%, 36), Himachal Pradesh (99.92%, 2), Uttara Khand (99.3%, 107), West Bengal (99.99%, 2)
95%	7	Assam (96.8%), Bihar (95.5%), Chhattisgarh (97.6%), Madhya Pradesh (97.1%), Jammu & Kashmir (98.2%), Uttar Pradesh (98.7%), Tripura (97.0%)
90%	3	Nagaland (90.1%), Rajasthan (90.2%), Jharkhand (92.1%)
80%	3	Orissa (81.6%), Mizoram (85.2%), Manipur (86.6%)
Under 80%	3	Andaman & Nicobar (77.8%), Meghalaya (79.8%), Arunachal Pradesh (68.7%)

5. Results and Discussion

In general, India's strategy is the encouragement of the development of renewable sources of energy by the use of incentives by the federal and state governments. Other examples of encouragement by incentive include the use of nuclear energy (India Nuclear Cooperation Promotion Act)), promoting wind farms. A long-term energy policy perspective is provided by the Integrated Energy Policy Report 2006 which provides policy guidance on energy-sector growth. Increasing energy consumption associated primarily with activities in transport, mining, and manufacturing in India needs rethinking India's energy production [8]. Recent steep fall in international oil prices due to shale oil production boom, would tilt the energy policy in favor of crude oil / natural gas.

Energy trading with neighboring countries

The per capita consumption is low compared to many countries despite cheaper electricity tariff in India. Despite low electricity per capita consumption in India, the country is going to achieve surplus electricity generation during the 12th plan (2012 to 2017) period provided its coal production and transport infrastructure is developed adequately. India has been exporting electricity to Bangladesh and Nepal and importing excess electricity in Bhutan. Surplus electricity can

be exported to the neighboring countries in return for natural gas supplies from [Pakistan](#), Bangladesh and Myanmar.

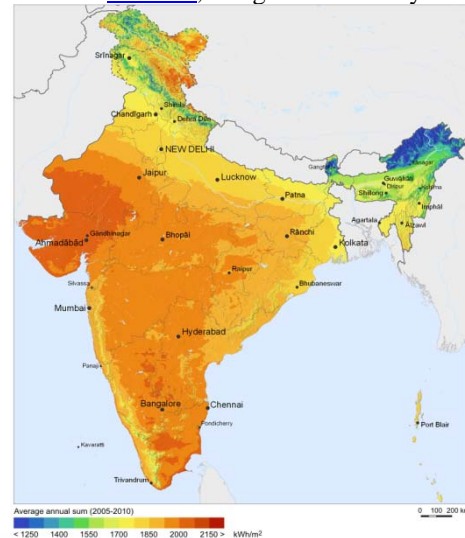


Figure 3: Energy Policies

Electricity as substitute to imported LPG and kerosene

The net import of [LPG](#) is 6.093 million tons and the domestic consumption is 13.568 million tons with Rs. 41,546 crores subsidy to the domestic consumers in the year 2012-13. The LPG import content is nearly 40% of total consumption in India. The affordable electricity retail price (860 kcal/kWh at 90% heating efficiency) to replace LPG (lower heating value 11,000 kcal/kg at 75% heating efficiency) in domestic cooking is 6.47 Rs/kWh when the retail price of LPG cylinder is Rs 1000 (without subsidy) with 14.2 kg LPG content. Replacing LPG consumption with electricity reduces its imports substantially [9]. The domestic consumption of [Kerosene](#) is 7.349 million tons with Rs. 30,151 crores subsidy to the domestic consumers in the year 2012-13. The subsidized retail price of Kerosene is 13.69 Rs/litre whereas the export/import price is 48.00 Rs/litre. The affordable electricity retail price (860 kcal/kWh at 90% heating efficiency) to replace Kerosene (lower heating value 8240 kcal/litre at 75% heating efficiency) in domestic cooking is 6.00 Rs/kWh when Kerosene retail price is 48 Rs/litre (without subsidy).

Distancing government from power sector

The new energy policy aims at distancing government from power sector. This resulted in drastically cutting of budgetary support to the sector.

Energy conservation

Energy conservation has emerged as a major policy objective, and the Energy Conservation Act 2001, was passed by the Indian Parliament in September 2001, 35.5% of the population still live without access to electricity. This Act requires large energy consumers to adhere to energy consumption norms; new buildings to follow the Energy Conservation Building Code; and appliances to meet energy performance standards and to display energy consumption labels. The Act also created the Bureau of Energy Efficiency to implement the provisions of the Act [10].

Rural electrification

The key development objectives of the power sector is supply of electricity to all areas including rural areas as mandated in section 6 of the Electricity Act. Both the central government and state governments would jointly endeavour to achieve this [11] objective at the earliest. Consumers, particularly those who are ready to pay a tariff which reflects efficient costs have the right to get uninterrupted twenty four hours supply of quality power. About 56% of rural households have not yet been electrified even though many of these households are willing to pay for electricity. Determined efforts should be made to ensure that the task of rural electrification for securing electricity access to all hold and also ensuring that electricity reaches poor and marginal sections of the society at reasonable rates is completed within the next five years. India is using Renewable Sources of Energy like Hydel Energy, Wind Energy, and Solar Energy to electrify villages [12].

[12] Energy Statistics 2015
http://mospi.nic.in/Mospi_New/upload/Energy_stats_2015_26mar15.pdf

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6. Conclusion

As a commodity different sources of energy has vast utilization. First by electrifying own country it can be sold to neighbor countries. This not only makes the country in category of developed countries from developing countries. This is sector where good policies will effectively make and efficiently implemented for great success.

7. Future Scope

In India to bridge the gap between electrification in RURBAN areas such type of advanced techniques is required. Coal based, Hydro power methods has geographical limitations so lots of scopes are there for new methods. Specially solar, wind, bio fuel has lots of scope. So in this area research is required to give reliable and low maintained system. Such techniques should be adopted which satisfy QoS (Quality of Service) and ROI (Return on Investment).

References

- [1] India Ministry of Non-Conventional Energy Sources (MNES) <http://mnes.nic.in/>
- [2] The President of India www.presidentofindia.nic.in
- [3] The Energy & Resources Institute (TERI) <http://www.teriin.org/>
- [4] Trade Team Canada Environment (TTC Environment) http://strategis.ic.gc.ca/epic/internet/inenva.nsf/en/h_eg02268e.html
- [5] Maps of India <http://www.mapsofindia.com>
- [6] U.S. Energy Information Administration (EIA) http://mospi.nic.in/mospi_energy_stat.htm
- [7] Global Energy Network Institute (GENI) www.geni.org
- [8] Canada India Business <http://canadaindiabusiness.ca/gol/cib/cib.nsf/en/ci0010.html>
- [9] ZenithEnergy <http://www.zenithenergy.com/index.HTM>
- [10] Confederation of Indian Industry (CII) <http://www.greenbusinesscentre.com/renenergy.asp>
- [11] Centre for Wind Energy Technology www.cwet.tn.nic.in