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An Overview of Energy Sector in India

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Abstract: ***The fast Increasing World Energy consumption levels are raising concerns over the depletion of natural resources and the increasing environmental pollution impacts like Ozone depletion, Climate change, global warming etc. The contribution from the developing countries towards energy consumption is increasing with increasing economic stability and population growth. In India, as per the NMEEE document, 2009, from annual consumption of 19200 KWh in 2005 only from Residential & commercial buildings, it is predicted to reach 89,823 KWh in 2030. As India is still in the initial stage of economic development, it is expected that it will increase further in near future. Though energy conservation steps in buildings shall be the main objective of the energy policies at all he levels of governance, implementation of the energy conservation policies are in nascent stage resulting in not able to adopt energy efficiency measures in many sectors. This paper tries to present the available information about the energy consumption in building sector especially commercial buildings in India.***

Keywords: Energy consumption, energy efficiency, commercial buildings

1. Introduction

The Fast increasing world energy consumption levels have already raised concerns over the excessive usage of resources and subsequent environmental impacts. The international energy agency has shown frightening information on energy consumption trends across the Globe. According to WEO(2009), energy is accounting for 65% of the World's Green house gas(GHG) emissions. Being a developing country, power consumption has been increasing at greater pace in India. Energy consumption growth rate in commercial buildings (8%) is more than that of Residential sector (5%) and Floor area increase itself is expected to grow from 659 million Sq.Mts in 2010 to 1900 million Sq.Mts in 2030. As per World Energy Council(WEC),China will overtake America in energy consumption by 2020 and with the present situation of economic growth, increasing fertility rate, India will overtake China by 2050.It is expected that there will be enormous gap between demand and supply by that time. But India is still in the nascent stage in energy conservation point of view in any of the sectors. As per the Prime Minister's vision statement, Energy saving potential in Building sectors both commercial and Residential is 20% (NMEEE, Bureau of Energy) and shall achieve 5% of energy saving by 2015. Hence it is essential and crucial to focus the research on energy performance of the buildings. This may be in terms of retrofit for the existing buildings or Architectural Design interventions at the initial stage of the project which can be a part of bye laws and Development Control Regulations.

2. Need of the Study

Construction industry has a very important role in on Indian economy, contributing on an average 6.5% of the GDP. At the same time, it has lot of impact on the environment with its consumption of energy both operational energy and embodied energy in the materials that it uses. Commercial Building space accounts for 33% of the total built space and increasing at a rate of 8-10% annually. The average annual electricity consumption for space conditioning and lighting in India is around 80 KWh/m2 and 160 KWh/m2 for residential and commercial buildings respectively. At this juncture it is very important to understand the pattern of energy consumption in building sector so as to take up energy conserving measures for the same.

Electricity is produced domestically but its supply depends upon the availability of coal, exploitation of hydro power sources and the scope for expanding nuclear power, and there are constraints affecting each source. There is a great disparity in the energy use amongst different regions of the world and even for countries like India where the rural areas are bereft of the benefits of energy and where obtaining food and shelter is a daily challenge. India needs to bridge this divide as soon as possible and this is of paramount importance for any growth which should include all sections of society.

Energy is central to achieving the interrelated economic, social, and environmental aims of sustainable human development. But if India is to realize this important goal, the kinds of energy India produces and the ways it uses them will have to change. Otherwise, environmental damage will accelerate, inequity will increase, and economic growth will be jeopardized. These analyses have shown that India will have to plan for the fulfilment of its energy needs based on a judicious mix of the natural resources endowed to it, keeping sustainable development in focus and having a minimum carbon foot print.

3. Indian Energy Scenario

India's energy sector is diversified compared to the rest of the World. Energy production in India is still dominated by the conventional sources such as coal and water based thermal power plants. Coal alone contributes 60% of the total energy production. The energy production by various sectors is as below:

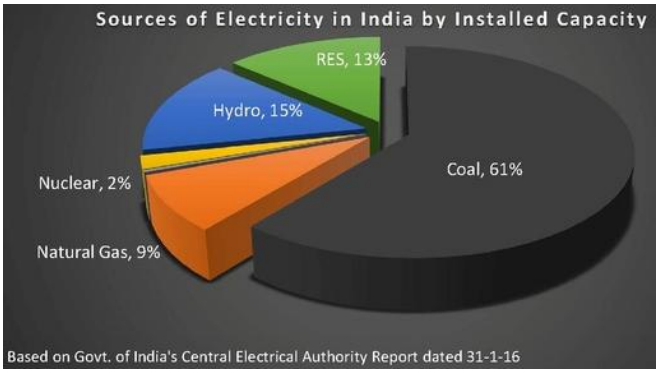

Figure 1: Sources of electricity in India by installed capacity (source: CEA Report, 2016)

The total energy consumption in India last year is 948,328 GWh with highest consuming setor is industries followed by domestic power consumption. As per the Energy statistics, 2016, sector wise energy consumption in india is given in the chart. India's aggregated primary energy demand is expected to grow by 2.3 times in the next two decades due to sustained economic growth in the building, transportation and industrial sectors. (Chaturvedi, et al, 2011)

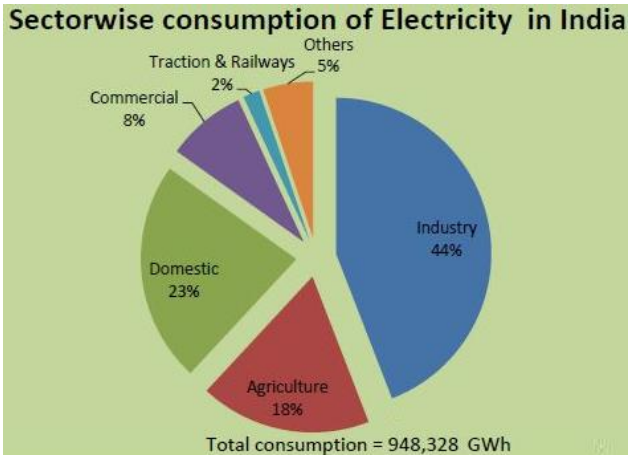

Figure 2: Sector wise energy consumption (Energy Statisti

Currently, the residential and commercial sectors account for 30% (22% residential and 8% commercial) of total electricity use and consumption in these sectors is rising at 8% annually (Dr Satish Kumar, USAID ECO – III Project, 2011). Due to growing demand for floor space, and to accommodate emerging service industries and urban migration, India expects a doubling of floor space by 2030 (Kumar et al, 2010). The increase in population and rise in building footprint in India has also put increased pressure on energy demand for buildings.

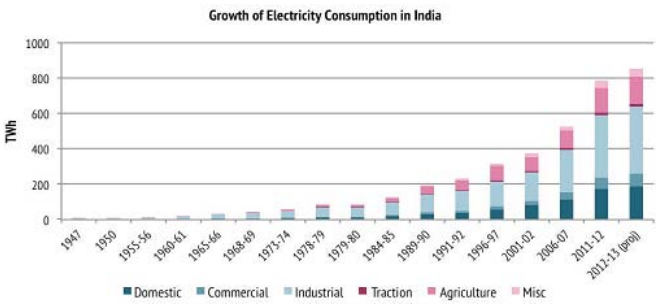

Figure 3: Growth of Electricity Consumption in India (Planning commission, 2011) Source: CEA, 2012

The energy consumption in Indian buildings is expected to rise due economic and human development. The demand for life style equipment like air-conditioners, heaters, refrigerators and TVs will rise due to improvement in standard of living. This rising energy demand can be reduced through energy efficient building strategies. The need for lighting, air-conditioning, heating and ventilation needs to be optimized to reduce the load on energy production and to facilitate an inclusive growth both economically and environmentally.

The Bureau of Energy Efficiency, a Government agency, predicts that India's constructed floor area will increase by around five times from 2005 to 2030 (Dr Satish Kumar, USAID ECO - III Project, 2011). This parallels other projections, such as the CEU study, which estimates an increase of around 400% by 2040, and the McKinsey study which estimates an increase of more than 400% by 2030. These studies predict that India's total residential floor area will be much larger than its total commercial floor area in 2030. CEU data suggests that, by 2050, 85% of floor space will be in residential use, while 15% will be used for commercial purposes.

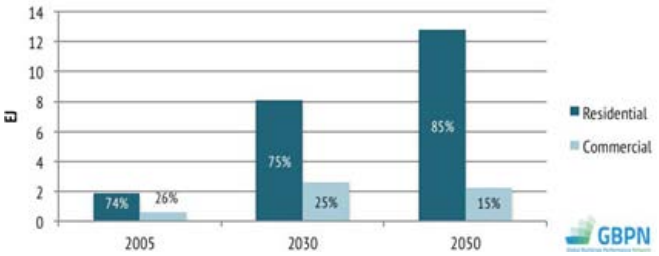

Figure 4: Projected energy consumption of India's buildings in 2030 and 2050 (Source GBPN, 2012)

The patterns of usage of electrical appliances are distinctly different in residential and commercial buildings. BEE's assessment shows that lighting and air conditioning use 80 per cent of the energy in commercial buildings whereas fans and refrigerators use maximum energy in residential buildings. Usage of appliances is also more varied in residential units that are mostly lifestyle and choice related.

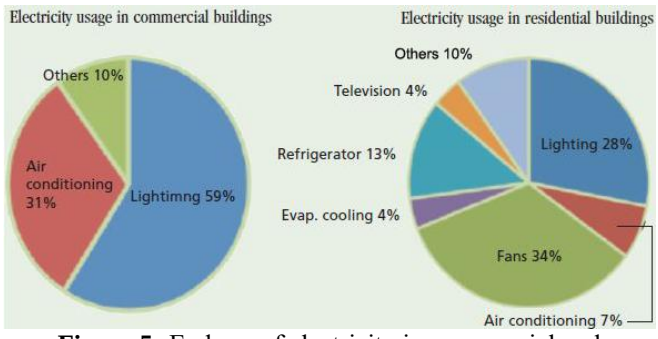

Figure 5: End use of electricity in commercial and residential buildings. (Source: Bureau of Energy Efficiency)

The electrical appliance market is being largely changing because of changing lifestyle and a substantial rise in income level on mid income group due to various employment opportunities and Globalization. A study by the Pune based think tank Prayas Energy shows that given the income levels in India the major initial spurt will be in the

basic appliances like fans and televisions as more households will move up the income ladder. Though much smaller in volume compared to fans and TVs, the air conditioning market is also improving at a much faster rate about 25 per cent a year.

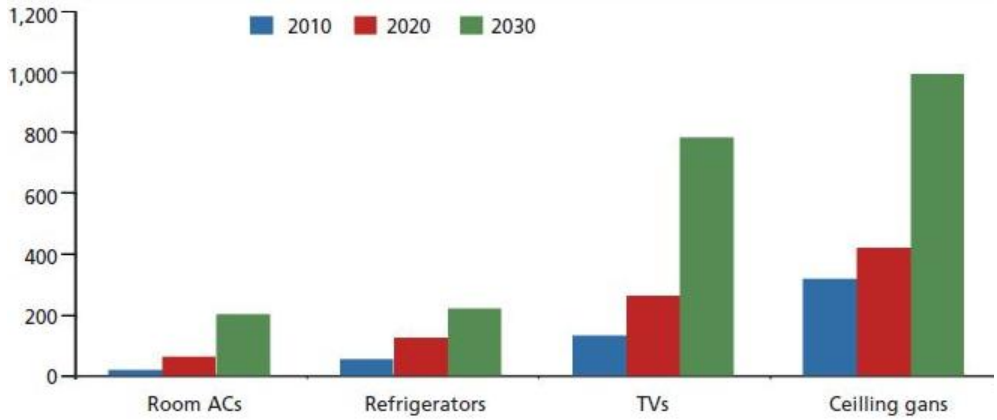

Figure 6: Ownership of appliances in India growing rapidly. (Source: Energy and Buildings, CSE)

4. Renewable Energy in India

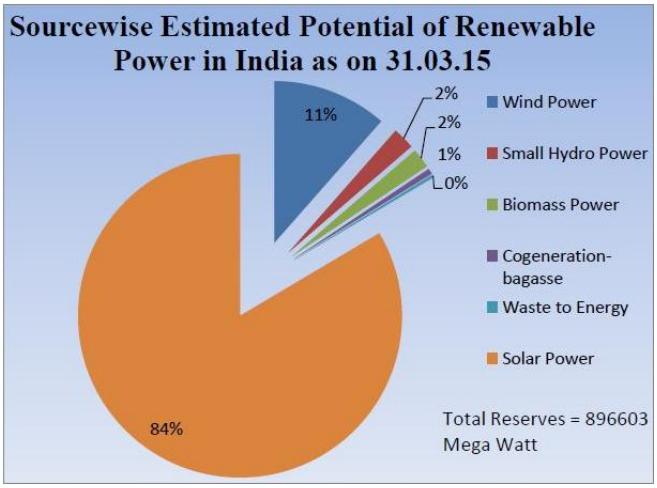

Figure 7: Sources estimated potential of renewable power in India
(Source: Energy Statistics **2016**)

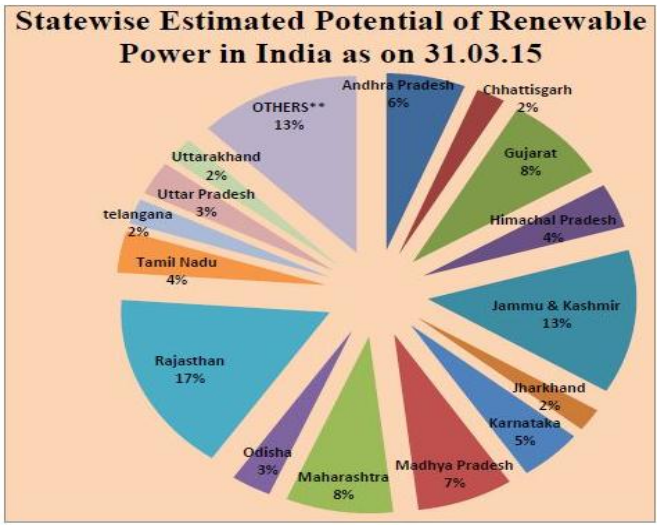

Figure 8: Statewise estimated potential of renewable in India
(Source: Energy Statistics **2016**)

India has been making continuous progress in conventional as well as renewable power generation. The trajectory of growth of installed capacity since 2002 (start of the 10th five year Plan), 2007 (start of 11th Plan), and as of 30 November 2010. However, problems are beginning to occur in each sector of conventional power. Mining and import of coal are both facing problems, especially for the huge quantities of coal required. This problem is getting complicated with the problems in logistics and transport issues. Moreover, at projected usage levels, questions are also raised about the period India's extractable coal reserves could last. Environmental and climate change threats are getting more severe and getting project clearances becoming more difficult. In spite of many policy and infrastructural initiatives, it is mostly unlikely that the required quantities of resources are available to achieve projected conventional power capacity. Large hydro thermal projects are also facing problems mostly related to environmental issues and also some of the execution difficulties and in building long transmission lines. Building up Nuclear power capacity is facing its own problems, especially with the huge targets proposed.

In the above backdrop, therefore, it could reasonably be expected that there could be substantial and worrisome slippages in creating conventional power capacities over the next two decades and even in the long term. It is almost inevitable that this would lead to more consumption of diesel, furnace oil and kerosene. In a situation where India is currently importing more than 80% of the countries fuel needs, and with internal reserves unlikely to improve this percentage, serious problems of energy security would arise. Moreover, these may entail rising financial burdens of import and internal financial burdens of subsidies, which are already controversial. It is, therefore, imperative that substantive measures be taken to reduce their consumption for energy purposes and also reducing consumption drastically in personalized urban and long-distance freight transport. If energy shortages persist it is difficult to expect much improvement in energy access.

However, even though this may provide grid connectivity too many uncovered areas (still leaving substantial numbers unconnected), actual supply of electricity through the grid would remain both constrained and unpredictable. Providing

energy access and energy security for the poor would, therefore, continue to be a major issue and problem. Solutions to this simply have to be found but which no longer appears possible from conventional sources. It is clear that India's need for secure, affordable, and environmentally sustainable energy has become one of the principal economic and development challenges for the country. It is also clear that while energy conservation and energy efficiency have an important role to play in the national energy strategy, renewable energy will become a key part of the solutions and is likely to play an increasingly important role for augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon developmental pathway.

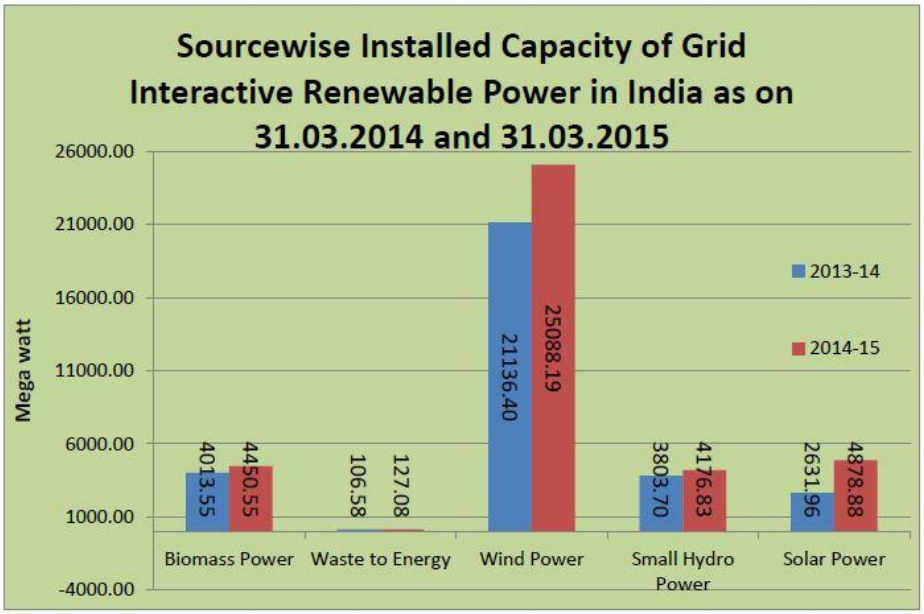

Figure 9: Source wise installed capacity of grid interactive renewable power in India. (Energy Statistics 2016)

5. Policy for Grid Renewable Power

The development of grid interactive renewable power essentially took off with the Electricity Act 2003 –which mandates the State Electricity Regulatory Commissions (SERCs) (i) to promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and (ii) fix certain minimum percentages for purchase of renewable power in the area of each Distribution licensee. Section 61(h) mentions that these should be guiding factors while specifying the terms and conditions of determination of tariffs.

The National Electricity Policy 2005 has further provided for progressive increases in these levels and purchases by distribution companies through competitive bidding processes. The tariff Policy 2006requires fixation by SERCs of a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs and procurement by distribution companies at preferential tariffs determined by the SERCs. As of date, most of the SERCs have specified percentages for purchase of electricity from renewable sources of energy. Preferential tariffs for grid interactive renewable power are being given in most potential States like Rajasthan, Gujarat, and Tamil Nadu etc.

Due to various measures taken by electricity regulatory commissions open access has been facilitated, thereby enabling buyers to choose their suppliers which not only fosters healthy competition but suppliers are forced to be innovative in quality and pricing to rope in customers. It has also led to more stable and secure grid operations which have led to decrease in outages due to grid failures. Depending on the availability of the renewable power in different states purchase obligations have been fixed in their respective distribution areas. Various states which have met their renewable purchase power obligations include Kerala (5%), Tamil Nadu (10%), Andhra Pradesh, Karnataka and Maharashtra (5%), Gujarat (2%) and Delhi (1%).However, the high cost of power from renewable sources discourages the states from buying than what is obligatory. However, there are other states which have not been able to meet the obligatory requirement due to a host of issues which include the precarious financial condition of distribution companies which are generally owned and operated by the state. The concept of Renewable Energy Certificates (REC) is being introduced so that those states which are deficient in renewable power can buy the REC's from renewable power generators located in different states.

Impact of Policy and Vision 2022

Table 1: Trajectory of Growth of Installed Power Capacity in India.

Time period	Thermal (%) (MW)	Hydro (>25MW) (%) In MW	Nuclear (%) (MW)	Renewable Power (%) (MW)
1.4.2002	70.85% 74429	25% 26269	2.59% 2720	1.55% 1628
1.4.2007	64.06% 87015	25.51% 34654	2.87% 3900	7.55% 10258
31.9.2010	63.95% 106518	22.41% 37328	2.7% 4560	10.90% 18,155

(Source: Ministry of New and Renewable Energy, Government of India)

Table 2: Share of Different Renewable Sources in India

Resource	Potential (MW)	Upto 9th Plan	Upto 10th Plan	11th Plan Target	Upto 30.09.10	Cumulative Achievement	12th Plan Projection (2017)	13th Plan Projection (2022)
Wind Power	48,500	1667	5,427	9,000	4,714	12,809	27300	38,500
Small Hydro Power	15,000	1,438	538	1,400	759	2,823	5000	6,600
Bio Power*	23,700	390	795	1,780	1,079	2,505	5100	7,300
Solar Power	20-30 MW/sq km	2	1	50	8	18	4000	20,000
Total		3,497	6,761	12,230	6,560	18,155	41,400	72,400

(Source: Ministry of New and Renewable Energy, Government of India)

* Includes biomass, bagasse cogeneration, urban and industrial waste to energy

During the last many years the share of renewable energy has steadily increased due to the initiative taken by Government of India and as indicated in Table 1. The share of various types of renewable energy is indicated in Table 2. All figures are in MW. It is estimated that total share of renewable energy will be 15.9% by 2022. In the larger perspective of grid power an innovative scheme is being tried in India called as tail-end grid. So far the emphasis has been on large plants whether they are wind, solar, hydro or biomass. Locations for wind and hydro are fixed. However, for biomass the difficulties of ensuring collection and transportation of fuel are leading towards smaller plants. For solar PV, a total of 100 MW capacities are being set up with smaller plants of 100 KW to 2 MW, which are connected to grid through 11 kV feeders. It is expected that small plants would reduce the transmission losses by 5-7% with respect to large capacity plants of 50 - 100 MW size and improve both voltage and frequency at the tail end. The same approach is being planned for biomass based power plants of up to 2 MW capacities as the logistics of fuel management would become much more manageable and more environmentally friendly. It is envisaged that hundreds of such plants will be built in the next few years thus improving the transmission infrastructure.

6. Conclusion

Energy is very important for the development of a country. This means that if the development of India is to grow as per the envisaged plan, it is necessary to ensure reliable amount energy. The power supply position prevailing in the country is characterized by persistent shortages and unreliability and also high prices for industrial consumers. There is also concern about the position regarding petroleum products. India depends to the extent of 70-80 percent on imported oil, and this naturally raises issues about energy security. These concerns have been exacerbated by recent movements in international oil prices. India, with its vast population and limited natural resources for meeting its energy requirements, needs to maintain its momentum of growth and this can be made possible only with a clear strategy for use of best possible energy options available. India needs to have a long term strategy for meeting its energy needs by 2050 and a short term goal of 2020 which can be small steps towards attaining energy security by 2050. The broad vision behind energy policy must be to meet energy demands reliably with energy which is clean and affordable and this must be done in an environmentally sustainable manner using different fuels and forms of energy, conventional and non-conventional, as well as new and emerging sources to ensure supplies at all times.

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