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## **COMMERCIAL ENERGY CONSUMPTION PATTERN IN INDIA**

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### **ABSTRACT**

Energy is an essential input in all production and consumption activities. With existing technologies, increasing per capita productivity is needed to increase per capita income which in term requires increased amount of energy. It is the primary output in the production of all goods and services for both urban and rural development. The supply of energy has not been increasing in the same proportion of the demand for energy. This article is the result of a study done in this context, focusing on study of commercial energy production and consumption in India from 2001-02 to 2018-19. These variables were analyzed through the secondary data collected from various published sources. The study indicates that commercial energy such as coal, lignite, crude oil, natural gas and electricity consumption growth rate was high as compared to commercial energy production. The share of renewable energy consumption was also increasing nowadays. Energy demand- supply gap may be overcome only with help of increasing energy production capacity through renewable sources available within our country. To achieve self reliance and economic stability, per capita energy consumption have to be raise , which in turn uplift standard of living of the people and pave the path for economic growth.

**KEY WORDS:** *Energy, Commercial energy, Production, Consumption, Growth rate*

## I. INTRODUCTION

Energy is an essential input in all production and consumption activities. With existing technologies, increasing per capita productivity is needed to increase per capita income which in turn requires increased amount of energy. Today, human activities related to agriculture, industry and domestic sectors have become largely energy consuming. Conventional energy production systems have not been able to keep pace with the growing energy demands of society. The supply and the demand for energy have been increasing today, where everyday life and economic activities change to the environment, global as well as local, are conditioned by energy production and use. India is an energy starved country. In order to increase the standard of living of the people on accelerated growth of the economy there occurs heavy use of energy.

India's energy requirements are met out from a variety of resources, both commercial and non-commercial. In spite of substantial increase in the supply of commercial sources of energy coal, oil, gas, non-commercial sources also dominated by fuel wood, still meet around half of our energy needs, particularly those of rural India.

### **Importance of energy:**

Economic development and the standard of living cannot be improved without energy. Further development in industrial, agricultural or service is not possible without the availability of energy. It is the primary output in the production of all goods and services for both urban and rural development. In the absence of energy supply, the aspirations of the human beings cannot be met out. It is a critical input for fueling and sustaining development processes in general and economic growth in particular.

Economic growth results in both qualitative and quantitative increases in the use of energy. Energy impinges on poverty, employment and

income access to social services, gender disparities, population, agricultural production and food security, health, land degradation etc.,

## II. REVIEW OF LITERATURE

Jangali Satish and Nagesha revealed that electricity and LPG are the main energy carriers used in the residential sector. The energy efficiency level was studied in terms of Specific Energy Consumption (SEC) and Energy Intensity (EI). There was substantial scope for energy efficiency improvements in residential sector. They suggested that high level of awareness about energy effective technologies are to be generated and economic & financial benefits are required to be supported for energy efficiency improvement and reduction in the environmental impact. Improvement in energy efficiency initiative can go a long way in the sustainable development of this sector of the economy.<sup>1</sup>

Srinivasan Chinnammai expressed that the solar energy technology was a natural endowment available freely and abundantly in the nature. At the time of increasing energy crisis, its full utilization will not only benefit the people but also helps to preserve the environment. Besides, it will be a contributing factor for improving the quality of life. He concluded that in future solar energy technology will become more popular and the development of this energy will drastically reduce the consumption of commercial sources of energy like electricity, petrol, diesel, kerosene, natural gas etc. which in turn protects the environment and makes pollution free society<sup>2</sup>.

Nidhi Tewathia, found that the trends in household electricity consumption clearly show that the domestic consumers, per capita electricity consumption in India, and in particular Delhi have increased over the years. The average monthly power consumption of the households

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<sup>1</sup> G Jangali Satish and N Nagesha, "Energy Consumption Pattern and Environmental Impact: A Case Study of Residential Sector in India", **IOP Conf. Series: Materials Science and Engineering** 577 (2019) 012035 IOP Publishing doi:10.1088/1757-899X/577/1/012035.

<sup>2</sup> Srinivasan Chinnammai, **International Journal of Modern Engineering Research (IJMER)**, Vol. 3, Issue. 4, Jul - Aug, 2013 pp-2177-2182. ISSN: 2249-6645

varies across seasons as the requirement of electricity varies as per the prevailing temperature. The inverted-U non linear TEC shows that as temperature rises, more electricity is consumed as a result of usage of cooling appliances like AC, fridge, Cooler etc. The independent variables; household income, stock of appliances, usage of appliances, family size, dwelling size, time spent out by the family members and higher education level were found to be significant. The income elasticity of household electricity consumption was moderate positive at 0.28.<sup>3</sup>

### III STATEMENT OF THE PROBLEM

The consumption of energy plays a vital role to determine the economic growth of a country. Our society is energy based one. Today the demand for energy has been growing rapidly due to increase infrastructure development, rise in per capita income, modernization, rapid population growth, industrialization, urbanization. Further this leads to change in the consumption of energy from traditional aspect to new modern technological aspect in the country. The supply of energy has not been increasing in the same proportion of the demand for energy. The country's economic condition influences the quantity of energy to be consumed by the various sectors from the availability of energy resources in India. Even though to fulfill the present energy need from our own resources still we are in the position to import energy resources from another country. In the present study, an attempt is made is to understand the changing commercial energy production and consumption pattern in India.

### IV. OBJECTIVES OF THE STUDY

1. To understand the commercial energy scenario in India.
2. To analyze the trend in commercial energy production and consumption in India.

### V. METHODOLOGY

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<sup>3</sup> Nidhi Tewathia, "Determinants of the Household Electricity Consumption: A Case Study of Delhi" **International Journal of Energy Economics and Policy**, Vol. 4, No. 3, 2014, pp.337-348 ISSN: 2146-4553.

The present study was based on secondary data collected from various sources like Energy Statistics 2020 database published by National Statistical Office ,Ministry of statistics and programme implementation , Government of India, IRENA-International Renewable Energy Agency Statistics 2020 and from various secondary sources of publications.

## VI. RESULTS AND DISCUSSIONS

India is the world's third-largest consumer of oil, the fourth-largest oil refiner and a net exporter of refined products (IEA India 2020 energy policy review). The primary energy consumption in India grew by 2.3% in 2019 and is the third biggest after China and USA with 5.8% global share (BP statistical review of World Energy 2020). It is also the world's third largest energy consumer and ranks third in renewable energy. However domestic energy demand does not fulfill by the available supply. India now generates around 1,160.1 billion units of electricity in financial year 2020, up 4.72% from the previous year. Energy production in India from 2001-02 to 2018-19 are represented in the accompanying table 1.

**TABLE: 1**

**Commercial Energy Production Pattern in India from 2001-02 to 2018-19**

YE A R	Coal (Million Tones)	Ann u al g r o w t h r a t e	Lignite (Millio n Tones)	Ann u al g r o w t h r a t e	Crude oil (Milli on Tones )	Ann u al g r o w t h r a t e	Natura l Gas (Billion Cubic meters )	Ann u al g r o w t h r a t e	Electrici ty (GWh)	Ann u al g r o w t h r a t e
2001- 02	327.79	-	24.81	-	32.03	-	29.71	-	93054.00	-
2002- 03	341.27	4.11	26.02	4.88	33.04	3.15	31.39	5.65	83404.00	-10.4
2003- 04	361.25	5.85	27.96	7.46	33.37	1.00	31.96	1.82	93022.00	11.5
2004- 05	382.62	5.92	30.34	8.51	33.98	1.83	31.76	-0.6	101621.0 0	9.24
2005-	407.04	6.38	30.23	-0.4	32.19	-5.3	32.20	1.39	118818.0	16.9

06									0	
2006-07	430.83	5.84	31.29	3.51	33.99	5.59	31.75	-1.4	142163.75	19.6
2007-08	457.08	6.09	33.98	8.6	34.12	0.38	32.42	2.11	162553.72	14.3
2008-09	492.76	7.81	32.42	-4.6	33.51	-1.8	32.85	1.33	152886.00	-5.95
2009-10	532.04	7.97	34.07	5.09	33.69	0.54	47.5	44.6	159642.84	4.42
2010-11	532.69	0.12	37.73	10.7	37.68	11.8	52.22	9.94	179926.46	12.7
2011-12	539.95	1.36	42.33	12.2	38.09	1.09	47.56	-8.9	214024.08	19.00
2012-13	556.4	3.05	46.45	9.73	37.86	-0.6	40.68	-14	204024.31	-4.67
2013-14	565.77	1.68	44.27	-4.7	37.79	-0.2	35.41	-13	234595.01	15.00
2014-15	612.43	8.25	48.26	9.01	37.46	-0.9	33.66	-4.9	238908.43	1.84
2015-16	639.23	4.38	43.84	-9.2	36.94	-1.4	32.25	-4.2	224571.11	-6.00
2016-17	657.84	2.91	45.23	3.17	36.01	-2.5	31.9	-1.1	241841.64	7.69
2017-18	675.40	2.67	46.26	2.28	35.68	-0.9	32.65	2.35	266308.30	10.1
2018-19	728.72	7.89	44.28	-4.3	34.2	-4.1	32.87	0.67	299465.00	12.5
<b>CAGR from 2001-2019</b>	<b>4.30</b>		<b>3.1</b>		<b>0.35</b>		<b>0.53</b>		<b>6.34</b>	

**Source: Energy statistics, 2014 – 2020.** National Statistical Office , Ministry of statistics and programme implementation , Government of India.

Table 1 reveals that the coal energy production was high in the year 2014-15, it was declined in the year 2010-11 with minimum growth rate 0.12 per cent .CAGR indicates that this energy production was almost declined trend during the study period. Lignite production was increased in the year 2011-12, with 42.33 Million tones and shows a negative trend in the year 2005-06. But the overall CAGR shows positive growth rate.

Crude oil energy production was raised in the year 2010-11, with 11.8 per cent. Comparing to all other energy production, the annual production growth rate was almost lowest and negative for this particular energy with 0.35 per cent growth rate. Regarding natural gas, it shows highest positive growth rate with 44.6 per cent 47.5 Billion Cubic meters in the year 2009-10, after that it started decelerating with minimum negative growth rate of -1.1 per cent in the year 2016-17 but slightly higher than crude oil energy. Electricity production growth rate was negative in the beginning period 2002-03, with -10.4 per cent after that it indicates positive growth rate. The CAGR for electricity energy production was 6.34 per cent. It resembles that, to achieve rapid economic development there was a need to meet growing energy demand in our country.

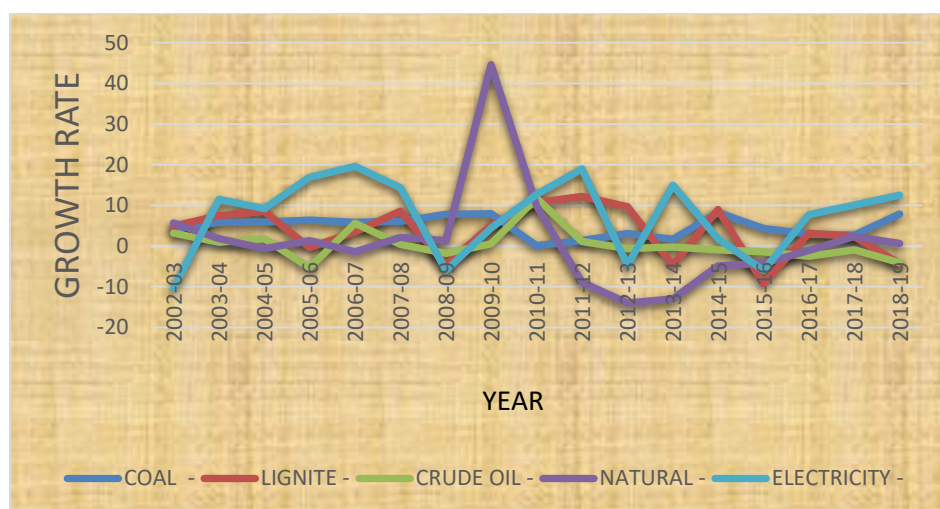


Fig 1. Commercial Energy Production in India

**Table: 2**  
**Commercial Energy Consumption Pattern in India from 2001-02 to 2018-19**

YEAR	Coal Million Tones	Growth rate	Lignite Million Tones	Growth rate	Crude oil Million Tones	Growth rate	Natural Gas Billion Cubic meters	Growth rate	Electricity GWh	Growth rate
2001-02	349.74	-	24.58	-	107.27	-	28.04	-	322459.00	-
2002-03	361.75	3.43	26.01	5.82	112.56	4.93	29.96	6.85	339598.00	5.32
2003-04	379.41	4.88	28.49	9.53	121.84	8.24	30.91	3.17	360937.00	6.28
2004-	404.6	6.66	30.09	5.62	127.1	4.33	30.78	-0.40	386134.0	6.98

05	9				2				0	
2005-06	407.04	0.58	30.23	0.47	130.11	2.35	26.86	-13.00	411887.00	6.67
2006-07	462.35	13.6	30.81	1.92	146.55	12.6	37.60	40.00	455749.00	10.6
2007-08	502.82	8.75	34.65	12.50	156.10	6.52	39.80	5.85	501977.00	10.1
2008-09	549.57	9.3	31.85	-8.10	160.77	2.99	32.99	-17.00	553994.71	10.4
2009-10	587.81	6.96	34.41	8.04	186.55	16.00	59.41	80.10	612644.99	10.6
2010-11	593.00	0.88	37.69	9.53	196.99	5.60	64.16	8.00	694392.00	13.3
2011-12	638.73	7.71	41.88	11.10	204.12	3.62	64.45	0.45	785194.00	13.1
2012-13	713.39	11.7	46.31	10.60	219.21	7.39	57.37	-11.00	824300.99	4.98
2013-14	739.34	3.64	43.90	-5.20	222.5	1.50	52.37	-8.70	874208.57	6.05
2014-15	822.13	11.2	46.95	6.95	223.24	0.33	51.30	-2.00	948521.82	8.50
2015-16	836.73	1.78	42.21	-10.00	232.86	4.31	52.52	2.38	1001190.68	5.55
2016-17	837.22	0.06	43.16	2.25	245.36	5.37	55.70	6.05	1061182.64	5.99
2017-18	898.52	7.32	46.32	7.32	251.93	2.68	59.17	6.23	1123426.86	5.87
2018-19	968.25	7.76	45.81	-1.10	257.20	2.09	60.75	2.67	1158310.06	3.11
CAGR	5.51		3.33		4.71		4.15		6.96	

**Source:** *Energy statistics, 2014 - 2020- National Statistical Office ,Ministry of statistics and programme implementation , Government of India.*

Table 2 indicates that coal was consumed highest with 13.6 per cent (462.35 Million tones ) in 2006-07 and shows minimum negative growth rate in the year 2016-17 (0.06 per cent ). CAGR for coal energy consumption was 5.51 per cent. Lignite consumption pattern disclose 12.5 per cent (4.65 Million Tones) growth rate in the year 2007-08 after that it declined to -8.1 per cent growth. But CAGR shows slightly higher growth rate (3.33 per cent) comparing to coal energy consumption. Crude oil was consumed more in the year 2009-10 (186.55 Million Tones) with 16 percent. Natural gas consumption growth rate indicates fluctuation in the consumption pattern during the study period with highest growth rate of



80.1 per cent ( 59.41 Billion Cubic meters) and lowest growth in 2014-15. Regarding electricity energy consumption , it also shows positive growth rate during the study period with highest growth rate of 13.3 per cent after that it started declining and shows minimum growth rate of 3.11 per cent in 2018-19. This may due to economic slowdown happened in the country.

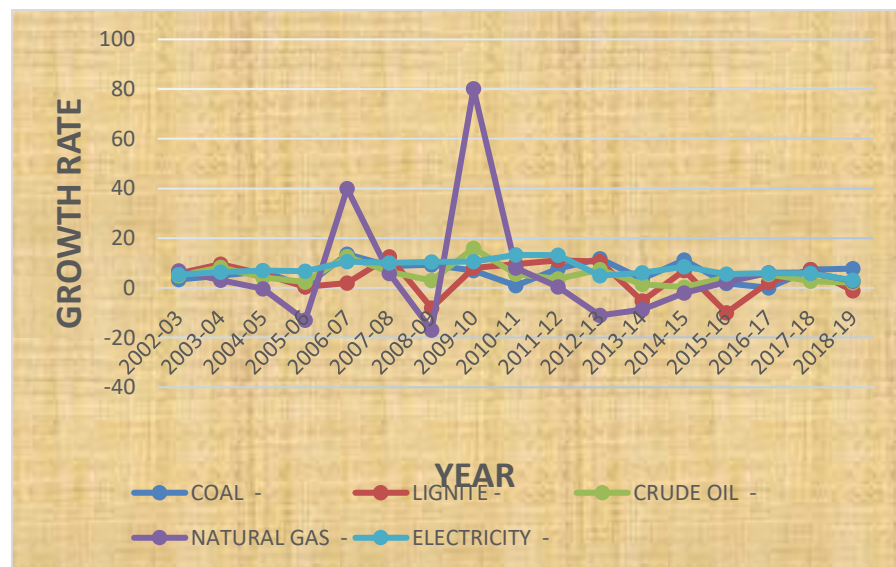


Fig 2.Commercial Energy Consumption in India

**Renewable energy consumption scenario in India:**

Though this commercial energy is non -renewable in nature, we are in need to change our energy consumption pattern which is low cost efficiency in consumption and emits less smoke which in turn reduces air pollution. The following table shows the renewable energy consumption pattern in India.

**TABLE: 3****Renewable Energy Consumption in India from 2009-2018**

Year	Hydropower (GWh)	Wind Energy (GWh)	Solar Energy (GWh)	Bioenergy (GWh)	Biogas (GWh)
2009	113684	14595	46	11320	1
2010	112125	16104	65	17049	1
2011	124673	19528	309	17700	6
2012	133094	23069	975	24068	10
2013	125953	24640	1684	28772	13
2014	140814	27235	3100	33465	16
2015	135512	31873	5979	29015	22
2016	130161	36273	10182	18404	24
2017	131351	47670	18128	16872	29
2018	136599	55009	31067	17997	29

**Source: IRENA - Renewable energy statistics 2020.**

Table 3 divulges renewable energy consumption in India. It implies that the share of hydropower energy consumption was high among all other type of energy consumption. The role of biogas consumption was very low; this is because of reduction in cattle farming. Solar energy plays a vital role in energy consumption, as we naturally have hottest climate throughout the year. Hydropower has shown the predominate source of renewable electricity in India followed by wind energy. Solar power has only started to grow in the last few years, supported by the 2022 target and auctions for new PV installations. In the five years 2013-17, solar power generation increased by 64% per year on average. Bio energy is also increasing in power generation. The principal source is co-generation units using bagasse residues from India's large sugar industry. Using biomass for power generation is a more sustainable use of bioenergy resources than the traditional use in households (International energy Agency- India 2020 Energy policy Review).

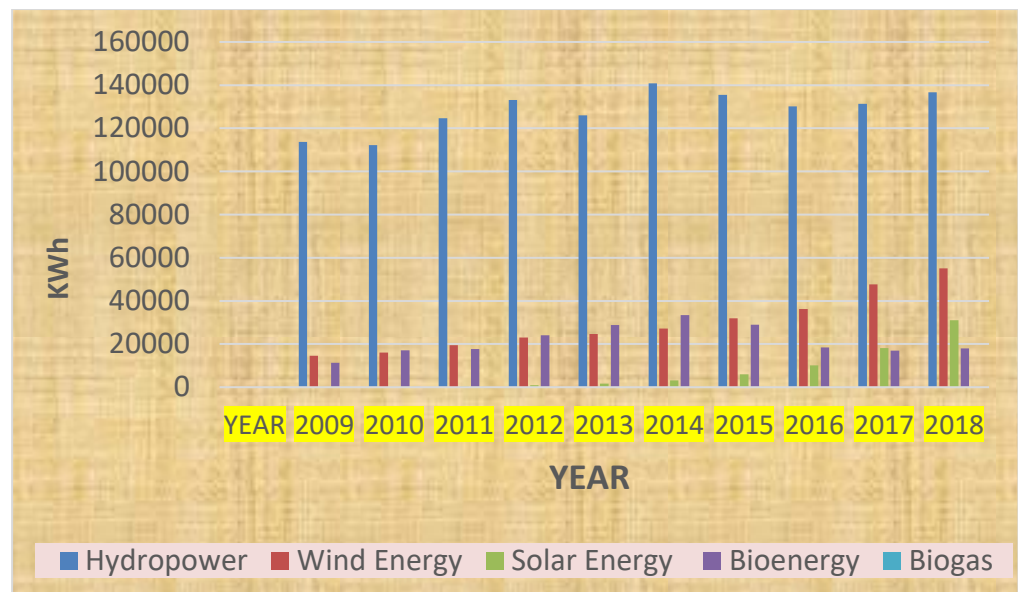


Fig 3. Renewable Energy Consumption in India

## VI. CONCLUSION

From the study, it may be concluded that there is energy intensity prevailing in our economy. The production annual average growth rate for the variables coal, lignite, crude oil, natural gas, electricity was minimum as compared to the consumption growth rate where it shows positive trend. Compound average growth rate for production during the period of study was low as compared to consumption. Commercial energy production was slowly declining and we are in the situation to import energy to meet the demand. But if it continues further, there arose energy crisis in our economy in future. Though the contribution of renewable energy is satisfactory, high priority will have to be given to this type of energy production. Energy demand- supply gap may be overcome only with help of increasing energy production capacity through renewable sources available within our country. To achieve self reliance and economic stability, per capita energy consumption has to be raised standard of living and pave the path of economic development.

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