ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.51765-51769, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

A STUDY OF INDIA'S ENERGY SCENARIO

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ARTICLE INFO

Article History:
Received 09th March, 2017
Received in revised form
13th April, 2017
Accepted 16th May, 2017
Published online 20th June, 2017

Key words:

Per capita consumption,
Non-renewable energy,
Development,
Environment.

ABSTRACT

India's per capita energy and electricity consumption are less than one tenth of developed countries' per capita consumption. The inequalities in urban vs rural, southern, western and northern region vs eastern and north-eastern region, and higher income vs lower income households are very high. Unfortunately, the regions where large fossil and renewable energy sources are accessible have lesser per capita energy consumption. For sustainable and equitable socio-economic growth such a situation needs to modify. Given the country's over dependence on coal, large scale import of oil and gas, difficulty in meeting the financial burden of import, environmental consequences of large scale energy production, transformation, transportation and use it is not wise to strive to attain the developed country level of energy consumption. To enhance the quality of life of Indian citizens, there is no doubt that per capita energy consumption has to increase. Through judicious approach, upper quality of life can be achieved with reasonable increase in energy consumption. The nation needs to make timely change of our emphasis on non-renewable energy. Such a transformation in strategy calls for a paradigm shift in our development approach, i.e. from a unsustainable progress oriented economic development to an environmental friendly equitable development. Subsequently three most serious environment related problems (Global warming, acid rain and ozone layer depletion) owe their origin to energy, it is in our national and global interest that we decrease 'energy want' without sacrificing the 'energy need' for a decent quality of life. A time bound plan is vital to change to 'renewable energy dominant decentralized system' from the existing 'non-renewable energy focused, fossil fuel centric centralized system'

Citation: Kavya Dwivedi and Prashant Jain, 2017. "A study of India's Energy Scenario", *International Journal of Current Research*, 9, (06), 51765-51769.

INTRODUCTION

Background

India ranks fourth in the world in total energy consumption, whereas more than 70% of its primary energy needs are being met through imports, mainly in the form of crude oil and natural Gas. The utility electricity sector in India has a National Grid with an installed capacity of 319.60 GW (as of 31 March 2017). Renewable power plants constituted 30.3% of total installed capacity. During the fiscal year 2015-16, the gross electricity generated by utilities in India was 1,116.84 TWh and the total electricity generation (utilities and non utilities) in the country was 1,352 TWh or 1,075.64 kWh per capita. (Growth of Electricity Sector in India, 2017) India is the world's third largest producer and fourth largest consumer of electricity. (All India Installed Capacity of Utility Power Stations, 2017; BP Statistical Review of world energy, 2016)

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Electric energy consumption in agriculture was recorded highest (17.89%) in 2015-16 among all countries. (Growth of Electricity Sector in India, 2017) The per capita electricity consumption is low compared to many countries despite cheaper electricity tariff in India. (IBEF Power, 2016) Electricity consumption in India is expected to rise to around 2280 BkWh by 2021-22 and around 4500 BkWh by2031-32. (Government decides to electrify, 2016) Capacity of body to do work is known as Energy, there are two forms of Energy which are as following:-

Conventional Energy

Conventional energy is the fossil fuels such as coal, oil and gas, which are likely to deplete with time. The consumption of fossil fuels and nuclear energy replaced totally the non-conventional techniques since of inherent advantages of transportation and certainty of availability; however these have polluted the atmosphere to a great extent. India is blessed with an plenty of sunlight, water and biomass. Efforts are made during the past two decades are now bearing fruit as people in all walks of life are more aware of the benefits of Non-

Conventional energy source, especially decentralized energy where required in villages and in urban or semi-urban centers

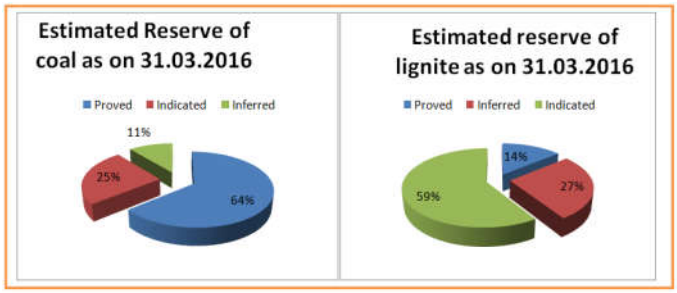
Non-Conventional Energy

Non-conventional sources of energy are that kind of energy sources which are essentially infinite. Examples of Non-Conventional include wind power, solar power, biomass energy, geothermal energy, tidal power and hydroelectric power. The non- conventional sources are available free of cost and are pollution-free.

Primary energy sources- its reserves and potential for generation

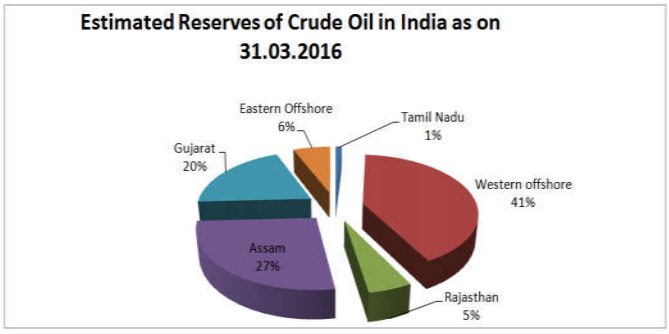
Coal and lignite

Coal deposits are mostly narrowed to eastern and south central parts of the country. The states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Telangana and Maharashtra account for 98.58 % of the entire coal reserves in the country. Jharkhand had the maximum share (26.29%) in the overall reserves of coal in the nation as on 31stMarch 2016 followed by the Odisha (24.58%). As on 31.03.16, the estimated reserves of coal were 308.80 billion tonnes, an addition of 2.20 billion tonnes over the last year. There has been an growth of 0.7% in the projected coal reserves during the year 2015-16 with Chattisgarh accounting for the maximum increase of 2.05%. The probable total reserves of lignite as on 31.03.16 was 44.59 billion Tonnes against 44.12 billion tonnes on 31.03.15. (http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2017.pdf)



Total Reserves of lignite = 44.59 Billion Tonnes
Total reserves of coal = 308.80 Billion Tonnes

crude oil in Arunachal Pradesh, Rajasthan and Assam decreased by 44.75, 17.04 and 2.11 % respectively, while the same in Tamil Nadu, Andhra Pradesh, Gujarat, Western Offshore and Eastern Offshore increased by 18.42 %, 15.30% , 2.58%, 1.88% and 0.59% respectively. The estimated reserves of Natural Gas in India as on 31.03.2016 stood at 1227.23 Billion Cubic Meters (BCM) as against 1251.90 BCM as on 31.03.2015. (http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2017.pdf)



Total Estimated reserves = 621.10 Million Tonnes

Renewable energy sources- it's potential

India has a very large potential for renewable energy exploitation. However, there is a wide gap among the potential and actual utilization. Technological constraints, high cost of production, weak institution and policy. This includes wind power potential of 102788 MW (8.57%) at 80m hub height, wind power potential of 302235 MW (25.21%) at 100 m hub height, SHP (small-hydro power) potential of 19749 MW (1.65%), Biomass power of 17,538 MW (1.46%), 5000 MW (0.42%) from bagasse-based cogeneration in sugar mills, 2556 MW (0.21%) from waste to energy and solar power potential of 748990 MW (62.48%). The topographical distribution of the estimated potential of renewable power as on 31.03.2016 reveals that Rajasthan has the maximum share of about 14% (167276 MW), followed by Gujarat with 13% share (157158 MW) and Maharashtra with 10% share (119893MW), mostly on account of solar power potential. (http://www.mospi.gov.in/sites/default/files/ publication_ reports/Energy_Statistics_2017.pdf)

Installed grid interactive renewable power capacity (excluding large hydropower) in India as of December 31, 2016 (RES MNRE)[10][12][13]

Source	Total Installed Capacity (MW)	2022 target (MW)
Wind power	28700.44	60,000.00
Solar power	9012.66	100,000.00
Biomass power (Biomass & Gasification and Bagasse Cogeneration)	7856.94	*10,000.00
Waste-to-Power	114.08	
Small hydropower	4333.85	5,000.00
Total	*50017.97*	175,000.00

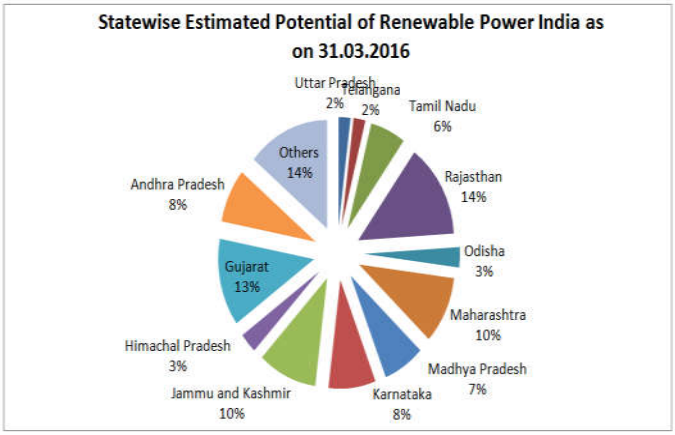
* The target is given for "bio-power" which includes biomass power and waste to power generation.

Petroleum and Natural gas

The estimated reserves of crude oil in India as on 31.03.2016 stood at 621.10 million tonnes (MT) against 635.60 million tonnes on 31.03.2015. Geographical distribution of Crude oil indicates that the maximum reserves are in the Western Offshore (39.79%) followed by Assam (25.89%), whereas the maximum reserves of Natural Gas are in the Eastern Offshore (36.79%) followed by Western offshore (23.95%). There was decrease of 2.28% in the predicted reserve of crude oil for the country as a whole during 2015-16 as compared to the position a year before. During the same period, estimated reserves of

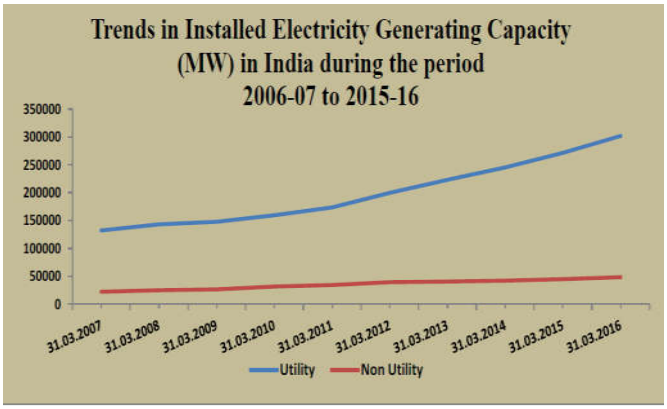
India was the leading country in the world to set up a ministry of non-conventional energy resources, in early 1980s. Till September 30, 2016 India's cumulative grid interactive or grid tied renewable energy capacity (excluding large hydro) came up to 44.24GW. (Executive Summary Power Sector September, 2016; Chandrasekaran, 2016; Physical Progress, 2016) 61% of the renewable power originated from wind, while solar contributed nearly19%. (Physical Progress, 2016; http://www.renewindians.com/2013/02/indian-renewable installed-capacity-has-reached-27.7GW.html) Large hydro installed capacity was 43.11 GW (Scheme wise Physical

Progress, 2016) as of September 30, 2016 and is administered separately by the Ministry of Power and not included in MNRE targets. (http://www.mospi.gov.in/sites/default/files/ publication_reports/Energy_Statistics_2017.pdf)

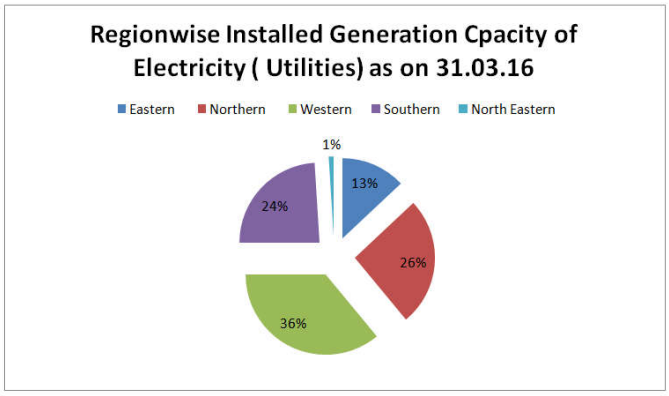


Electricity

The total mounted capacity for electricity generation in the nation has increased from 154664MW as on 31.03.2007 to 350367 MW as on 31.03.2016, recording a CAGR of 8.52%. Electricity ability amplified by 10.74% to 33987 MW in 2015-16. The maximum rate of annual growth from 2014-15 to 2015-16 in installed capacity was for Other Renewable sources (ORS) (19.25%) followed by Thermal Power (10.91%). The total Installed capacity of power utilities in the country got better from 132329 MW in 31.3.2007 to 302088 MW as on 31.3.2016, with a CAGR of 8.60% in that period. At the end of March 2016, thermal power plants accounted for an tremendous share of 73.50% of the total installed capacity in the country, with an installed capacity of 257528 MW. Other renewable Sources (excluding hydro) following with an installed capacity of 44217 MW, with a share of 12.62% of the total installed Capacity. The part of Hydro and Nuclear energy was only 12.23% and 1.65% of total installed capacity. Non-utilities had a share of 13.78% (48279 MW) of the whole installed electricity generation capacity. (http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2017.pdf)



The topographical distribution of Installed generating capacity of electricity as on 31.03.16 indicates that Western Region (both central and state sector) accounted for the maximum share (36%) followed by Northern Region (26%), Southern Region (24%), Eastern Region (13%) and North Eastern Region (1%).



Total Installed Capaciy= 302.08 GWh

Availability of Primary Energy Sources (http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_ Statistics_2017.pdf)

Availability of Coal and Lignite

The total availability of raw coal in India in 2015-16 was 843.27 MTs and that of lignite was 45.47 MTs. The availability of coal in the period of 2015-16 increased by 1.60% compared to 2014-15. The obtain ability of lignite declined by 8.27% during the same period. The availability of coal has increased at a CAGR of about 5.74% during the time from 2006-07 to 2015-16. This increased availability might be credited to the increase in the coal production (482.37 MTs during 2006-07 to 843.27 MTs during 2015-16) added by imports. The availability of lignite has increased at a CAGR of about 3.65% during the time period from 2006-07 to 2015-16.

Availability of Natural Gas

The making of natural gas has steadily increased from a 37.60 BCM during 2006-07 to 48.83 BCMs during 2015-16, recording a CAGR of 2.65%. Most of this growth in the ethnic production is due to finding of new reserves.

Availability of Crude Oil and Petroleum Products

The availability of crude oil in the country improved from 145.49 MTs in 2006-07 to 239.80 MTs during 2015-16 . During this time period, crude oil production raised from 33.99 MTs to 36.95 MTs and the net import increased from 111.50 MTs to 202.85 MTs between 2006-07 and 2015-16. Report shows that there is a increase of 5.69% in availability of crude oil during 2015-16 over 2014-15.

Availability of Electricity

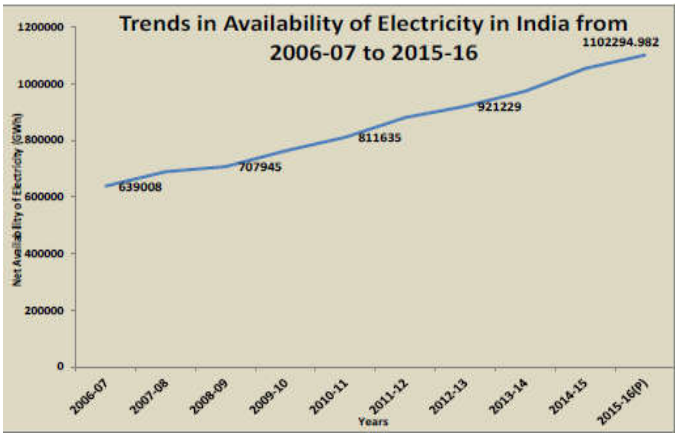
Electricity accessible for supply increased from 6,39,008 Gwh in 2006-07 to 11,04,228 Gwh in 2015-16, thus showing a CAGR of 5.62% through this period. The availability of electricity increased at 4.73% in 2015-16 over its worth in 2014-15.

Consumption of Primary Energy Sources (http://www.mospi.gov.in/sites/default/files/ publication_ reports/Energy_Statistics_2017.pdf)

Consumption of Coal and Lignite

The projected total consumption of raw coal by industry has amplified from 462.35 MT during 2006-07 to 832.46 MT

during 2015-16 with a CAGR of 6.06% (Table 6.1). The yearly growth rate from 2014-15 to 2015-16 is 1.29%. Consumption of Lignite increased from 30.81 MT in 2006-07 to 42.52 MT in 2015-16 registering a compound growth of 3.28%. Consumption of Lignite in Electricity Generation sector is the maximum, accounting for about 89.57% of the total lignite consumption. The maximum intake of raw coal is in Electricity generation, followed by steel industries. Industry-wise prediction of consumption of coal proves that during 2015-16, electricity generating units used up 508.25 MT of coal, followed by steel & washery industries (56.45 MT), cement industries (8.93 MT) and sponge iron industries (7.76 MT).

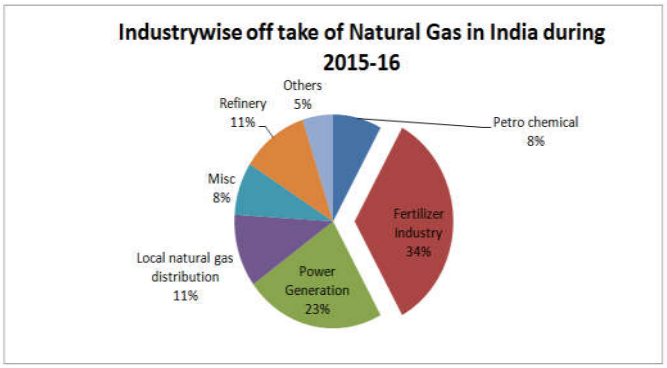


Consumption of Crude Oil and Natural Gas

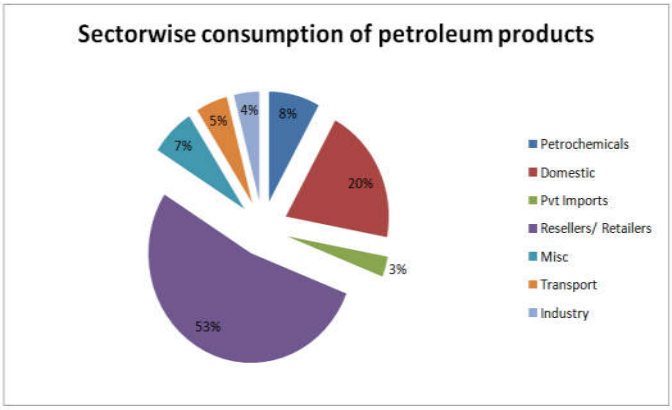
The estimated consumption of crude oil has a stable increase, from 146.55 MMT through 2006-07 to 232.87 MMT during 2015-16 with CAGR of 4.74%. It increased from 223.24 MMT in 2014-15 to 232.87 MMT in 2015-16. The full use of Natural Gas is in fertilizers industry (33.72%) followed by power generation (22.76%) and 11.42% natural gas was used for domestic fuel. Industry wise off-take of natural gas shows that natural gas has been used together for Energy (55.76%) as well as Non-energy (44.24%) purposes.

Consumption of Petroleum Products

High speed diesel oil has the share of 40.42% of total consumption of all types of petroleum products in 2015-16. This was followed by Petrol (11.83%), LPG (10.63%), Petroleum Coke (10.45%) and Naphtha (7.19%). Consumption of Light Diesel oil constantly reduced from 2006-07 (0.72 MT) to 2015-16 (0.41 MT). Sector-wise consumption of different petroleum products discloses that Reseller/Retail pays 53% in the total consumption followed by Domestic sector with contribution 20%.



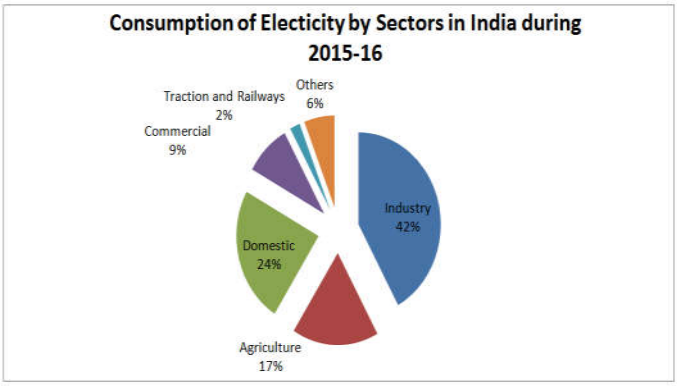
Total consumption=47.85BCM



Total consumption=121408 Thousand Tonne

Consumption of Electricity

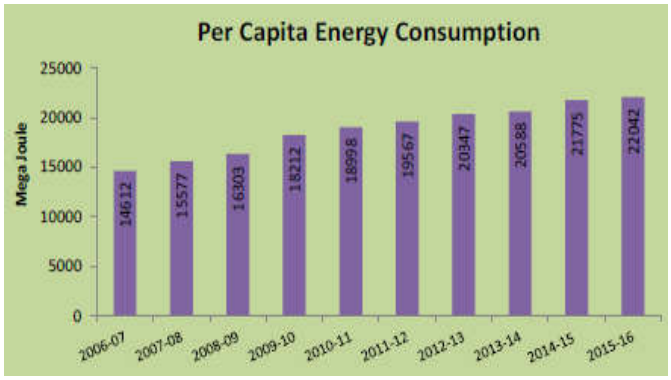
The estimated electricity consumption improved from 4,55,749 GWh during 2006-07 to 10,01,191 GWh during 2015-16, viewing a CAGR of 8.19% . The growth in electricity consumption is 5.55% from 2014-15 (9,48,522 GWh) to 2015-16 (10,01,191 GWh). Of the entire consumption of electricity in 2015-16, industry sector accounted for the largest share (42.30%), followed by domestic (23.86%), agriculture (17.30%) and commercial sectors (8.59%). The electricity consumption in Industry sector and domestic sector has improved at a much faster speed compared to other sectors during 2006-07 to 2015-16 with CAGRs of 9.47% and 7.97% correspondingly. Loss of electricity due to transmission has declined from 28.64% during 2006-07 to 21.81% during 2015-16.



Total consumption= 10,01,191GWh

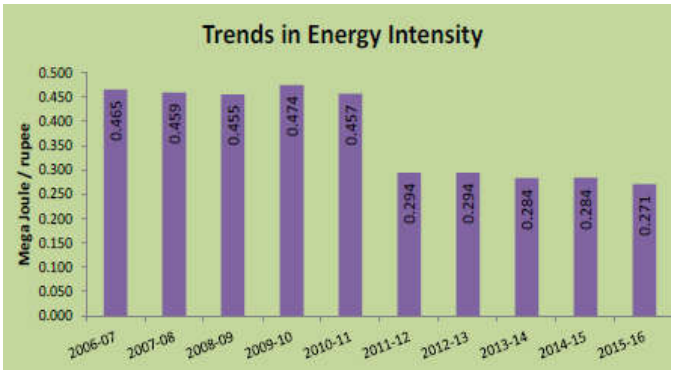
Per-Capita Energy Consumption

The consumption of energy in petajoules in the form of Coal and Lignite which accounted for about 46.28% of the total consumption throughout 2015-16. Crude Petroleum was second (34.48%), while Electricity (12.75%) was third. The entire consumption of energy from conventional sources improved from 27,589 petajoules during 2014-15 to 28,276 petajoules during 2015-16, showing an increase of 2.49%. Per-capita Energy Consumption (PEC) during a year is computed as the ratio of the estimate of total energy consumption during the year to the estimated mid-year population of that year. Per-capita Energy Consumption (PEC) increased from 14,612 Mega Joules in 2006-07 to 22,042 Mega Joules in 2015-16, a CAGR of 4.2%. The annual growth in PEC for 2015-16 over 2014-15 was 1.23%.



Energy Intensity

Energy Intensity is defined as the quantity of energy consumed for generating one single unit of Gross Domestic Product (at constant prices). PEC and Energy intensity are the maximum used policy indicators, both at nation-wide and world-wide. In the absence of data on consumption of non-conventional energy from several sources, particularly in rural areas these binary indicators are commonly computed on the basis of consumption of conventional energy. The Energy Intensity (at 2004-05 prices) reduced from 0.465 Mega Joules per rupee in 2006-07 to 0.284 Mega Joules per rupee in 2014-15 to 0.271 Mega Joules in 2015-16.Energy intensity has narrowed over the last decade. This decline may be attributed to faster development of GDP than energy demand, the services sector having a growing share of the economy, use of energy efficiency programmes, etc.



Nomenclature:

TWh	Tera Watt Hour
BkWh	Billon Kilo Watt hour
BCM	Billon Cubic Meter
CAGR	Compound Annual Growth Rate
SHP	Small Hydro Plants
GW	Giga Watts
MNRE	Ministry of New and Renewable Energy
PEC	Per Capita Consumption
GDP	Gross Domestic Product

Conclusion

Energy scenario in India is not satisfactory. The country has very low per capita energy consumption in comparison to developed countries, mainly dependent on low quality indigenous coal and imported oil and gas. There is a huge gap between renewable energy potential and actual achievement. To bridge the gap the country has to overcome the restrictions of technology, financial resource crisis, policies and institutions. Continued overdependence on fossil fuels will further depreciate the negative environmental concerns of global warming, acid rain and ozone layer depletion. For sustainable economic development with long term energy security India has to transfer from the presently dominated centralised fossil fuel centric energy system to decentralised renewable energy centric energy system. The energy related environmental issues should be resolved through source reduction rather than emission control. In the long run this can be effectively accomplished by changing the products, (with technologies, policies and pressures) which produce waste and increase the pollution. To implement this requirement Speth's suggestion, way back in 1988, covering several huge scale social and technological transitions are even relevant nowadays.

Transition 1: Move away from era of fossil fuels towards an era of energy efficiency and renewable energy.

Transition 2: Transfer from an era of capital and material intensive technologies to an era of new technologies that rely on inputs with low environmental costs.

Transition3: Change towards ecologically oriented production technologies ("design with nature").

Transition 4: Shift towards "honest" economics in which policies don't subsidize the use of raw resources or the generation of waste.

Transition 5: Shift to further national approaches to solve environmental problem.

Transition 6: Advancement of a stable population.

REFERENCES

"Growth of Electricity Sector in India from 1947-2016" (PDF). CEA. Retrieved 17 February 2017.

"All India Installed Capacity of Utility Power Stations" (PDF). Retrieved 7 April 2017.

"BP Statistical Review of world energy, 2016" (PDF).

"IBEF Power" (PDF). IBEF. Retrieved 28 October 2016.

"Tariff & duty of electricity supply in India". report. CEA, Govt. of India. March 2014.

"Government decides to electrify 5.98 croreun electrified households by December 2018". Retrieved 20 June 2016

"Executive Summary Power Sector September 2016" (pdf). report. Central Electricity Authority, Ministry of Power, Govt. of India. 30 September 2016. Retrieved 18 November 2016.

Chandrasekaran, Kaavya (10 June 2016). "Capacity for renewable energy in India hits 42,850 mw; surpasses capacity of hydel projects" The Economic Times of India. Retrieved 10 June 2016.

"Physical Progress (Achievements)". Ministry of New and Renewable Energy. Retrieved 23 May 2016.

"Physical Progress (Achievements)" (web). report. Ministry of New and Renewable Energy, Govt. of India. Retrieved 18 November 2016.

http://www.renewindians.com/2013/02/indian-renewable-installed-capacity-has-reached-27.7GW.html

"Ministry of New and Renewable Energy, Annual Report 2015-2016.".

"Scheme wise Physical Progress in 2016-17" Report. Ministry of New & Renewable Energy. 31 July 2016. Retrieved 31 August 2016.

http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2017.pdfRetrieved 2ndApril 2017.

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