

# Electrical Energy Scenario INDIA 2024

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**Abstract:** The global energy demand rises day by day with increase in population, industrialization and improvement in living standard of people. An energy source can be renewable or non-renewable. The energy of coal, gas, petroleum products, nuclear fuels etc. transformed into electrical energy from long period so called conventional sources of energy. But the global energy crisis firmly motivates us to tap the energy from all available sources like small streams, solar light, wind, tidal energy, geothermal energy etc. called non-conventional sources of energy. These sources have been used for a few decades. After a few decades of use the non-conventional source becomes conventional.

Here in this paper we will discuss the energy scenario in India for electricity generation from various conventional and unconventional sources, the installed capacity of various power plants in India and the energy generation share of various energy sources.

**Keywords:** Non-Conventional energy source, Conventional energy source, Renewable energy.

**Abbreviations:** BU: Billion Units (1 Unit=1kWh), MU: Mega units, TPP: Thermal Power Plant, NCES: Non-Conventional energy Sources, NPP: Nuclear Power Plant, SHP : Small hydro Power Plant.

## I. INTRODUCTION

India is the world's third largest electricity consumer [1] with per capita electrical energy 1327kWh for FY 2022-23. In 2020 India meets its all energy demand (electricity, transportation, fuel etc.) coal 44%, Petroleum 24%, natural gas 6%, nuclear 1%, biomass and waste accounted for 21%, hydropower 2% and renewable fuel sources consumption 1% [2]. The total installed capacity of power plants in India is 444.76 GW as of May 2024. The energy consumption in India has doubled in the last thirteen years from 808.498 Billion Units to 1624.16 BU [3]. The electrical energy requirement of 2400 BU by the year 2029-30 as per 19th Electric Power Survey [4]. For meeting the future energy demand proper planning is needed and load forecasts have a major role in it. Most of our energy demand we meet from fossil fuels e.g. Coal, natural gas etc. Although fossil fuels are nonrenewable, they cause environmental pollution and impact global warming.

## II. ELECTRICAL ENERGY GENERATION FROM NONRENEWABLE SOURCES

**2.1 Thermal power Plants :** It uses coal or natural gas as fuel for generation of electricity. The fossil fuels being used for a long time for energy transformation to electrical energy also called conventional sources of energy. These are not renewable, yet they share a major portion i.e. 56.8% of our total installed capacity (thermal power plant, gas power plant, diesel power plant). About 76.48 % of total energy generated from thermal power plants in the year 2023-24. Coal is the abundant fossil fuel in India [5].

**2.2 Nuclear Power plants:** It uses nuclear fuel for generation of electricity and it's a conventional source for electricity generation. The installed capacity of nuclear power plants is about 1.6% of total installed capacity and 2.76 % of total energy generated from it in India for the year 2023-24 [5].

## III. ELECTRICAL ENERGY GENERATION FROM RENEWABLE SOURCES

### 3.1 Conventional Energy source based Plant

**Hydro power plants:** The installed capacity of HPP is about 46.42 GW, shares 11.2% of total installed capacity and generated 7.73% of total electrical energy generation for the year 2023-24. The HPP having capacity above 25MW is conventional [5].

### 3.2 Non-conventional energy source based plants

The future energy crisis firmly motivates us to tap the energy from all available sources like small streams, solar light, wind, tidal energy, geothermal energy, geothermal sources ocean thermal energy, etc. called non-conventional sources of energy. These sources are called so because these are not being used for a long time and after a few decades they become conventional sources.

**3.2.1 Wind power plant :** The installed capacity for WPP in India is about 46422.47MW and shares 10.3% of total installed capacity. It generated 83.38 GU contributing 4.8% to overall generation in FY 2023-24 [5].

**3.2.2 Solar power plant:** The installed capacity for SPP in India is about 84277.42 MW and shares 16.1% total installed capacity. SPP contributes 115.97GU electrical energy generation in FY 2023-24 and shares 6.68% of total energy generation [5].

**3.2.3 Biomass and Bagasse :** The energy conversion plants having capacity about 10355.35MW and shares 2.5% of total installed capacity. It contributes 3.47GU generation and shares 0.2% of energy generation in FY 2023-24 [5].

**3.2.4 Waste to power generation :** The electrical energy conversion plants have capacity about 249.74 MW and share 0.1% of total installed capacity. It contributes 2.27GU generation and shares 0.0156% of energy generation in FY 2023-24 [5].

**3.2.5 Small hydro Power plants :** Any hydro plant having installed capacity equal or below 25MW is non-conventional. SHPP installed capacity is about 5005.25MW which is 1.2% of total installed capacity. It had produced 9.48 GU of electrical energy in FY 2023-24 and shares 0.55% for total generation [5].

## IV. INSTALLED CAPACITY OF VARIOUS POWER PLANTS IN INDIA

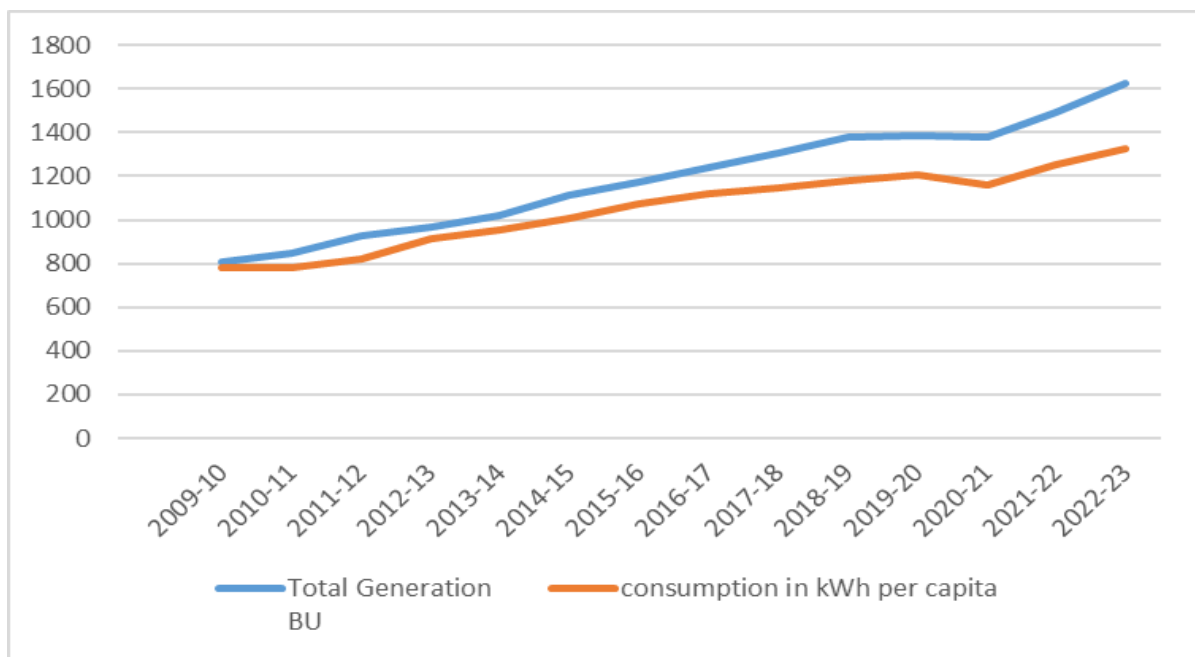
The installed capacity fuel wise of all power plants up-to May 2023.

<b>1. Fossil Fuel :237269 MW 56.8%</b>		
Coal	205235 MW	49.1 %
Lignite	6620 MW	1.6%
Gas	24824 MW	6.0%
Diesel	589 MW	0.1%
<b>2. Non-Fossil Fuels (Renewable)</b>		
Renewable Energy Source	173619MW 41.4%	
A. Conventional Hydro Power Plant	46850 MW	11.2%
B. Non Conventional Source		
Wind	46422.47 MW	10.3%
Solar	84277.42 MW	16.1%
Bio Mass Power/ Cogen	10355.35 MW	2.5%
Waste to Power	249.74 MW	0.1%
Small hydro Power	5005.25 MW	1.2%
<b>3. Non-Fossil Fuels (Non-Renewable)</b>		
Nuclear Fuel	6780 MW	1.6%

## V. ANNUAL GENERATION AND GROWTH IN ELECTRICAL ENERGY

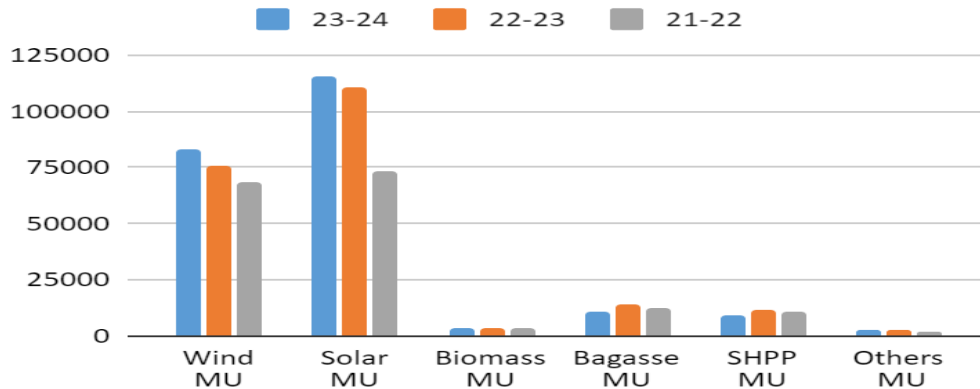
The energy demand keeps on increasing. It has doubled in the last thirteen years. The electrical energy requirement of 2400 BU [4].

Year	Total Generation BU	+Growth -Decline	Consumption in kWh per capita
2009-10	808.498	+7.56	779
2010-11	850.387	+5.59	779
2011-12	928.113	+9.14	819
2012-13	969.506	+4.46	914.41
2013-14	1,020.20	+5.23	957
2014-15	1,110.39	+8.84	1010
2015-16	1,173.60	+5.69	1075
2016-17	1,241.69	+5.8	1122
2017-18	1,308.15	+5.35	1149
2018-19	1,376.10	+5.19	1181
2019-20	1,389.10	0.95	1208
2020-21	1,381.86	-0.52	1161
2021-22	1,491.86	+7.96	1255
2022-23	1,624.16	+8.87	1327



## VI. ELECTRICAL ENERGY GENERATION FROM NON-CONVENTIONAL SOURCES

Year	Wind MU	Solar MU	Biomass MU	Bagasse MU	SHPP MU	Others MU	Total Generation MU
23-24	83385.4	115975.1	3417.2	10825.6	9485	2746.5	225834.8
22-23	75940.4	110348.5	3479	14304.2	11852.5	2744.7	218669.3
21-22	68640.1	73476	3482.8	12573.9	10463.6	2268	170904.4

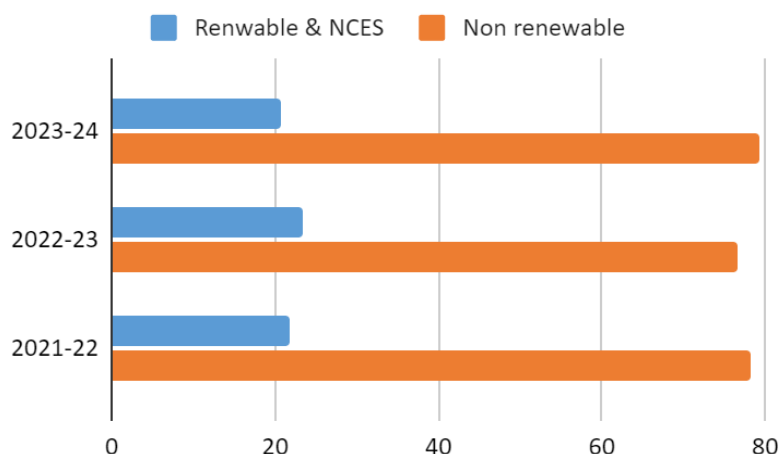


## VII. ELECTRICAL GENERATIONS FROM ALL RENEWABLE SOURCES INCLUDING NCES

Year	NCES BU	HPP BU	Total Energy generation in India BU	NCES Shares %	HPP Shares %	Renewable sources (Include NCER) Share %
23-24	225.83	134.05	1734	13.02	7.73	20.75
22-23	218.67	162.10	1632.84	13.39	9.934	23.32
21-22	170.9	151.63	1484.35	11.51	10.22	21.73

## VIII. ELECTRICAL GENERATION SHARE OF NONRENEWABLE ENERGY SOURCE

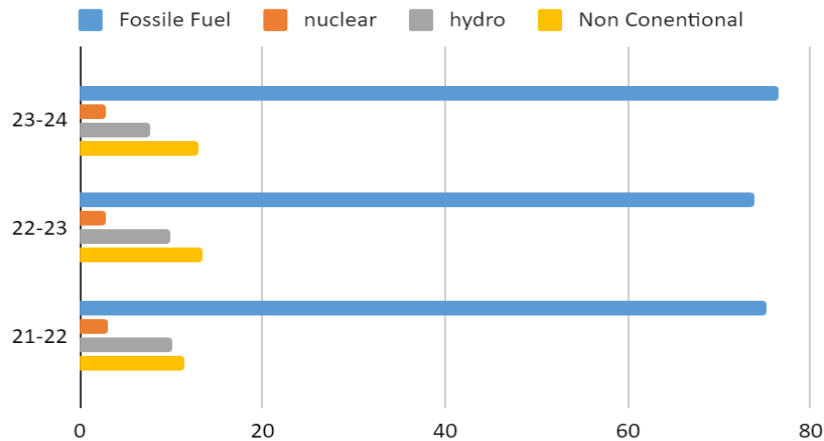
Year	Renewable Energy Source (Including NCES) Share %	Non Renewable share %	Total generation BU
2023-24	20.75	79.25	1734.11
2022-23	23.32	76.68	1632.84
2021-22	21.73	78.27	1484.35



## IX. SHARE OF VARIOUS FUELS FOR ELECTRICAL ENERGY GENERATION.

India has the 4th largest coal reserve in the world, about 352 BT. The reserve to production rate of India is 147 for the year 2020 [ a ].It means the coal for India will last for 147 years if it is used at the same amount as in 2020. So , we have to develop a sustainable way to use coal reserves . In fossil fuel, natural gas and diesel have very little contribution to generation.

Year	Fossil Fuel %	Nuclear %	Hydro %	Non Conventional %
23-24	76.49	2.76	7.73	13.02
22-23	73.87	2.81	9.92	13.39
21-22	75.10	3.17	10.21	11.51



**X. ENERGY SHARE OF CONVENTIONAL AND NON-CONVENTIONAL SOURCES.**

Year	Non-Conventional %	Conventional %	Total generation BU
2023-24	13.02	86.98	1734.10727
2022-23	13.39	86.61	1632.84053
2021-22	11.51	88.49	1484.35387

**XI. CONCLUSION**

Energy is a ‘strategic commodity’ and any uncertainty in supply can threaten the economy [9]. Our approx. 24% of primary energy demand is met by petroleum , which should be reduced by enhancing electrical transportation and utilizing available energy sources effectively. It will also reduce financial burden for importing crude oil in our country. As most of our energy is generated from fossil fuels especially coal. It is available in abundance in India. Exhaust from TPP causes pollution and causes global warming. Old non efficient TPP should be retired and new more efficient plants should be installed.

Fossil fuel can be converted to hydrogen thermochemical process. Hydrogen is an excellent energy carrier, producing zero emission as fuel.

More and more renewable sources should be harnessed for sustainable development.

Electrical vehicles should be motivated, so that oil demand can be reduced.

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