

# Electricity Power Resource Development in Telangana: A Geographical Analysis

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**Abstract:** *The primary objective for deploying renewable energy in Telangana is to advance economic development, improve energy security, improve access to energy, and mitigate climate change. Sustainable development is possible by use of sustainable energy and by ensuring access to affordable, reliable, sustainable, and modern energy for citizens. Strong government support and the increasingly opportune economic situation have pushed India to be one of the top leaders in the world's most attractive renewable energy markets. The government has designed policies, programs, and a liberal environment to attract foreign investments to ramp up the country in the renewable energy market at a rapid rate. It is anticipated that the renewable energy sector can create a large number of domestic jobs over the following years. This paper aims to present significant achievements, prospects, projections, generation of electricity, as well as challenges and investment and employment opportunities due to the development of renewable energy in India. In this review, we have identified the various obstacles faced by the renewable sector. The recommendations based on the review outcomes will provide useful information for policymakers, innovators, project developers, investors, industries, associated stakeholders and departments, researchers, and scientists.*

**Keywords:** India, Sustainable, Renewable energy, Achievements, Initiatives, Barriers, Recommendations, Investment, Telangana

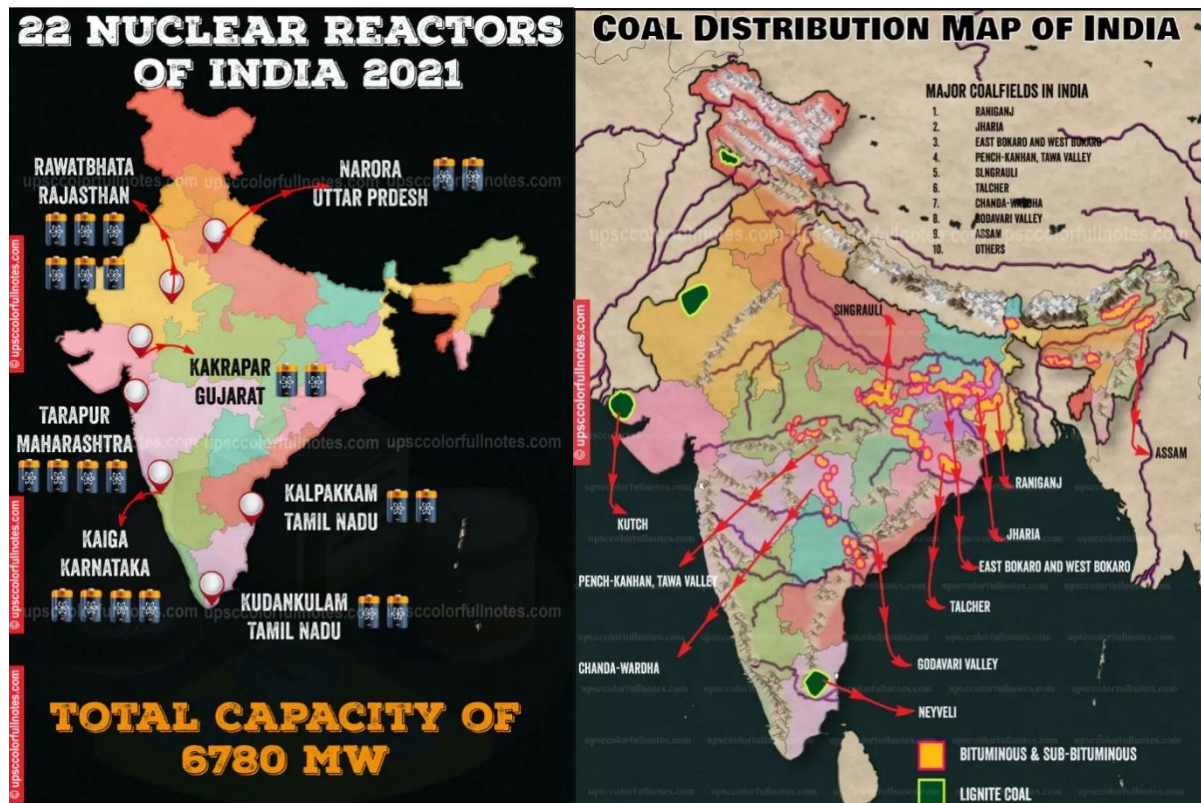
## 1. Introduction

The sources of electricity production such as coal, oil, and natural gas have contributed to one - third of global greenhouse gas emissions. It is essential to raise the standard of living by providing cleaner and more reliable electricity [1]. India has an increasing energy demand to fulfill the economic development plans that are being implemented. The provision of increasing quanta of energy is a vital pre-requisite for the economic growth of a country [2]. The National Electricity Plan [NEP] [3] framed by the Ministry of Power (MoP) has developed a 10 - year detailed action plan with the objective to provide electricity across the country, and has prepared a further plan to ensure that power is supplied to the citizens efficiently and at a reasonable cost. According to the World Resource Institute Report 2017 [4, 5], India is responsible for nearly 6.65% of total global carbon emissions, ranked fourth next to China (26.83%), the USA (14.36%), and the EU (9.66%). Climate change might also change the ecological balance in the world. Intended Nationally Determined Contributions (INDCs) have been submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The latter has hoped to achieve the goal of limiting the rise in global temperature to well below 2 °C [6, 7]. According to a World Energy Council [8] prediction, global electricity demand will peak in 2030. India is one of the largest coal consumers in the world and important economy, the country imported 171 million tons of coal in 2013–2014, 215 million tons in 2014–2015, 207 million tons in 2015–2016, 195 million tons in 2016–2017, and 213 mil - lion tons in 2017–

2018 [9]. Therefore, there is an urgent need to find alternate sources for generating electricity.

In this way, the country will have a rapid and global transition to renewable energy technologies to achieve sustainable growth and avoid catastrophic climate change. Renewable energy sources play a vital role in securing sustainable energy with lower emissions [10]. It is already accepted that renewable energy technologies might significantly cover the electricity demand and re - duce emissions. In recent years, the country has developed a sustainable path for its energy supply. Awareness of saving energy has been promoted among citizens to increase the use of solar, wind, biomass, waste, and hydropower energies. It is evident that clean energy is less harmful and often cheaper. India is aiming to attain 175 GW of renewable energy which would consist of 100 GW from solar energy, 10 GW from bio - power, 60 GW from wind power, and 5 GW from small hydro - power plants by the year 2022 [11]. Investors have promised to achieve more than 270 GW, which is significantly above the ambitious targets. The promises are as follows: 58 GW by foreign companies, 191 GW by private companies, 18 GW by private sectors, and 5 GW by the Indian Railways [12]. Recent estimates show that in 2047, solar potential will be more than 750 GW and wind potential will be 410 GW [13, 14]. To reach the ambitious targets of generating 175 GW of renewable energy by 2022, it is essential that the government creates 330, 000 new jobs and livelihood opportunities [15, 16].

**Power distribution Map of India**



A mixture of push policies and pull mechanisms, accompanied by particular strategies should promote the development of renewable energy technologies. Advancement in technology, proper regulatory policies [17], tax deduction, and attempts in efficiency enhancement due to research and development (R&D) [18] are some of the pathways to conservation of energy and environment that should guarantee that renewable resource bases are used in a cost-effective and quick manner. Hence, strategies to promote investment opportunities in the renewable energy sector along with jobs for the unskilled workers, technicians, and contractors are discussed. This article also manifests technological and financial initiatives [19], policy and regulatory framework, as well as training and educational initiatives [20, 21] launched by the government for the growth and development of renewable energy sources. The development of renewable technology has encountered explicit obstacles, and thus, there is a need to discuss these barriers. Additionally, it is also vital to discover possible solutions to overcome these barriers, and hence, proper recommendations have been suggested for the steady growth of renewable power [22–24]. Given the enormous potential of renewables in the country, coherent policy measures and an investor-friendly administration might be the key drivers for India to become a global leader in clean and green energy.

#### Projection of global primary energy consumption

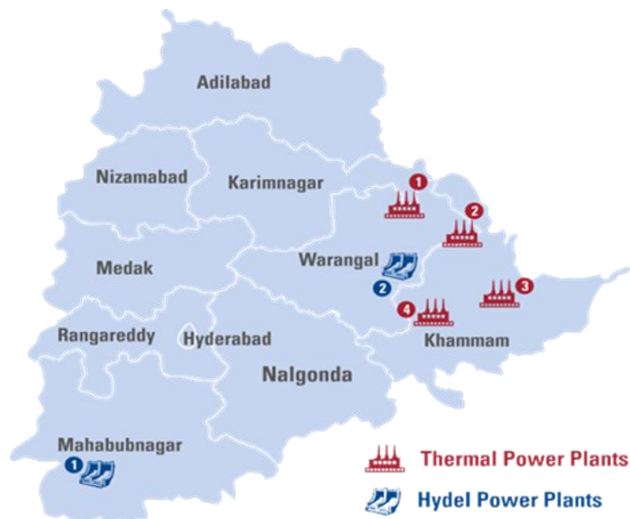
An energy source is a necessary element of socio-economic development. The increasing economic growth of developing nations in the last decades has caused an accelerated increase in energy consumption. This trend is anticipated to grow [25]. A prediction of future power consumption is essential for the investigation of adequate environmental and economic policies [26]. Likewise, an outlook to future power consumption helps to determine

future investments in renewable energy. Energy supply and security have not only increased the essential issues for the development of human society but also for their global political and economic parameters [27]. Hence, international comparisons are helpful to identify past, present, and future power consumption.

Table 1 shows the primary energy consumption of the world, based on the BP Energy Outlook 2018 reports. In 2016, India's overall energy consumption was 724 million tons of oil equivalent (Mtoe) and is expected to rise to 1921 Mtoe by 2040 with an average growth rate of 4.2% per annum. Energy consumption of various major countries comprises commercially traded fuels and modern renewables used to produce power. In 2016, India was the fourth largest energy consumer in the world after China, the USA, and the Organization for Economic Co-operation and Development (OECD) in Europe.

#### Scenario energy consumption in Telangana

Quality power to various competing sectors is a sine qua non to meet the objectives of the newly formed state of Telangana. Driven by considerable growth in demand from agriculture, domestic and industrial sectors and the metro city of Hyderabad, total energy requirement in Telangana in FY 2014-15 was 50,916 MU. As against this only 48,788 MU was met leading to a deficit of nearly 4%.



**Map of Thermal and Hydel Power Plants in Telangana**

Implementation of the above objectives will translate into significant energy requirement owing to key demand drivers including:

- Planned urban centers of Karimnagar, Warangal, Khammam and Nalgonda leading to high commercial, industrial and domestic demand
- Aspirational increase in household per - capita consumption
- Major industrial projects such as Bayyaram steel plant, and large - scale infrastructure additions such as HMR and Water Grid and planned LI schemes
- 5% reserve margin from FY 15 - 16 onwards.

Given these factors, energy requirement of Telangana is expected to nearly double from 50, 916 MU in FY 2014 - 15 to 105, 974 MU by FY 2018 - 19. The peak demand is also expected to increase three - fold from 8, 331 MW in FY 2014 - 15 to 19, 053 MW in FY 2018 - 19. The demand ramp - up of such scale requires planning and readiness across the entire power sector value chain including power procurement/generation, transmission, distribution and financial health.

**Electrification Plan**

As on date, there are 44, 532 urban and 721, 588 rural households to be electrified in the state of Telangana. The state plans to complete its electrification of all households by the end of FY 2017 - 18 under GoI Schemes like DDUGJY and IPDs.

**Power supply position**

Energy deficit in the state of Telangana for last three years was in the range of 4% - 12%. The energy requirement was 50, 916 MU in FY 14 - 15, of which only 2, 128 MU could

not be met resulting in an energy deficit of nearly 4.2%. The state saw a historic maximum peak demand of 8, 331 MW in FY 2014 - 15.

**Generation Plan**

The state generation utility, TSGENCO is planning significant investments to the tune of 6, 840 MW amounting to a total project cost of INR 42, 491 Crs from its upcoming thermal power stations including Kakatiya, Kothagudem, Bhadradi and Damercherla Thermal Power Stations to meet the increasing demand through capacity additions by FY 2018 - 19. Also, TSDISCOMS are planning to procure capacity from various sources including 4, 733 MW of power from CGS sources, 4, 819 MW of power from other long - term sources and 6, 016 MW from Renewable Energy Sources. These capacity additions together sum up to 22, 408 MW in installed capacity terms by end of FY 18 - 19.

In a realistic scenario taking into account manageable delays in COD of power sources and anticipated onset of demand from various major projects, the state will move from a deficit position till FY 2017 - 18 to a surplus position by FY 2018 - 19.

**Transmission Plan**

The state transmission utility has planned significant investments to the tune of INR 17, 803 Crores (excluding the investments for solar parks planned) by the end of FY 18 - 19 for ensuring adequacy of the system to provide reliable and quality power to the consumers in the state. The above proposed transmission system will be adequate in meeting the projected peak load of over 21, 000 MW upto FY 2018 - 19 and RE power of about 6, 016 MW which is mainly through solar generation. The additional transmission system (if required) for evacuation of anticipated RE power more than planned capacity shall also be identified, approved and implemented as per system requirement matching with the RE generation.

**Power Supply Position and Demand Projections**

**Power Supply Scenario**

Energy deficit in Telangana for last three years was in the range of 4% - 12%. Energy requirement in Telangana was 50, 916 MU in FY 14 - 15, of which only 2, 128 MU could not be met resulting in an energy deficit of nearly 4.2% with a maximum historic peak demand of 8, 331 MW in 2014 - 15.

As can be seen from the table below, peak demand has increased by over 2, 588 MW during the period FY 2008 - 09 till FY 2014 - 15 as against which peak met has increased by 1, 345 MW.

**Historical Power Supply Position in Telangana State**

Period (MW)	Peak Demand (MW)	Peak Met (MW)	Peak Deficit/ Surplus (MW)	Peak Deficit/ Surplus (%) (- /+)	Energy Requirement (MU)	Energy Availability (MU)	Energy Deficit/ Surplus (MU)	Energy Deficit/ Surplus (%) (- /+)
2008 - 09	5, 743	5, 303	- 440	- 8%	31, 883	30, 348	- 1, 535	- 4.8%
2009 - 10	6, 263	5, 655	- 608	- 10%	34, 808	32, 752	- 2, 055	- 5.9%



2010 - 11	6, 600	6, 239	- 361	- 5%	36, 490	35, 802	- 688	- 1.9%
2011 - 12	6, 866	6, 461	- 405	- 6%	47, 987	45, 312	- 2, 675	- 5.6%
2012 - 13	6, 741	6, 317	- 424	- 6%	48, 758	42, 942	- 5, 816	- 11.9%
2013 - 14	7, 876	7, 177	- 699	- 9%	47, 428	44, 946	- 2, 482	- 5.2%
2014 - 15	8, 331	6, 648	- 1, 683	- 20%	50, 916	48, 788	- 2, 128	- 4.2%

There was a 11% increase in the peak deficit in FY 2014 - 15 over FY 2013 - 14 attributable to the increased agricultural loads whereas the energy deficit has decreased by 1% attributable to the extensive short - term market purchases which contributed to 21% of the total power purchased in FY 2014 - 15.

**Demand Projections**

Implementation of 24x7 supply across the State is likely to increase the electricity consumption substantially.

Various factors that have been considered for future energy projections include

- Demand from Domestic segment
- Agriculture supply from 7 hours to 9 hours in a day
- Implementation of LI Schemes
- Urban development in cities of Hyderabad, Warangal, Nizamabad and Karimnagar.
- Upcoming major projects such as Hyderabad Metro Rail,

Hyderabad ITIR region

- Upcoming Bayyaram Steel Plant in 2016 - 17.

**Domestic Demand**

Projections of domestic demand have been undertaken by aggregating demand from the following categories

- Demand on account of power supply to already electrified households
- Demand on account of power supply to unelectrified households
- Demand from electrification of newly constructed households
- Demand from 24x7 supply to rural
- The year wise addition of households have been projected based on the historical compounded annual growth rates (CAGR) of the DISCOMs.

**Historic household data for Telangana State**

Sr. No. Particulars	2001 (Census) (units)	2011 (Census) (units)	Difference (units)	Decadal Growth (%)	CAGR (%)	Total H/ H by 2014 as per DISCOMs (units)
1 Total Households	5, 759, 920	7, 974, 704	2, 214, 784	38.45%	3.31%	8, 473, 917
2 Rural Households	4, 268, 176	5, 146, 897	878, 721	20.59%	1.89%	4, 109, 068
3 Urban Households	1, 491, 744	2, 827, 807	1, 336, 063	89.56%	6.60%	4, 364, 849
4 Total Electrified	4, 538, 390	7, 331, 105	2, 792, 715	61.54%	4.91%	7, 707, 797
5 Rural Electrified	3, 103, 845	3, 850, 217	746, 372	24.05%	2.18%	3, 387, 480
6 Urban Electrified	1, 434, 545	3, 480, 888	2, 046, 343	142.65%	9.27%	4, 320, 317

**Demand from electrified households**

Improvement of supply as well as natural load growth will result in increase of the consumption levels in the hitherto electrified households. Historic values of per household consumption have been considered for projecting demand for next five years. Based on computed CAGR for per household consumption, overall consumption and additional consumption have been estimated. The projections for the state of Telangana depict increase of household consumption from the current levels of 1.47 units/ day in FY 2014 - 15 to 3.56 units/ day in FY 2018 - 19 for in rural areas whereas it is expected to increase from 4.17 units/day in FY 2014 - 15 to 6.60 units/day in FY 2018 - 19 in urban areas

with the improvement in the standards of living and the historic load reliefs thereby overcoming the comparatively low per capita consumption in the previous years and accordingly the growth rates have been changed.

**Demand from un - electrified households**

Telangana DISCOMS plan to undertake 100% electrification of all households by FY 2017 - 18 in line with the PFA objectives. Hence state energy requirement is expected to increase in the coming years with the electrification of the Urban and Rural households by FY 2018 - 19 and detailed energy consumption projections have been showed in the Table 3.

The projections have been made incorporating the expected increase in aspirational consumption level of the households

**Electrification of households**

Electrification of unelectrified Household Nos.	-	15, 000	15, 000	14, 532	-
Cumulative H Helectrified Nos.	-	15, 000	30, 000	44, 532	44, 532
Targeted Electrification of unelectrified %		20%	40%	40%	0%
Electrification of unelectrified Household Nos.	-	144, 318	288, 635	288, 635	-
Cumulative HH electrified Nos.	-	144, 318	432, 953	721, 588	721, 588
Total households electrified out of unelectrified Nos.	-	159, 318	303, 635	303, 167	-
Cumulative Annual Energy Requirement for Electrification of MUs	-	20	45	74	82
Cumulative Annual Energy Requirement for Electrification of MUs	-	85	270	764	810

The same has been taken into account while arriving at the total domestic demand of the state.

As on 31.3.2015 there are 44, 532 urban and 721, 588 rural households to be electrified in the state of Telangana.

#### Demand from other category of consumers

The high CAGRs for the categories - Industrial, Agriculture and LIS, Traction and Aviation can be attributed to the additional sales on account of parameters like Bayyaram Steel Plant, 9 Hours of agricultural Supply, LI Schemes, Water Grid Projects and Hyderabad Metro Rail.

#### Demand from other category of consumers:

Sales from other category of consumers in MU						
Category FY14 - 15	FY15 - 16	FY16 - 17	FY17 - 18	FY18 - 19	CAGR	
Commercial	4, 230	4, 572	5, 054	5, 591	6, 189	9.98%
Industrial	13, 619	12, 960	16, 670	20, 571	24, 688	16.03%
Agriculture and LIS	12, 162	17, 050	21, 451	28, 097	31, 532	26.89%
Street Lighting, Townships	1, 224	1, 372	1, 489	1, 618	1, 759	9.50%
Traction and Aviation	576	855	1, 182	1, 298	1, 387	24.60%
Others	779	847	944	1, 053	1, 175	10.83%
Base sales projections and additional load parameters for other than domestic consumers						
Category	FY14 - 15	FY15 - 16	FY16 - 17	FY17 - 18	FY18 - 19	
Base Projections (MU)						
LT	25, 600	28, 437	31, 766	35, 649	39, 963	
HT	16, 213	17, 362	19, 167	21, 198	23, 486	

## 2. Results & Conclusion

Successful implementation of 24X7 Power Supply Scheme requires clear communication among all the stakeholders across the value chain, including the consumers. In order to avoid potential roadblocks in implementation due to poor communication and flow of information, the following table lists the primary responsibility of each stakeholder and the corresponding method in which it will be carried out.

The financial position of the distribution utilities of Telangana makes it imperative to raise tariffs while other initiatives including 24X7 supply are implemented. Such tariff increases would inevitably impact consumers and meet with resistance. To address this, the utilities would clearly communicate their plans on implementing the reliable 24X7 supply scheme along with the other reliability and efficiency improvement measures that they are implementing. A high level of involvement of the Government of Telangana will also be required

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