



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 9, September 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

# Analysis on Demand Side Management by Scaling of Solar Roof Top on Indian States

Akash Kumar Yadav<sup>1</sup>, Dr. Shailendra Verma<sup>2</sup>, Praveen Kumar Gavel<sup>3</sup>, Jay Verma<sup>4</sup>

M. Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>1</sup>

Head of Department, Department of EE, CCET, CSVTU BHILAI, C.G India<sup>2</sup>

M.Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India<sup>3</sup>

Certified Energy Manager, BEE, C.G, India<sup>4</sup>

**ABSTRACT:** This paper is a detailed discussion on the effects and observation on demand side after the implementation of Solar Roof top and other Solar Farm projects implemented in the Indian states as per the capacity. As per the schemes of central government various states has been given some target of several megawatts and subsidies accordingly. The distribution companies and state designated agencies in collaboration with private vendors the implementation of Solar Roof top projects is under progress. The 100 Kw potential of solar roof top will affect the demand side management and the approximate calculation of technical and financial analysis has been completed in this work. The base calculation as per the 100 Kw potential we can easily calculate the energy savings and financial analysis of Megawatts capacity which has been targeted for that particular state.

**KEYWORDS:** MNRE Ministry of New and Renewable Energy, Solar Roof Top, DISCOM Distribution Company, Capex Capital Expenditure, Resco Renewable energy service companies

## I.INTRODUCTION

The Sun has been worshiped as a life-giver to our planet since ancient times. The industrial ages gave us the understanding of sunlight as an energy source. India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Solar photovoltaic power can effectively be harnessed providing huge scalability in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. Off-grid decentralized and low-temperature applications will be advantageous from a rural application perspective and meeting other energy needs for power, heating and cooling in both rural and urban areas. From an energy security perspective, solar is the most secure of all sources, since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements.

There has been a visible impact of solar energy in the Indian energy scenario during the last few years. Solar energy based decentralized and distributed applications have benefited millions of people in Indian villages by meeting their cooking, lighting and other energy needs in an environment friendly manner. The social and economic benefits include reduction in drudgery among rural women and girls engaged in the collection of fuel wood from long distances and cooking in smoky kitchens, minimization of the risks of contracting lung and eye ailments, employment generation at village level, and ultimately, the improvement in the standard of living and creation of opportunity for economic activities at village level. Further, solar energy sector in India has emerged as a significant player in the grid connected power generation capacity over the years. It supports the government agenda of sustainable growth, while, emerging as an integral part of the solution to meet the nation's energy needs and an essential player for energy security.

National Institute of Solar Energy has assessed the Country's solar potential of about 748 GW assuming 3% of the waste land area to be covered by Solar PV modules. Solar energy has taken a central place in India's National Action Plan on Climate Change with National Solar Mission as one of the key Missions. National Solar Mission (NSM) was launched on 11th January, 2010. NSM is a major initiative of the Government of India with active participation from States to promote ecological sustainable growth while addressing India's energy security challenges. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. The Mission's objective is to establish India as a global leader in solar energy by creating the policy conditions for solar technology diffusion across the country as quickly as possible. The Mission targets installing 100 GW grid-connected solar power plants by the year 2022. This is line with India's Intended Nationally Determined Contributions(INDCs) target to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources and to reduce the emission intensity of its GDP by 33 to 35 percent from 2005 level by 2030.

In order to achieve the above target, Government of India have launched various schemes to encourage generation of solar power in the country like Solar Park Scheme, VGF Schemes, CPSU Scheme, Defence Scheme, Canal bank & Canal top Scheme, Bundling Scheme, Grid Connected Solar Rooftop Scheme etc. Various policy measures undertaken included declaration of trajectory for Renewable Purchase Obligation (RPO) including Solar, Waiver of Inter State Transmission System (ISTS) charges and losses for inter-state sale of solar and wind power for projects to be commissioned up to March 2022, Must run status, Guidelines for procurement of solar power through tariff based competitive bidding process, Standards for deployment of Solar Photovoltaic systems and devices, Provision of roof top solar and Guidelines for development of smart cities, Amendments in building bye-laws for mandatory provision of roof top solar for new construction or higher Floor Area Ratio, Infrastructure status for solar projects, Raising tax free solar bonds, Providing long tenor loans from multi-lateral agencies, etc.

Recently, India stands 4th in solar PV deployment across the globe as on end of 2021. Solar power installed capacity has reached around 61.97 GW as on 30th November, 2022. Presently, solar tariff in India is very competitive and has achieved grid parity. [1]

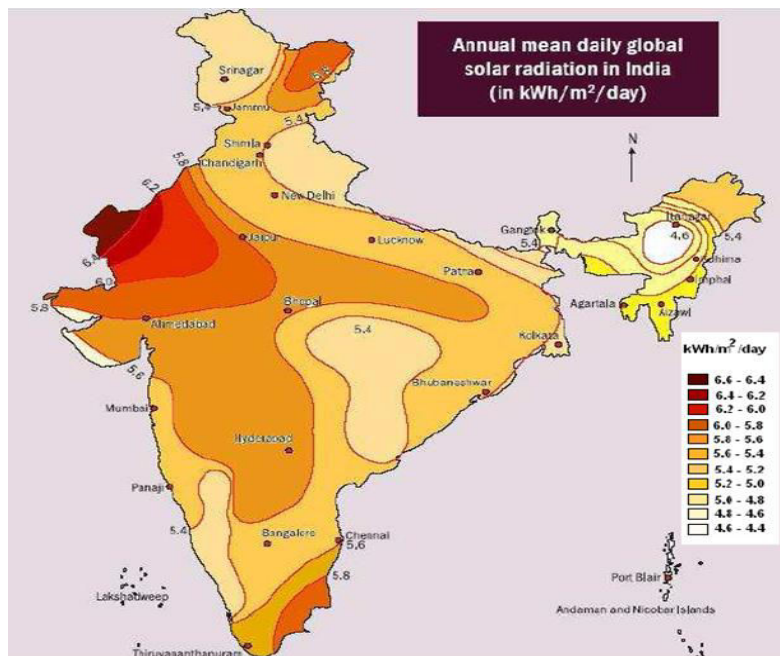


Fig. 1 Annual mean solar radiations in India

Table 1- List of States and latest targets allotted by MNRE

S.NO	STATE	CAPACITY KW
1	ANDAMAN and NICOBAR ISLANDS	1000 KW
2	ANDHRA PRADESH	8000 KW
3	ASSAM	1500 KW
4	BIHAR	10000 KW
5	CHANDIGARH	20000 KW
6	CHHATTISGARH	10000 KW





7	GOA	20000 KW
8	GUJARAT	75000 KW
9	JHARKHAND	10000 KW

In phase 2 the targets allocated to Discom for the grid connected roof top by the latest information in which the work is under progress. In this work a calculation has been done as per the installation cost and the central financing assistance from the central and state government so that we can calculate the effects on the demand side management and the Discom loads as well as the improvements in the peak load of the particular state. So for example if we take a state and calculate the units generation by using software of a 100 KW capacity installed and we can take this calculation as a base for the MW capacity of the state.

### II.METHODOLOGY

In this process we have to first realise how much capacity required as a target for any particular state as we can see from the above table the latest targets of solar roof top capacity so as an example we have taken a site of Gujarat and for the base calculation we have taken 100 KW capacity and by using a solar PV watt calculator we have calculated the units generated. As the units generation of a 100 KW capacity plants of a year is available for calculation. We can find out the other financial calculations by the units per KW cost and central financial assistance provided by the central government an approximate calculation has been done and as per this base calculation we can go for the bigger units plants calculation for example 10 Megawatts we have done in this work. Taken the tariff rates as an average rates we can take the particular tariff rates of any states for which we want to calculate the technical details of units generated, financial cost of the units installed and after subsidies as well as payback period.



Fig. 2 Selected site location for analysis

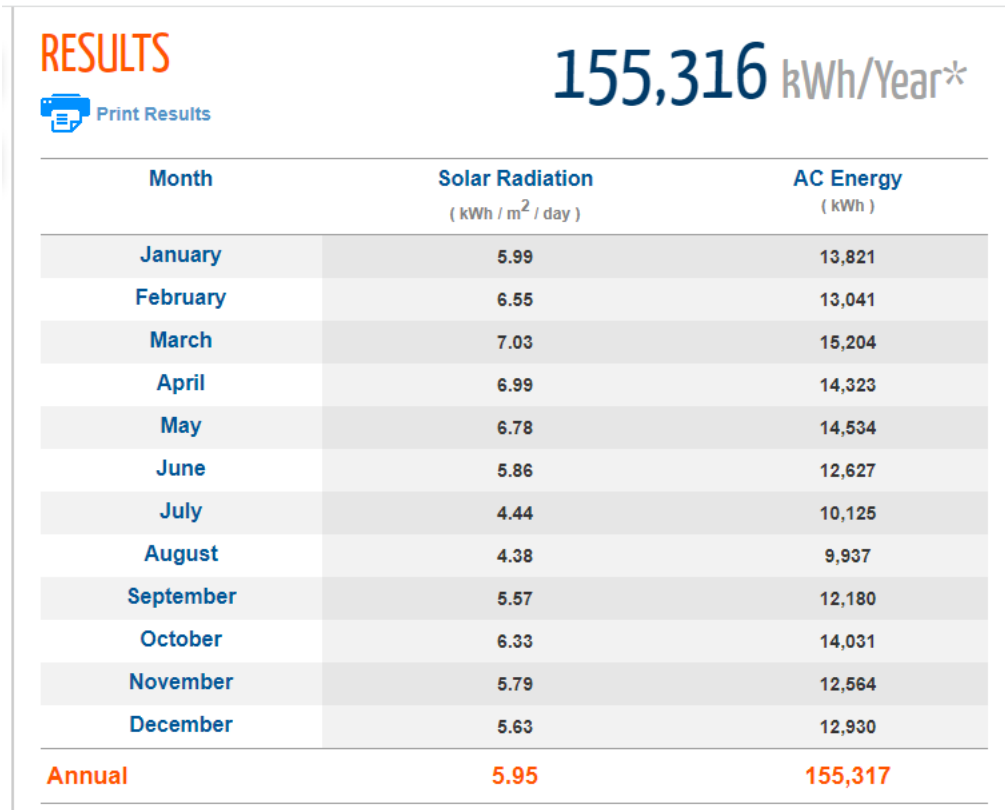


Fig. 3 Units generated by 100KW panel in site

Requested Location	ahmedabad					
Weather Data Source	Lat, Lng: 23.05, 72.65 3.5 mi					
Latitude	23.05° N					
Longitude	72.65° E					
<b>PV System Specifications</b>						
DC System Size	100 kW					
Module Type	Standard					
Array Type	Fixed (open rack)					
System Losses	14.08%					
Array Tilt	20°					
Array Azimuth	180°					
DC to AC Size Ratio	1.2					
Inverter Efficiency	96%					
Ground Coverage Ratio	0.4					
Albedo	From weather file					
Bifacial	No (0)					
Monthly Irradiance Loss	Jan	Feb	Mar	Apr	May	June
	0%	0%	0%	0%	0%	0%
	July	Aug	Sept	Oct	Nov	Dec

Fig. 4 PV System Specification



**Table-2 Calculation sheet of 100KW plant**

Calculation for 100Kwp Solar Roof Top Savings	
Total kWp potential	100
Solar PV Panel Efficiency	16%
Annual Energy Generation	1,55,316
Cost per kWp	50,000
Total capital cost for proposed Solar PV plant	50,00,000
CFA amount for 10Kwp	1,21,284
CFA amount for 100 Kwp	12,12,840
Total capital cost for proposed Solar PV plant after adjusted with CFA	37,87,160
Electricity cost per kWh	7.95
Total cost saving	12,34,762.2
Payback period	3.07

**Table-3 Calculation sheet of 10 MW plant**

Calculation for 10MWp Solar Roof Top Savings	
Total kWp potential	10,000
Solar PV Panel Efficiency	16%
Annual Energy Generation	1,55,31,600
Cost per kWp	50,000
Total capital cost for proposed Solar PV plant	50,00,00,000
CFA amount for 100 Kwp	12,12,840
CFA amount for 10000 Kwp	12,12,84,000
Total capital cost for proposed Solar PV plant after adjusted with CFA	37,87,16,000
Electricity cost per kWh	7.95
Total cost saving	12,34,76,220.0
Payback period	3.07

### III. BUSINESS MODEL

**CAPEX MODE-** In this model, a group of residential consumers will identify a piece of land/roof/mix of land & roof to set up a solar plant under VNM arrangement. The cost of plant (excluding MNRE subsidy) and land is borne by the consumers. The EPC developer/vendor will install the plant and maintain as per agreed terms. The electricity generated from the solar power plant is distributed to all the 4 participating consumers in the same ratios as the share of cost of plant (including land) among them. The DISCOM or Electricity department will adjust generated units in consumer’s electricity bill.

**RESCO MODE-** a RESCO developer will design, build, fund and operate the entire solar power plant (roof or ground-mounted). Consumer shall pay to the developer against assured monthly unit generation per kW. DISCOM will adjust generated units in consumer’s electricity bill.



#### IV. RESULT AND DISCUSSION

We can consider this calculation for the whole area to achieve a certain megawatts we can see that the amounts needs to be installed along with the subsidies provided by the government bodies, the payback period is near about 3 Years after installation. We have done this calculation by the assumptions of all the units generated will be used for the captive load, but in usual case the extra units generated will be exported to the respective distribution companies with a tariff decided by the government and will be reduced by the bills or units imported from the discom.

#### V. CONCLUSION AND FUTURE WORKS

This work describes an approximate calculations and the procedure to find out the impacts of solar roof top scaling in any of the state after the study of this paper a person can easily identify the units generated after the heavy capacity installed in any states of India. We can work on the power purchase and the savings from the discom side as we know there are various long term and short term agreements for the power purchase and at the time of peak loads the tariffs for power purchase is so high so in the next stage by using this calculation the power purchase of very high tariffs can be avoided by the distribution companies and that will be the actual savings financially.

#### REFERENCES

- [1] Ministry of new and renewable energy.
- [2] Vijaykumar Pundlik Sonawane, Rooftop Solar Installations for Demand Side Management - A Case Study Published under license by IOP Publishing Ltd IOP Conference Series: Materials Science and Engineering, Volume 1116, International Conference on Futuristic and Sustainable Aspects in Engineering and Technology (FSAET 2020) 18th-19th December 2020.
- [3] Strbac G. 2008. Demand side management: Benefits and challenges. *Energy Policy*, 36 (12), 4419-4426.C.
- [4] Byrne J, Hegedus S, Wang Y. 1994. Photovoltaics as a demand-side management technology: An analysis of peak-shaving and direct load control options. *Progress in Photovoltaics: Research and Applications*, 2(3), 235-248.
- [5] Weniger J, Tjaden T, Quaschnig V. 2014. Sizing of Residential PV Battery Systems. *Energy Procedia*, 46, 78-87.
- [6] Wu Z, Tazvinga H, Xia X. 2015. Demand side management of photovoltaic-battery hybrid system. *Applied Energy*, 148, 294-304.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.423**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details