

INFLECTION OF ROOFTOP SOLAR PLANT AND ITS EMERGENCE

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Abstract— Industrial and commercial enterprises in India are operating in a very difficult environment, with intense competition from both domestic and international players. Continuous power failures as well as growing prices for grid electricity and diesel fuel to power diesel generators are a major concern for companies in India. Photovoltaic systems for industrial and commercial rooftops are the mainstay of distributed electrical energy supply. Solar rooftop systems for captive consumption can be integrated with the existing electricity infrastructure to offset a major part of your energy needs. Business leaders are keen to know how rooftop solar power can be leveraged to provide more value than just units of electricity generated.

This ARTICLE provides an overview on the strategic value of rooftop solar power. Be seen along with international companies that are shaping the future. Expand capacity previously constrained by lack of grid power. Gain new customers as green supply chains become an urgent need for global business.

We also discuss a few myths surrounding solar power and the reality, enabling you to take an informed decision on incorporating rooftop solar power in your enterprise. Review of rooftop solar power from a top management perspective, presented in a concise format to ensure we present the big picture to the top management.

Index Terms— Introduction, Emergence of solar rooftops, Organization involved, Installation rates and methods, Government policies, Rooftop solar power myth vs. realities, Business overview.

I. INTRODUCTION

India is a country that has tremendous solar energy potential. As the nation is facing an increasing demand - supply gap in energy, it is important to tap the solar potential to meet the energy needs. India is in a state of perennial energy shortage with a demand-supply gap of almost 12% of the total energy demand. This trend is significant in the electricity segment that is heavily dependent on coal and other non-renewable sources of energy.

Renewable energy (RE) sources contribute only 13% of the total installed power capacity of 275,912 MW in India. Figure 1 shows the total installed solar capacity in comparison to other countries. Among the Renewable energy sources, wind power is the dominating component while solar energy currently contributes to less than 0.1% (on-grid+ off-grid) of the total installed capacity. The solar energy potential in India is immense due to its convenient location near the Equator. India receives

nearly 3000 hours of sunshine every year, which is equivalent to 5000 trillion kWh of energy. India can generate over 1,900 billion units of solar power annually, which is enough to service the entire annual power demand even in 2030 (estimates).

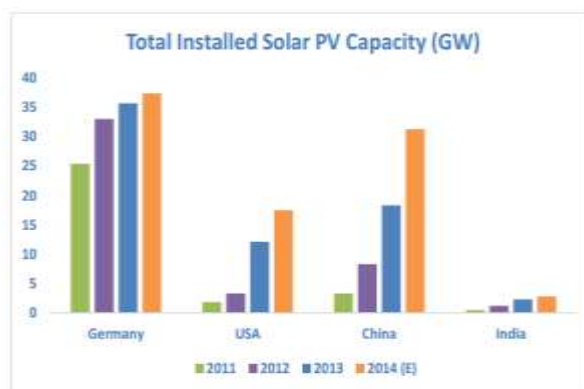


Figure 1: Installed PV capacity

With power demand growing 10-15 percent annually, uttrakhand has good potential of solar power. Solar energy is available for about 300 days in the state, with a rate of 4.5 to 5.5 KWh per sq meter which provides an excellent potential for the installation of rooftop and small solar power plants. The state is 5.2% energy deficit for 2014-2015. Emergence of solar power and its products with decreasing in per unit cost nationally makes it more effective source to overcome this deficiency.

According to UREDA(uttrakhand renewable energy development agency) state is targeting 500 MW solar energy production till 2017. Uttarakhand has been engaged in setting up solar-based home lighting systems, especially in rural and remote areas. Around 600 villages in the state have already been provided with such lighting systems.

II. EMERGRNCE OF SOLAR ROOFTOPS

India's target of 20,000 MW solar production in 2022 has been increased to 100,000 MW which requires 6.5 trillion rupees. In this expected amount of production 40,000 MW will come from rooftops and distributed generation project. This share of solar rooftop describes its importance and future requirements. Figure 2 shows

the estimated rooftop solar installation in India and abroad.

Less than 1 in 250 Indian companies currently have a rooftop solar plant. Going solar not only adds to your energy security, but also makes you stand out amongst your competitors. Going solar is a significant international trend that Indian companies cannot afford to miss.

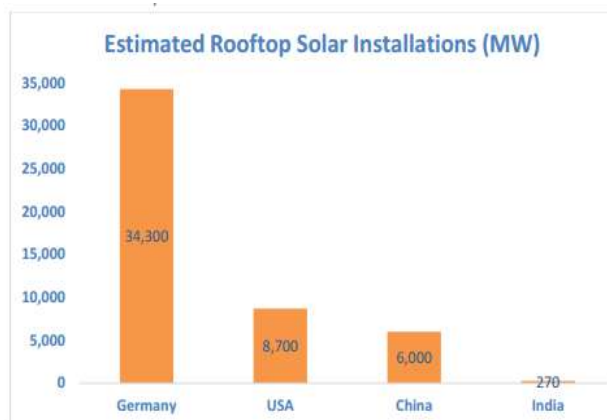


Figure 2: Rooftop solar installations

Considering the requirement of solar rooftops to empower energy needs, Uttarakhand government has launched solar rooftop policy which will benefit people not only to consume green energy but to earn for extra unit produced. According to the data from UREDA, the capacity of rooftops and small scale solar power plant is 7 MW and most are in Haridwar, Dehradun, Pauri and Nainital.

Today, solar is more than just a cost-centric strategy. With the decentralized paradigm providing energy security to increase your productivity, and by enabling you to project your business as a responsible action leader, rooftop solar benefits your top line, bottom line and business branding.

The last benefit will be especially crucial if your business is operating in or catering to international markets.

A rooftop solar plant can be commissioned and start generating power in very short periods of time, allowing you to quickly increase your supply of power and implement your business strategy.

III. ORGANISATIONS INVOLVED

There are many startups in the field of sustainability. Now that the policies are opening up and coal prices are going up as well, people and industries are pushing for solar power or solar wind hybrid systems. Indian market has this amazing capability to adopt these systems.

For a developing country there is applaudable interest in renewable energy in India already. One might not be

aware of too many start-ups in this field because the products that come out of these companies aren't able to start an epidemic in the market. Few organizations and startups which are involved in solar rooftop or off-grid business with the blend of technology planning and essence of government policies are discussed to know the market trend in this sector.

Mera Gao Power builds, owns, and operates micro grids in Uttar Pradesh, India serving off-grid villages with high quality, dependable lighting and mobile phone charging services. MGP's unique model is able to provide service to a typical hamlet for \$1,000, making its lowest cost design the first commercially viable rooftop micro grid targeted at the rural poor.

Azure Power, a leader in the Indian Solar Industry, has been at the forefront of developments in the sector since its inception in 2007. Azure Power is driving India's economic development by delivering lowest cost [clean energy] to communities, governments, and commercial customers through India. Azure Power has continuously demonstrated its cost leadership and drive towards grid parity for solar power in India. The Company has several projects operating under various policies for grid connected, rooftops and off-grid systems in the country and has invested significant capital in its power plants in India.

Sunkalp Energy has been at the fore-front of developing and deploying technology tools to organize and aggregate the roof-top solar industry. Our partnerships with the leading solar equipment manufacturers and installers ensure that the systems you purchase meet the promise of quality and energy production. Sunkalp Energy is headed by technologists from the Massachusetts Institute of Technology and Delhi College of Engineering who have rich international experience in distributed energy generation, technology and analysis of the solar industry. Sunkalp Energy has consistently given back to community through its rural electrification projects and Solar for Schools competition that raises awareness amongst children.

IV. INSTALLATION RATES AND METHODS

A rooftop solar plant can be commissioned and start generating power in very short periods of time, allowing you to quickly increase your supply of power and implement your business strategy. Figure 3 shows the time to commission rooftop solar plant by capacity.



Figure 3: Time required to commission rooftop solar plants

These timelines may be shortened or extended based on material procurement and labour availability. The primary activities involved are

| Phase of project | % of total duration |
|---|---------------------|
| Surveys, drawings, initial site work | 20% |
| Manufacturing of mounting structures, procurement of major components | 55% |
| Installing, testing, commissioning | 25% |

Figure 4: Phase wise project duration (percentage)

There are few basic steps which should be followed to get rooftop solar on facility which will help users to opt for solar rooftops for installation. These are

Energy consumers can either buy the solar plant itself, or only pay for the power generated by the plant, on a per KWh basis – Build Own Operate (Transfer) model. Solar vendor may have specific criteria for eligibility for the BOOT model, such as credit rating.

Identify qualified solar vendors - based on expertise, execution capabilities, team size, proximity to site location. Invite vendors for site visit and load analysis.

Based on interaction with vendors, decide plant size; plant architecture; components to be used.

Invite quotations from vendors, negotiate on price, timelines, AMC, warranty, responsibilities, etc.

Choose the best combination of vendor credentials and terms. Sign contract with finalized vendor.

V. GOVERNMENT POLICIES

Under the scheme, the ministry of new and renewable energy would provide one-time subsidy of 30 per cent on the benchmark cost of the project.

The policy has been divided into two broad categories, where for installation up to a 100 KW power plant, the benchmark cost would be Rs 100 per watt power (WP).

In the other category, the benchmark cost would be Rs 90 per WP for installing power plants between 100 KW to 500 KW. In both cases, the subsidy would be 30 percent.

The hallmark of the scheme is that one can sell power to the grid under the rates decided by the Uttarakhand Electricity Regulatory Commission, which is Rs 9.20 a unit. Under the new guidelines, DISCOMS have been asked to purchase solar power from those who produce excess solar power.

The government has fixed a target of producing 2,500 KW of solar power this year from the new rooftop scheme. But we will review our target next year. Government is offering scheme on first-come-first basis.

The grid-interactive rooftop system can work on a net metering basis, wherein the beneficiary pays to the power utility on net meter reading basis only.

Alternatively, two meters could be installed to measure the export and import of power separately.

The scheme for Grid Interacted Rooftop and Small SPV (solar photo voltaic) Power Plant in Uttarakhand was launched on August. Applications for nearly 1,700 KW have already been received," says A K Tyagi, chief project officer of Uttarakhand Renewable Energy Development Agency.

VI. ROOFTOP SOLAR POWER -MYTHS VS REALITIES.

While rooftop solar power does have a few constraints, flexible, robust, cost-effective solar solutions are available to suit the requirements of different types of energy consumers. There are few myths regarding solar rooftops which is explained with its concerned realities respectively to make users understand about the usefulness of solar rooftops.

I. MYTH

- Rooftop solar power can eliminate all diesel consumption.
- Rooftop solar power can provide electricity during power failure.
- Only concrete roofs can support rooftop solar plants.
- Solar power generated on holidays is wasted.
- Rooftop solar power is expensive.
- Rooftop solar power requires expensive batteries to work.
- Rooftop solar plants cannot power heavy machinery.

II. REALITY

- Rooftop solar power can reduce, but not usually eliminate, diesel consumption.
- Rooftop solar power will need to be integrated with another source of power, such

as diesel or batteries, to provide electricity during power failure.

- Many metal roofs, and even some asbestos roofs, can support rooftop solar plants.
- If net metering facility is made available, excess solar power generated can be monetized.
- Rooftop solar power has already achieved grid parity for many industrial and commercial units across India.
- Where grid power supply is fairly reliable, there is little or no need for batteries along with rooftop solar power.
- When supported by grid power, rooftop solar plants can support some heavy machinery.

VII. BUSINESS OVERVIEW

Rooftop solar power can add significantly more value to your business than just provision of electricity. It can be a strategic tool for business expansion and branding.

A rooftop solar plant can help position companies as a pioneer in their industry as very few Indian companies currently have rooftop solar plants. Through green branding, a rooftop solar plant can help companies gain more customers. For many industrial and commercial consumers, rooftop solar power is already a cost effective option as it is cheaper than grid power.

During Jawaharlal Nehru National Solar Mission scheme phase 1, batch 2 tariff prices declined to Rs 7.49-9.44 per KW from Rs 10.95-12.76 per KW which was further reduced to Rs 5.45 per KW as the concept of viability gap funding was introduced. Figure 5 show the impact of accelerated depreciation on solar plant cost.

| Particulars | Rs. |
|----------------------------------|---------------|
| Cost of 1 kW plant | 100,000 |
| Accelerated depreciation @ 80% | 80,000 |
| Tax savings (Tax rate of 35%) | 28,000 |
| Net cost after AD benefit | 72,000 |

Figure 5: Summary of cost estimation

Rooftop solar power allows enterprises to expand production capacity that was previously constrained due to lack of power. Rooftop solar plants can be installed and commissioned quickly. Attractive government incentives are available for rooftop solar plants. Rooftop solar plants can themselves serve as partial roofing, thus making vacant rooftops more productive.

Selecting the right vendor and appropriate architecture is vital to gain the most from the rooftop solar plant. Rooftop solar power does have a few constraints, which

should be understood before deciding on including solar power in the energy mix.

Considering all points with constraints uttrakhand seems to be a profitable business with decent market share for using solar rooftops and making the environment cleaner.

CONCLUSIONS

Roof top solar PV systems have great potential in uttrakhand. There is a need for awareness creation both about rooftop solar PV systems/ technology packages as well as about the financing avenues available.

There is need for standardization. The policy support is essential in terms of regulations for net metering, grid interconnection, and energy accounting. There is a need for promoting large scale, local manufacturing of dual function inverters (functionality of both grid-tied and hybrid inverters) to reduce cost. There is need for technical innovations in storage technologies - mainly to reduce costs and improve efficiency.

Roof tops solar PV systems can play an important role in providing reliable and assured power for buildings and establishments. The market can broadly be categorized into two major segments –

- a) residential systems and b) commercial/ industrial and institutional systems.

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