

# Meeting Growing Energy Demand Through Solar Power



Picture from <http://solex.in/Solar-Rooftop-System.aspx>

1/21/17

An analysis suggesting ways to increase solar penetration and consumer energy sustainability habits

This report suggests policy, technology and finance improvements and ideas in the Indian Solar Energy industry in order to achieve the target of 100 GW of solar energy by 2022. These interventions have been formulated on the basis of targeting areas of growing demand and large consumers of solar power.

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# INTRODUCTION

India is a growing economic superpower. At this point in time, we are sitting at the tip of our economic explosion. The vast reserves of resources in all factors of production have earned us the title of **The Land of Potential**. Since Independence, our executive machinery and citizens have worked hand-in-hand to further better our standard of living with each passing year. Unfortunately, we have always had to play catch-up to the Western level of development. The energy plans of India chart an 'Indian' way of decentralized, renewable energy-led development, different from the western, centralized, conventional energy rich energy system.

The West achieved its economically superior status by extensively burning fossil fuel resources to achieve urbanization, electrification and industrialization. This has been one of the primary causes of the global rise in temperature due to greenhouse gases. The growing paucity of conventional sources of energy and climate concerns calls for energy needs to be met by renewable, unlimited sources of energy. With abundant resources like wind, solar and hydro energy at our disposal, India is in prime position to switch its gears and accelerate towards economic world domination by tapping into these sources. Fueled by natural forces, development does not taper off.

In light of the current global sentiment towards achieving the COP 22 (Marrakech) climate action goals, India has pitched in and set goals to achieve renewable energy integration in its energy ecosystem. The Government of India has set a target of 175 GW of renewable energy to be installed by 2022. Of this, 100 GW is to be sourced from solar energy and 40 GW out of this from decentralized Rooftop Solar units.

This mammoth task which, is still in its inception phase, has a very short timeline to be achieved in. Due to the novelty of this sector in a country of our size, we do not have a tried and tested template to follow. The aim of this report is to identify the obstacles that stand in the path of integration of roof-top solar energy in the lives of ordinary Indian citizens and propose solutions to make solar energy a norm of Indian living. As is borne out by the analysis below, due to the size and scale of solar power deployment, the roof-top segment has different challenges as compared to large grid-connected solar power plants.

## ANALYSIS

### I. THE BASIC FACTS

- Solar energy is harnessed from photovoltaic cells made of poly (8% efficiency)/ monocrystalline (12%) silicon and solar thin films (6%). They are connected in a parallel fashion to constitute a solar panel, that is sold to homes and corporations to service energy needs.
- In India, the average cost of a 1kWh panel is INR 60,000. The costs could vary depending upon the location and technology.
- The Capacity Utilization Factor of solar power in India ranges from 14-17%.
- Electricity tariffs are charged by DISCOMS according to the consumer category and time of the day.
- Domestic electricity tariffs cost an average of INR 3-4 per unit. The rates are of the slab type wherein they go up at higher levels of consumption. The highest slabs cost up to INR 8. Domestic electricity rates are highly subsidized and are hence of lesser revenue importance to DISCOMs.

- Industrial electricity tariffs cost an average of INR 6-7, with highest slabs costing upto INR 12. These rates are not subsidized and hence industries provide the largest chunk of DISCOM revenues. Losing industrial consumers can further increase the financial peril of DISCOMs who subsidize domestic and agricultural consumers.
- Thermal power plants generate power constantly, however it can be stepped up and down (albeit over large intervals) to cater to fluctuating demand.
- Solar power is only generated during the day when the sun shines. To access solar power at night, it must be stored in lead-acid, lithium-ion or flow type batteries. Batteries are an expensive component of a solar PV system and contribute substantially to the cost build-up of solar power. They must be replaced at 4-7 year intervals.
- Solar power is variable in nature. To account for this, power-balancing by using alternate fuels to cater to demand when solar power is unavailable and forecasting services are required for proper working of the solar panels and the grid.

## II. THE CHALLENGES

The domestic (consumer), industrial and DISCOM sectors each face different sets of challenges regarding solar power. Since this technology is new and does not have enough market demand, the entire industry has to bear the brunt of the high cost of its technology. Detailed below are the challenges faced by each of the three stakeholders: domestic consumers, industry and DISCOMS.

**Domestic Sector:** There are estimated to be 24 crore households in India. Out of these, only grid connected consumers (approximately 2 crore households) are capable of holding solar panels on their roofs. This highlights the problem of base infrastructure being unavailable. The return on

investment takes a long time to be noticeable by the consumer. An average of 1500 units is produced by a 1 kWh plant (few houses can support greater capacities) in a year, while the cost/kWh of the plant is approximately INR 60,000. Looking to the subsidized nature of domestic power, it takes a long time to recover this cost, for which customers are neither educated nor patient enough for. The electricity tariffs for domestic use are highly subsidized (INR 3 per unit), while solar power generation costs are approx. INR 5 per unit, thus making customers unwilling to go solar.

On the other hand, the rural habitations that do not have access to grid-connected supply could be an ideal candidate for rooftop solar. In many cases, due to remote locations, the cost of delivering power through the grid is not an efficient solution. The Government is already rolling out Home Lighting Solution through solar rooftop technology in such villages across India. The catch is, that without battery attachment, these consumers would be denied power in the night when they need it the most. The high cost of battery makes this an expensive proposal. India looks forward to further decline in the price of storage technologies.

**DISCOM Sector:** DISCOMs in India are operating under financially perilous conditions. The rooftop solar is being adopted mostly by consumers who are paying high tariffs due to large power consumption. Hence, the higher paying segment of domestic power supply is being substituted by self-generation. By adopting solar power net-metering policies, the DISCOMS are further increasing their negative returns. In the domestic market, DISCOMs are unwilling to let consumers set up solar energy systems that supply more than 30% of the sanctioned capacity of the house, further discouraging setting up of solar panels. DISCOMs are fundamentally opposed to buying

solar power from consumers because they are financially unhealthy and try and discourage consumers from purchasing these panels by deeming rooftops unfit.

**Industrial Sector:** The industrial sector is the ideal consumer for solar power. They have the capital necessary for installation; they have large, time-related power needs (peaking in the day time); and they face high tariffs from DISCOMs and cheaper solar power is ideal. However, established industries need grid support to cater to the times when no solar/ stored solar power is available. These players are discouraged by DISCOMs who put in place policies which discourage the adoption of roof-top solar by Industries. The latter, unwilling to fight these players for power which they already have access to, too back down from solar projects.

### III. CURRENT SITUATION AND PROGRESS

India is inching towards its 2022 targets. While several challenges exist, the solar industry space is looking brighter as we speak:

- The industry as a whole has clocked a 101% growth since 2015.
- Approximately 4.9 GW of energy capacity was added over the 2016 calendar year, with 9 GW further tendered.
- Total installed solar capacity is now more than 10 GW with solar rooftops accounting for over 1 GW of the total.
- The tariffs for solar power have now fallen below INR 5, a significant market demand booster. With fall in Chinese demand, this price is expected to further reduce to INR 4 in the coming year.

- Reputed Indian project developers like Tata Power, SunEdison and Punj Lloyd are responsible for buying more than 90% of tendered capacity. This has significantly boosted credibility and investment prospects of this sector.
- The World Bank has sanctioned a \$500 million loan to the State Bank of India to be used by project developers to procure and install solar energy equipment and sell renewable power to consumers and pay back the loan principle and interest.
- The UDAY scheme has boosted DISCOM confidence and demand of solar energy.
- However, a growing incidence of delayed power purchase payments by many DISCOMs and curtailment risks have been observed in the solar power sector. While this wasn't an alarming concern when solar energy was small, with increasing solar capacity, these risks significantly challenge the growth of this new energy segment.

*The initial phases of creating the ecosystem are the most challenging. What may seem like slow growth at first is not a discouraging sign for growth. The initial financial hardship borne by large players and the government facilitates the challenge of commercializing and commodifying solar power to be further expanded to industries, commercial establishments and consumers. However, there are always ways to improve the current situation. The novelty of the industry calls for novel solutions. The next section of this report provides suggestions for the current industry and ideas for a brighter solar future.*

## SUGGESTIONS: THE WAY AHEAD

The word most commonly associated with solar power is “expensive”. The first task of the government is to recognize this and provide a reliable source of funds that developers and consumers can access to bring solar energy into their lives. The following suggestions are classified according to whether they are concerned with technology and policy or finance.

### TECHNOLOGY AND POLICY

- **Current industrial sector:** The current industrial and commercial sector is the most viable consumer segment for solar power. The government should target commercial office spaces in large urban districts and large, stable industries in this exercise and classify them as “Clean Power Buildings”. Instead of providing a capital/interest subsidy to these entities, the government can offer fiscal benefit for production of goods made by using clean solar power as opposed to solar power and a reduction in corporate taxes/other relevant taxes that are filed by commercial establishments like office buildings, malls, markets etc. However, it remains to be seen whether this option will at all be available once the GST kicks in.
- **Current domestic sector:** The government should aim to spend its funding for solar energy in the domestic sector, to directly serve consumers. In *urban* areas, the government should target Tier II cities for rapid solar integration. The smaller size of the city makes the platform for an aggregator/municipality owned business model (described below) much easier. Consumers are educated enough to understand the benefits of clean energy and would be willing to adopt if there were attractive financing schemes by the government.

Further, they have ample rooftop space without the congestion and building restrictions of large cities. Once a few successful systems are set up, other buyers will know soon and be ready to adopt this technology as well. In *rural* areas, especially those right outside large cities face a lot of distress from the fluctuating supply from the DISCOMs. These areas are placed at a lower priority than the city. If rural consumers want electricity during peak hours then the supply is denied by DISCOMS as the power prices are higher and not lucrative for DISCOMS to meet rural power demand. A solution out of this would be to encourage DISCOMS to adopt a village and make it solar. This would benefit both parties. Rural consumers can fulfil their small power needs by accessing the power generated by these solar panels and pay a nominal extra charge to the DISCOM for this service for a designated period. This would benefit the DISCOM in the way that it would not have to pay for high cost thermal power being sourced from far away. Instead, it can be power positive to the city by using the net electricity generated by these rural panels to service the city's peak demands.

- **Future industrial sector:** In the future, to incentivize industry set-up in rural areas, the government can consider setting up solar villages. Industries and the government can assist in developing homes around the intended factory site. These homes are to be loaded with roofs which are made of solar cells and walls that have batteries. Crowd-funding and investors can also be used to finance these. The solar village itself will have needs much lower than their generation. The net remaining power is to be used by the industry. Essentially, instead of drawing transmission lines to the factory, the industry is setting up its own power plant in the form of a village bundled solar project. Rural consumers can finance the rent of these houses from the Pradhan Mantri Awas Yojana and can pay

nominal electricity prices since solar power has no working capital costs. The industry would have to pay large amounts for their power, even if thermally sourced. This money can be better invested in community solar development and self-sufficiency. Further, this makes the industry eligible for a tax subsidy on its produce by virtue of its clean power sources.

- **Future domestic sector:** The future domestic sector should target large cities. Apart from just tapping roofs as sites for solar panels, areas like bus-stop roofs, railway and metro station roofs and streetlights can be used for solar power generation. Solar streetlights would include a small panel on top and a battery in the stem. Solar public utility roofs described would involve the solar cells being embedded in the roof from construction. These can be financed from local municipality and zila parishad funds. A reallocation of funds in the budget towards the set-up of this system is called for. Further, to keep a check on excessive and unnecessary residential construction, the government can mandate that all new housing must have solar roofs and solar wall batteries (or equivalent technology), not just mounting solar panels.

## FINANCING

- **Micro-level grid:** This is to be targeted at rural agricultural areas with vast tracts of land. It is suggested that developers set up in each farmer's plot a panel that is approximately 2-3 times his requirement. The farmer uses up his required quota from the panel and the rest is fed in a micro-grid that would power the entire village. The farmers can pay a small monthly rent to partially cover the installation cost of the panel while not paying for

any power. The developer makes money from selling the excess power that is generated from this micro-grid.

- **Market creation:** The solar industry will only take off when there is a market for the product. To generate a platform for buying and selling of solar power, the government can mandate that a certain percentage of electricity used all public utility establishments like government offices, airports, metro and rail stations etc. must be sourced from solar sources. This will help pump capital into the sector and further aid commoditization of solar products which is crucial in propagating the product to the consumer market. So far, the above strategy also called RPO has not worked due to poor enforcement/enforceability of these mandates.
- **Interstate banking:** This scheme involves renewable/solar energy rich states selling their excess renewable power in summer months to energy deficient states/thermal power dependent states. This helps reduce dependence on coal sources in times of peak demand. In times of low solar productivity, the reverse process is suggested wherein these states withdraw energy from thermal states.
- **Aggregator business model:** The aggregator business model involves a developer who is responsible for setting up/incentivizing consumers to set up decentralized solar panels on their rooftops. The consumer provides the roof and the developer is responsible for providing subsidized power according to a Power Purchase Agreement. The developer is responsible for regular maintenance of the system. The third-party earns money by selling excess power to DISCOMs to distribute in areas of low electrification.
- **Utility/Municipality owned model:** Similar to the aggregator model, the municipality offers loans to consumers to set up solar panel systems in their houses. The key factor

responsible for the success of this model is the long term is the long time-period given to the consumer to pay back this loan, hence not putting them under financial duress. This model is feasible in smaller districts too, where budgets are of the order INR 400-700cr. In the case of customers being unable to independently pay back the loan, the municipality can provide a loan to a community for the set-up of a bundled solar panel system. An officer designated could be designated entirely for this purpose of selling and local solar co-ordination.

# CONCLUSION

*In conclusion, there are many ways to make India a renewable super power. Mechanically and financially we are equipped to make this a reality. However, the biggest challenge we face is the lack of educated customers. Simply creating the mechanism to adopt solar power is not enough; agencies must devote resources to educating the ordinary India about the boundless benefits of solar power. In addition to adopting new, innovative measures in this sector, our executive machinery must also work on improving coordination between key stakeholders in this sector. Lastly, this mammoth task cannot be carried out if the people behind it do not believe in its power. Only when passionate citizens work in this field can growth be clocked. Having a large workforce behind this is not necessary; a willing workforce can easily achieve this efficiency.*

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