

# Solar Rooftop PV Installations by MSMEs with Bank Financing



Study by:



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# Imprint

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# Key Findings

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## **Existent cases of bank financed solar rooftops for MSMEs in India are successful in terms of payback and generation.**

- 1** All cases shown in this report are promising projects with a payback time of less than 5 years. A green image enabling higher exports is another major motivating factor for MSMEs to go for solar project installation.

## **Bank financed solar rooftop in India's MSMEs are still very few and far.**

- 2** MSMEs contribute about a third to India's \$2 trillion economy. Despite the fact that solar rooftops have recently become commercially viable, installations are still not considered and implemented broadly. This can be seen as one reason for non-existent financing products.

## **Demand aggregation of planned solar rooftop installations in the MSME clusters is an important tool to increase the volume to be financed**

- 3** which makes it more attractive for banks to offer customized loans. The larger project size makes it more feasible to attract technically sound project developers and EPC contractors assuring high quality installations.

## **Industrial cluster associations are able to facilitate solar rooftop PV projects.**

- 4** Most MSME Cluster Associations in India have very good access to their members and recommendations are respected amongst them. Showcasing champions and dissemination of best practice cases amongst their members can provide a boost to the solar rooftop market. Based on their experience in business models for common facilities, many associations are able to take lead in the aggregation of demand.

## **Major barriers are complex net-metering related state regulations, small project sizes and banks unable to accept the solar rooftop asset itself as collateral guarantee.**

- 5** Most of the solar rooftop owners interviewed faced challenges in availing net metering benefits by the local DISCOM. Another key barrier to several consumers is the collateral guarantee demanded by banks as security to finance the projects, since in many cases, the SMEs have their assets already mortgaged for previous loans and the solar rooftop asset itself is insufficient for the bank.

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## FOREWORD

India is all set to achieve 100 GW solar energy target by 2022, out of which 40 GW is expected to come through rooftop solar installations. Hence, there is an increased thrust to promote solar rooftops in India. Among different target segments such as commercial, industrial, residential and public sector, micro, small and medium scale enterprises (MSMEs) have a substantial potential for the use of solar rooftops because of the technical and economic feasibility in most enterprise facilities.

However, the potential for rooftop PV in MSME sector has not been utilized significantly for capacity addition. Considerable efforts, have been put by the Governments, Regulatory Commissions and concerned agencies to develop the rooftop solar photovoltaic sector in India. As a result, basic framework has been implemented in most parts of the country. Financing is available from various multi/bilateral organizations through domestic banking systems for promotion and upscaling of solar rooftop PV in India.

MSMEs contribute nearly one-third to the India's USD 2 trillion economy. However, MSMEs all over the country suffer from high power tariffs and erratic power supply, leading to deployment of expensive captive power generation based on DG sets which are also polluting the environment. Solar PV projects make eminent sense for accelerated implementation.

The German Chancellor and the Indian Prime Minister established the Indo-German Energy Forum (IGEF) in April 2006. Strategic cooperation projects between the German and the Indian government, research institutions, and the private sector are the major objectives of the IGEF. GIZ programme 'Responsible Enterprise Finance (REF) (II) has been designed with an objective to enable MSMEs to have better access to inclusive and responsible finance. The major activities of the program are: implementation of effective sustainability standards for the finance sector, dissemination of responsible finance products and services for MSME and creation of conducive business environment for financing of inclusive business models.

Both GIZ projects IGEF and REF II have jointly commissioned the study which presents cluster level analysis and document case studies and showcases best practices in rooftop solar projects at MSMEs. The study also informs about successful solar projects which helps in confidence building among entrepreneurs and other MSME unit owners. The study carried out by PwC India focuses on MSME units in the districts of Aurangabad



(Maharashtra), Tirupur (Tamilnadu), Jodhpur (Rajasthan) and Bangalore (Karnataka) for drawing analysis. These districts house MSME clusters that cater to a wide range of industries. Cluster level analysis covers major industrial activities supported by rooftop solar PV.

The case studies also cover MSME details, rooftop solar project information, motivation of installation, project execution, financing of the project, major challenges and overall barrier analysis. For preparation of case studies, PwC project team has visited MSME rooftop project sites to gather general plant information such as product manufactured, energy demand and supply to the SME unit, roof-type, mounting structure, etc. The team has conducted meetings with various stakeholders such as unit owners, system integrators, banks, industrial associations to understand their individual perspectives on issues and challenges affecting rapid deployment of Solar PV in MSME sector.

I would like to compliment IGEF and REF-GIZ and PwC India in bringing out this timely publication. I hope that the case studies presented here will go a long way in building more confidence among MSME entrepreneurs to adopt Solar PV power generation projects and thereby contribute to reduction of GHG emissions besides actively contributing to the energy transition in the country.



31.10.18  
(Sudhir Garg)

Place: New Delhi:  
Date: October 31, 2018

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# Abbreviations

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<b>AD</b>	: Accelerated depreciation
<b>AMC</b>	: Annual maintenance contract
<b>Capex</b>	: Capital expenditure
<b>Discom</b>	: Distribution utility
<b>EPC</b>	: Engineering procurement construction
<b>FI</b>	: Financial institution
<b>GW</b>	: Gigawatt
<b>HT</b>	: High tension
<b>IGEF</b>	: Indo-German Energy Forum
<b>INR</b>	: Indian Rupees
<b>KW</b>	: Kilowatt
<b>LT</b>	: Low tension
<b>MNRE</b>	: Ministry of New and Renewable Energy
<b>MSME</b>	: Micro, small and medium scale enterprises
<b>MU</b>	: Million units
<b>MW</b>	: Megawatt
<b>NREL</b>	: National Renewable Energy Laboratory
<b>Opex</b>	: Operational expenditure
<b>RPO</b>	: Renewable purchase obligation
<b>RTPV</b>	: Rooftop photovoltaic
<b>SIDBI</b>	: Small Industries Development Bank of India

# 1. Executive Summary

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India has set itself on a path to achieve 100 GW through grid-connected solar energy, out of which 40 GW is targeted to come through rooftop solar installations by 2022. Hence, there is an increased thrust for promoting solar rooftops in India. Among different target segments such as commercial, industrial, residential and public sector, micro, small and medium scale enterprises (MSMEs) have substantial potential for the use of solar rooftops because of the technical and economic feasibility in most enterprise facilities. However, this potential for rooftop PV in MSME sector has not been converted into a significant number of installations/ capacity additions. Considerable efforts, have been put by the Governments, Regulatory Commissions and concerned agencies to develop the rooftop solar photovoltaic sector in India. With these efforts, basic framework now exists in almost all parts of the country and rooftop solar power plants have started getting implemented. However, there still appears a scope for the development of market and addressing the barriers faced by the stakeholders involved in the implementation of plants, including the huge potential in the MSME sector.

Substantial capital is being deployed by various multi/bilateral organizations through domestic banking systems for promotion and upscaling of solar rooftop PV in India. Additionally, strategic tie-ups and political dialogues between countries also help sharing knowledge and develop the sector collaboratively. One such initiative has been taken by Indian and German governments wherein to enhance and deepen the strategic political dialogue about the ongoing energy transition in both countries, the German Chancellor and the Indian Prime Minister established the Indo-German Energy Forum (IGEF) in April 2006. Strategic cooperation projects between the German and the Indian government, research institutions, and the private sector are the major objectives of the IGEF.

GIZ programme 'Responsible enterprise finance (II)' has been designed with an objective to enable MSMEs to have better access to inclusive and responsible finance. The major activities of the program are: implementation of effective sustainability standards for the finance sector, dissemination of responsible finance products and services for MSME and creation of conducive business environment for financing of inclusive business models.

In line of the same, this study aims to do cluster level analysis and document case studies and best practices in rooftop solar projects at MSMEs and increase awareness about successful solar project which act as confidence building measures to entrepreneurs and other MSME unit owners. The study focused on the districts of Aurangabad (Maharashtra), Tirupur (Tamilnadu), Jodhpur (Rajasthan) and Bangalore (Karnataka) for analysis. These districts house SME clusters that cater to a wide range of industries. Cluster level analysis covers major industrial activities in the cluster and rooftop solar PV activities in the cluster. Additionally, total 7 case studies have been covered in the study i.e.

- 100 kW RTPV project at S.N. Metallurgical Services, Aurangabad
- 40 kW RTPV project at Ashapura Engineering Private Limited, Aurangabad
- 102 kW RTPV project at B.S. Apparel, Tirupur
- 95 kW RTPV project at Hi-life Labels, Tirupur
- 66kW RTPV project at Sharma Industries, Jodhpur
- 66kW (33 kW + 33 kW) RTPV project at Sharma Industries, Jodhpur
- 100 kW (33 kW + 33 kW) RTPV project at somu industries, Bangalore

The case studies cover MSME details, rooftop solar project information, motivation of installation, project execution, financing of the project, major challenges and overall analysis which covers the salient aspects of the case study. For preparation of case studies, project team visited MSME rooftop project site to gather general plant information such as workmanship, roof-type, mounting structure, pictures etc. The team also met various stakeholders such as unit owners, system integrators, banks, industrial associations to understand their respective perspectives. Unit owners provided inputs on motivation of installation, experience with banker, system integrator and distribution utility, EPC selection and any major challenges faced during the project. The bankers were consulted for their overall outlook on rooftop solar lending, loan due diligence, risk perception, general loan terms, marketing initiatives and training programs of staff for solar credit growth. Perspective of industrial association is also covered on various aspects such as cluster level efforts to promote solar power, expectations from government and financiers, challenges and any cluster level initiatives to increase awareness of solar power.

# 2. Background

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## 2.1. Context of the assignment

India has set itself on a path to achieve 100 GW through grid-connected solar energy, out of which 40 GW is targeted to come through rooftop solar installations by 2022. Hence, there is an increased thrust for promoting solar rooftops in India. Among different target segments such as commercial, industrial, residential and public sector, micro, small and medium scale enterprises (MSMEs) have substantial potential for the use of solar rooftops because of the technical and economic feasibility in most enterprise facilities. MSMEs in India contribute to more than 37% of the GDP and hence, are expected to play a key role in contributing towards this ambitious rooftop PV target. However, despite the significant role played by MSMEs, their major obstacle is the lack of sufficient need-based finance especially in case of suitability oriented investment. This lack of proper financing for MSMEs makes them account for almost 70% of industrial pollution in the country. MSMEs are also important for the development of various business models that provide goods, services, employment and livelihoods to less privileged sections of the society. Nevertheless, the capital for the MSME segment remains limited and there is a need for funding of energy efficiency and renewable energy projects by SIDBI and other leading banks.

Currently, MSMEs mainly rely on grid power and a subsequent diesel back-up for their power consumption needs. Both the sources are not very reliable and are getting expensive by the day. Therefore, it is imperative that MSMEs will consider the installation of solar rooftop PV systems to meet their electricity needs, to an extent possible. Considerable efforts, have been put by governments, Regulatory Commissions and concerned agencies to develop the rooftop solar photovoltaic sector in India. With these efforts, basic framework now exists in almost all parts of the country and rooftop solar power plants have started getting implemented. However, considering the targets committed in the International forums as well as in the United Nation, with respect to rooftop solar photovoltaic plants, there still appears to be a lot of scope for the development of market and addressing the barriers faced by stakeholders involved in the implementation of plants, including the huge potential in the MSME sector.

Solar Rooftop PV systems make economic sense in places where the grid tariff is higher than the levelized tariff from the solar rooftop set up (including other feasibility factors). However, in case of most such industrial MSMEs, it is observed that the electricity tariff paid is quite high as compared to large industries and hence, their interest to install solar rooftop PV system is increasing at a rapid pace. The challenges, however, needs to be addressed to further intensify the growth in this sector.

The evolution of solar rooftops in India has witnessed a significant transformation to reach a phase where all but one Indian state has issued net metering guidelines to promote solar rooftops. In terms of technology, the quality of components has become better and there have been drastic reductions in costs. The electricity tariffs under the Renewable Energy Service Company (RESCO) mode have come down to INR 3.5-4.5 per kWh depending upon the infrastructure and state incentives. This comes just 7 years from the time when utility scale plants had signed agreement at tariffs of more than INR 17 per kWh, signifying a reduction of almost 75% in tariffs.

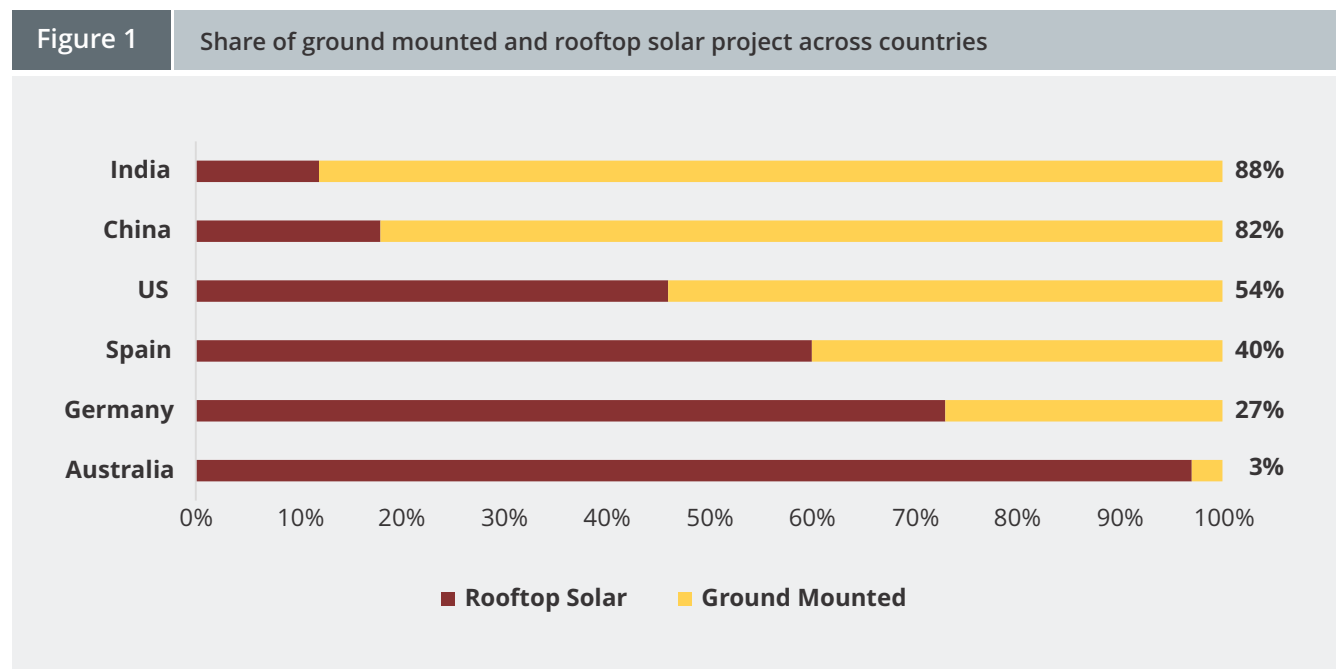
Substantial capital is being deployed by various multi/bilateral organizations through domestic banking systems for promotion and upscaling of solar rooftop PV in India. Dissemination of information through best practice case studies, awareness creation and capacity building can be progressive steps in quick acceptance of PV systems and increased uptake of credit lines.

GIZ programme 'Responsible enterprise finance (II)' has been designed with an objective to enable MSMEs to have better access to inclusive and responsible finance. The major activities of the program are: implementation of effective sustainability standards for the finance sector, dissemination of responsible finance products and services for MSME and creation of conducive business environment for financing of inclusive business models.

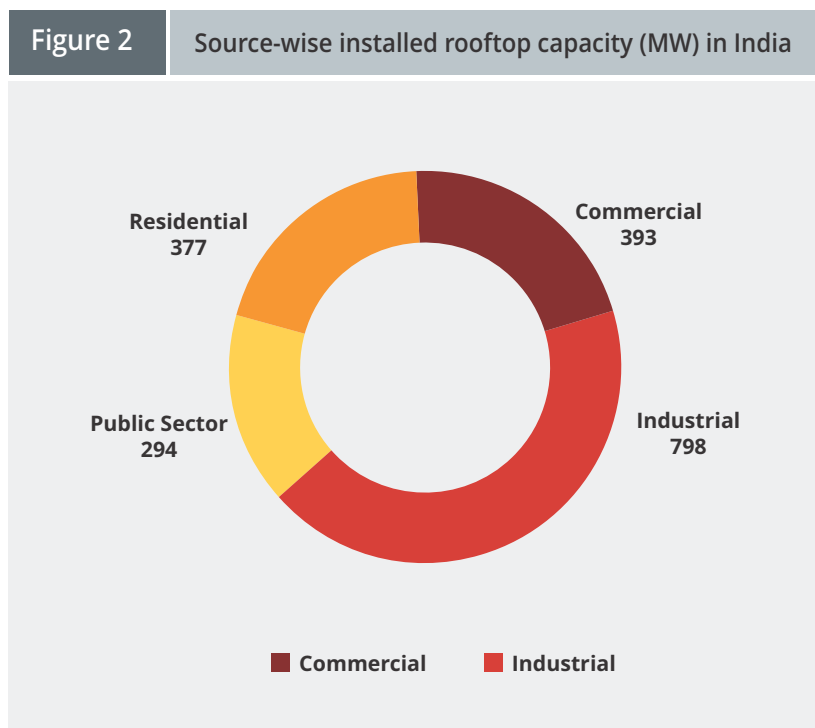
In line with the same, this study aims to document case studies and best practices in rooftop solar projects at MSMEs and increase awareness about successful solar projects, which act as confidence building measures to entrepreneurs and other MSME unit owners.

## 2.2. Current status of rooftop solar in India

The Rooftop solar market in India is now in advance stages but still, just a minute fraction of the enormous potential of total solar capacity has been installed in the country. Total ground mounted and rooftop solar installed capacity in India by January 2018 were 17.38 GW and 1.07 GW <sup>1</sup> (Grid connected rooftop) respectively. Total rooftop solar installations in India are less than 2 GW, which include grid-connected and standalone systems. Hence, total rooftop solar has maintained a 10-12% share of overall solar capacity and has a vast scope of adding rooftop solar installations along with ground mounted if the desired targets are to be achieved. This is much lower than other key markets such as the US, Germany, China, Spain and Australia as shown in Figure 1.



India lags astoundingly behind its competitors in terms of rooftop solar installations and account for a meagre 12% of the rooftop solar PV of the total installed solar PV capacity. Moreover, of this total installed capacity, the industrial sector is the highest contributor, accounting for almost 43% of the total rooftop solar whereas the residential sector contributes just about 20%. This shows that industrial sector has been at the forefront in rooftop PV installations and MSMEs can play a significant role in achieving the Government's ambitious target of 40 GW provided that enabling policy, regulatory and financing environment is conducive to growth.



1 source MNRE Website

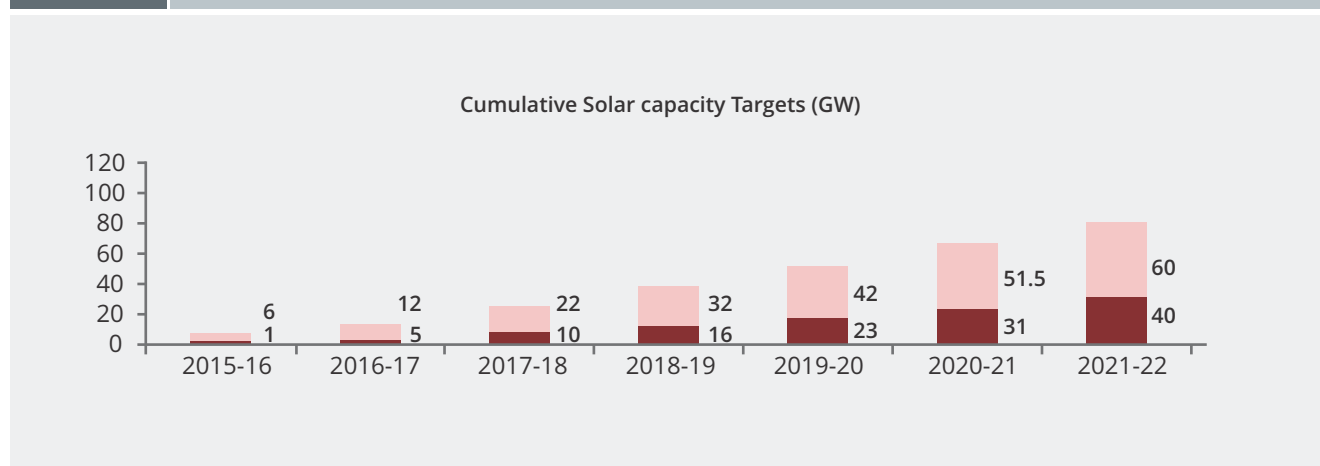


An investment in the range of approximately INR 2,00,000 Crore is required in Indian Rooftop Solar sector in order to realise the set target of 40 GW installations by 2022. There is a serious need to bridge the vast gap between rooftop and ground mounted installations, if we want to achieve the set target and this creates a huge potential in the rooftop solar segment especially for the MSMEs, which will remain at the forefront for these rooftop PV installations. This, in turn, requires hefty investments in the sector along with stable and suitable policy implementation. The investment needs to be driven by corporates including private equity backed IPPs along with the funding from government agencies.

This provides a vast opportunity for leading banks, private equity ventures, multilaterals and bilateral for investments in the sector as the demand is expected to pick up again from the next financial year after a slowdown in the current year due to the lull in the recent tender activity.

The year-wise break-up of the solar capacity addition targets till 2022 as per MNRE is shown in Figure 3:

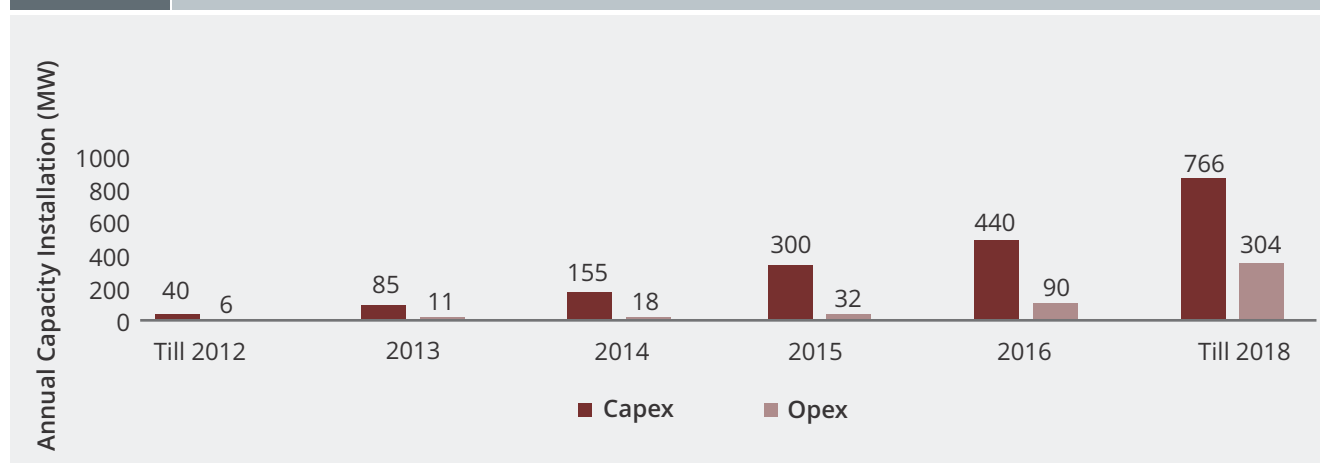
**Figure 3** Cumulative solar capacity targets by year 2022



As evident in Figure 3, we are far behind in rooftop installed capacity as compared to targeted capacity. In order to achieve the solar rooftop target of 40 GW by 2022, an investment of approximately INR 2,00,000 crore is required in the sector that can only be achieved with the combination of financing from commercial banks, NBFCs as well as from multilaterals and bilateral funding agencies such as private equity firms.

Capital Expenditure (CAPEX) route accounts for nearly 84% of total installed capacity but the Operating Expenditure (OPEX) model has been gaining ground in the last couple of years. OPEX market share has risen to 30%. Total rooftop solar market has grown at a CAGR of 66% from 2013 to 2017. Figure 4 shows the comparison of CAPEX and OPEX mode installations with respect to the annual capacity additions in the sector.

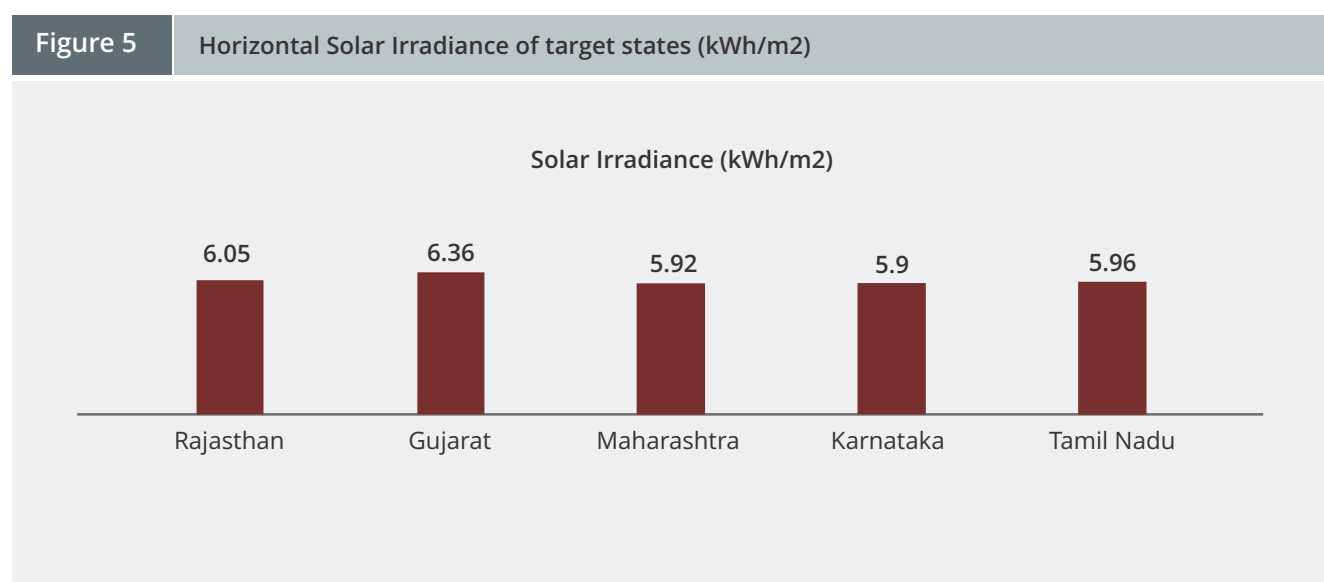
**Figure 4** Capex vs Opex share in Rooftop solar PV installations



The Government of India has been offering several financial incentives to promote the solar sector. But as cost of solar power is coming down, these benefits are being slowly phased out. For example - all solar projects have been historically eligible to avail accelerated depreciation of 80% of asset value but this rate was reduced to 40% from April 2017 onwards. Moreover, a 10-year income tax holiday was being offered to solar projects so far, but this benefit has been withdrawn from April 2017 onwards.

### 2.3. Status of rooftop solar in target states

India's power deficit dropped to a historical low of less than 1% in the last fiscal, thanks to record electricity generation and capacity addition over the last few years, renewable energy contribution, adequate coal stocks and transmission facilities, coupled with energy efficiency programme. Figure 5 represents the solar irradiance of our target states in the country as per the NREL website. Thus, we can see that our target states of Rajasthan, Gujarat, Maharashtra, Karnataka and Tamil Nadu are really suitable for solar PV installations based on irradiance levels. The average solar irradiance of these states is more than 6.0 kWh/m<sup>2</sup>; however, for India, it lies in the range of 5.5 kWh/m<sup>2</sup>.



The state wise installed capacity of rooftop solar along with the installation potential till 2022 (as per the allocated targets) is shown in the table 1, which signifies the gap and an immense potential to amplify the rooftop solar PV installations.

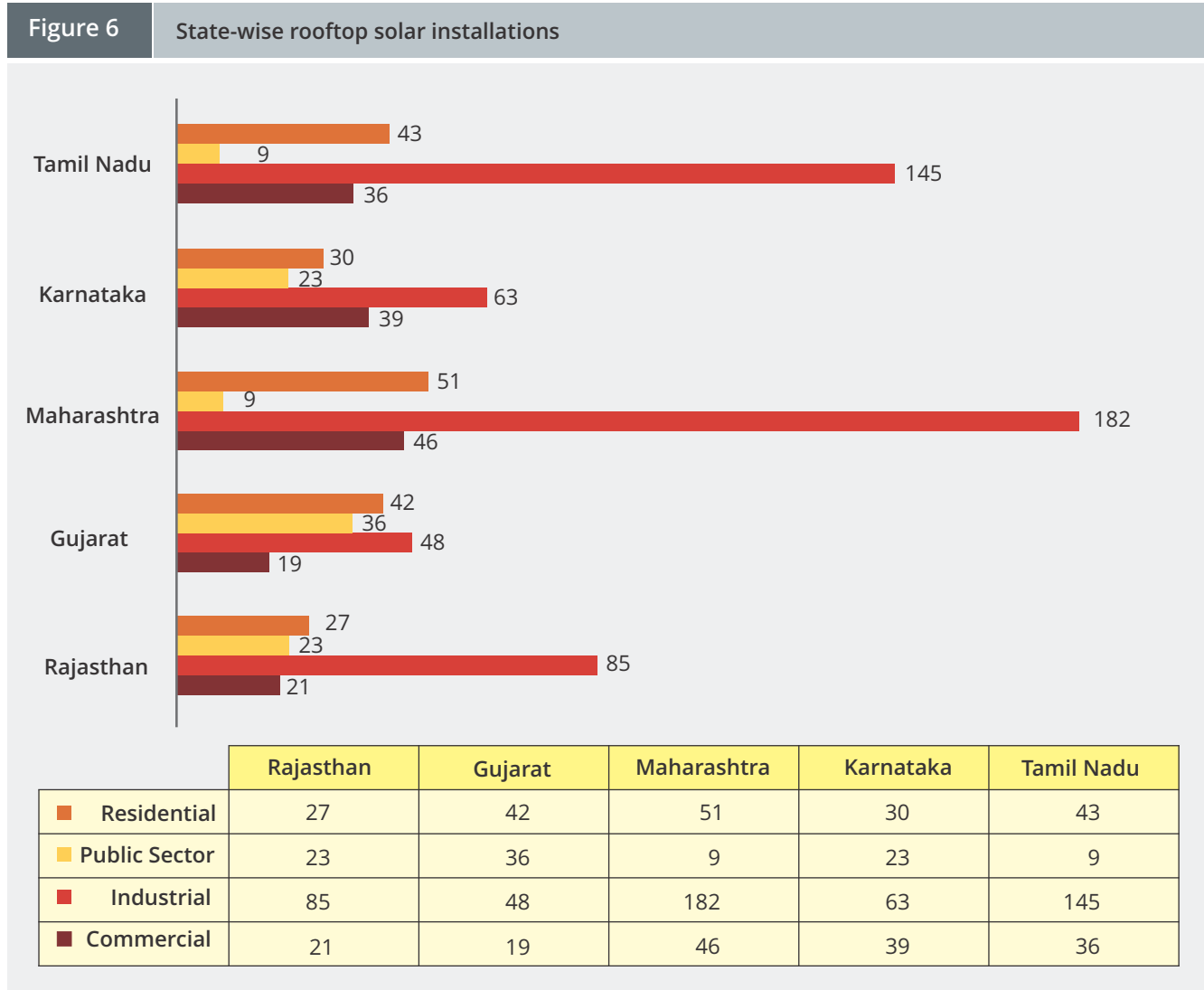
State	Solar potential of state (GWp)	Allocated target till 2022 (MW)	Installed capacity till Jan 2018 (MW)	Installation Potential till 2022 (MW)
Rajasthan	142.31	2300	156	2144
Gujarat	35.77	3200	145	3055
Maharashtra	64.32	4700	288	4412
Karnataka	24.70	2300	155	2145
Tamil Nadu	17.67	3500	233	3267

As shown in the table 1, all the states are far behind the MNRE allocated targets in rooftop solar project installation.

State	Irradiation (GHI)	Industrial Tariff (INR)
Rajasthan	6.05	7.00
Gujarat	6.36	6.04
Maharashtra	5.92	7.64
Karnataka	5.90	7.68
Tamil Nadu	5.96	7.81

The industrial tariffs are rather high in these states and almost 40–50% of the expenses for most of the MSMEs arise from their electricity bills (especially the energy intensive MSMEs) subsidising their revenues and minimising their returns on investments. The average industrial tariff in our target states is in the range of INR 6–8 per unit. Thus, solar power not only provides a much cheaper alternative bringing electricity tariffs significantly down: as shown in Table 2, but also serve as a green energy substitute to the conventional sources of energy while enhancing energy security through diversification of fuel sources and providing opportunities for mitigating greenhouse gas emissions.

Rooftop solar installations are divided into sub-categories such as commercial, industrial, public sector and residential out of which the industrial sector leads the way with an overall installations of 798 MW while the public sector has the least solar rooftop PV installations of only 294 MW. The total rooftop solar installed capacity, category wise in the target states is shown in Figure 6.

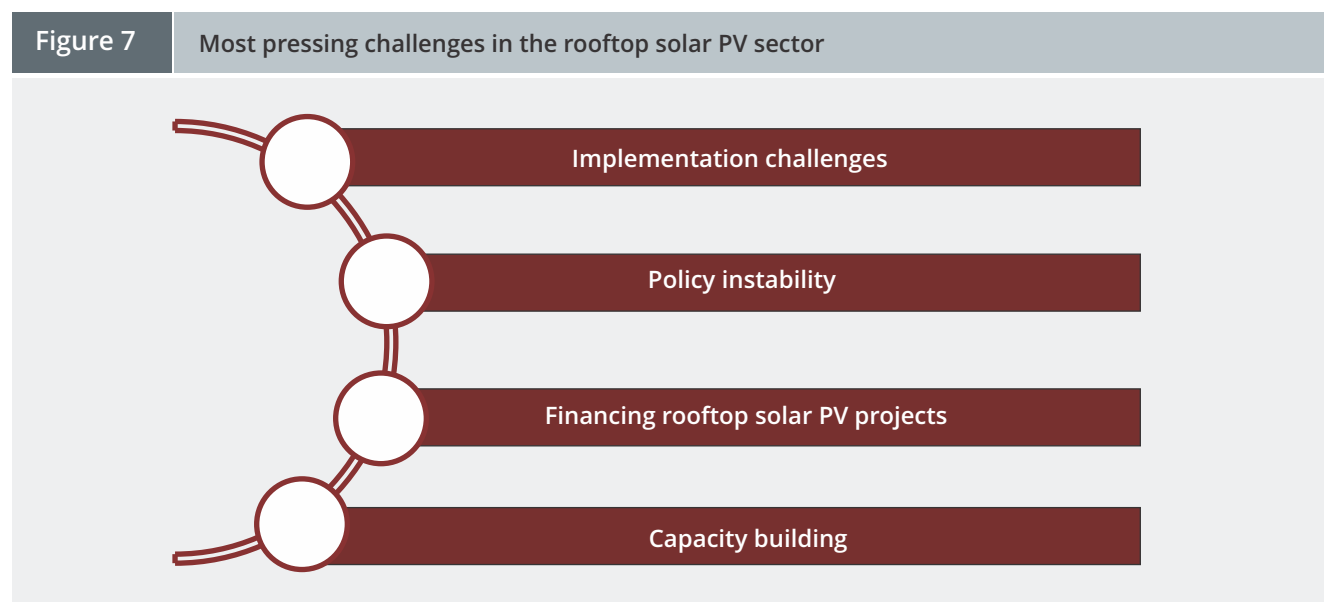


**2.4. Challenges in Indian rooftop solar – a general perspective**

Considering the targets committed by India including in the international forums with respect to rooftop solar photovoltaic plants, there is still a long way to go in complete development of the market and addressing the barriers faced by stakeholders in the sector. These barriers are due to the most pressing challenges in rooftop solar PV sector and the set targets can only be achieved by overcoming these challenges.

With vast scope for capacity addition in the rooftop solar segment in India, financing of these projects is the biggest challenge surrounding the sector that must be addressed immediately. Overall investment required is massive (approx. 2,00,000 crore) for 40 GW installations that can only be achieved with the combined efforts of government lending agencies such as IREDA, PFC, commercial banks as well as multilateral and bilateral agencies. Among all these organizations, commercial banks and government lending agencies hold utmost importance in terms of the magnitude of funding as well as the volume of solar projects that needs to be financed.

Figure 7 shows the most pressing challenges in the rooftop solar PV sector according to developers, installers, nodal agencies, distribution licensees:



These challenges are explained in detail below:

#### 2.4.1. Implementation challenges:

There is a lack of clarity in procedures regarding implementation and Grid connection of the projects slowing down the development and growth of the solar energy sector. Net metering is the most preferred mechanism for solar rooftop in India and hence, the promotion and awareness regarding the same needs a push from both state and central agencies. The procedures issued by a few DisComs for connecting net metered based rooftop PV system to grid are not clear or specific and need to be more detailed and improved. In many states, the net metering guidelines are not available at all.

Moreover, proper standards need to be established and implemented for selection of appropriate components, infrastructure, EPC contractors and integrators to enhance the quality, performance and efficiency of installed projects. It is necessary to select the EPC contractors and integrators based upon their past experience, volume of projects installed by them and the quality of their projects. Grid integration of rooftop PV is also a major challenge since the penetration of solar rooftop is insignificant.

#### 2.4.2. Policy instability:

There is no specific rooftop PV policy for the country as a whole. The solar rooftop PV policy is state specific and hence all the onus lies on individual states for the development of projects. Tariff of rooftop PV was kept same as that of ground mounted system during JNNSM phase 1. Later a few SERCs came out with differentiated tariff to correct the flaw in earlier policy decisions that failed to recognise the benefits of economies of scale available to large utility scale projects. Furthermore, net-metering came into the picture and states started issuing regulations for the same. Capital subsidy available from the MNRE also changed during the course numerous times, starting from all consumers to only residential and institutional etc. in current scenario or from 30% to 15% and then again 30%. Such fluctuations in the policy landscape have affected the rooftop solar PV segment and has slowed the progress, which is one of the major concerns for developers and financing institutions.

#### 2.4.3. Financing rooftop solar PV projects:

The Indian rooftop solar market is predominantly a net metering-driven model. We know that under this model, owners of the rooftop solar PV system are rarely remunerated for the amount of electricity injected in



to the grid. Therefore, due to no clear revenue stream through the net metering model, it becomes difficult for a lender to finance such projects. What makes it more challenging for lenders is to finance rooftop projects is the fact that the rooftop solar PV system is not considered as collateral as the systems are not identified as an asset in the eyes of the lender.

As India has set a ambitious target of 100 GW of solar installations by 2022, financing of solar projects is of utmost concern, since these projects are capital intensive. India lags behind in investments from countries such as China and the US. India needs to extensively increase its investments (both, equity and debt) towards renewable energy projects. Due to small project capacities, rooftop solar projects are not a very attractive proposition for banks and main financial institutions whose focus is always on large scale ground mounted solar projects. There is a stark need to develop financing options through small banks and micro finance institutions through credit enhancement from partial risk coverage funds for rooftop solar PV projects.

Additionally, the cost of obtaining capital for rooftop solar energy projects in India is commonly considered high. The perceived risks range from technology risk (low for solar in India) to developer risk (low-medium) and ultimately to counter party risk (high), which makes financing more expensive and all the more difficult. The high counter party risk in India arises from the potential off-taker (domestic, commercial and/or industrial consumers) and the net metering scheme, which again does not provide a clear revenue stream to banks in India.

#### **2.4.4. Capacity building:**

In order to accelerate the solar rooftop installations, it is necessary to develop and strengthen skill sets, talents and abilities of the resources that are involved in these implementations. It is hence necessary that information about the central and state government incentives and procedures to avail them such as Accelerated Depreciation which is readily available, Central Financial Assistance and applicable subsidies provided by the respective state governments. The level of awareness amongst electricity consumers and the availability of skilled technicians and trained manpower needs to be enhanced. Thus, there is a requirement for capacity building exercise organised at state nodal agencies level through workshops or training programs for skill development.

It is also important that training and capacity building of state level DisComs, Banks /FIs and project developers/ entrepreneurs should be done. The strategic reach out and schedule of the training programmes should be based on the consultation with the respective stakeholders. It is necessary that banks need to do technical due diligence along with the financial due diligence before disbursing the loans. Officials from DisComs need to be well versed with the technical know-how and installation of the systems. They must be aware of how to conduct the feasibility studies and cost benefit analysis of the rooftop PV systems.

This can be achieved by conducting workshops, study tours and training programs as part of the awareness campaign at state and national level in order to create enabling environment, adopt best practices, knowledge sharing and exposure to the latest developments in new and innovative rooftop PV related technologies.

# 3. Industrial cluster level analysis

A cluster is defined as a concentration of enterprises producing same or similar products or strategic services and is situated within a contiguous geographical area spanning over a few villages, a town or a city and its surrounding areas in a district and face common opportunities and threats. In our approach, we did target clusters based on the industries that they cater to in their contiguous geography.

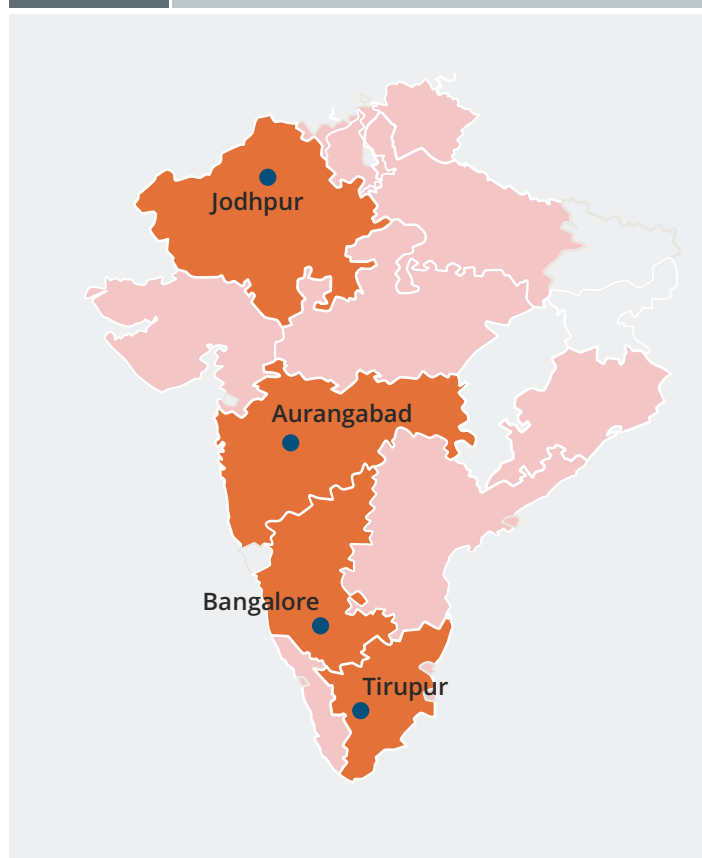
MSMEs contribute more than 45% of the industrial output of India and form the backbone of the economy. They employ nearly 35% of the work force particularly in the manufacturing and exports sector. It is therefore paramount for the government to ensure that the industry remains competitive and adopt latest technologies and processes that will help lower the costs and improve the efficiency to compete globally.

Electricity form a significant operating expense for the MSME units and are catered by special financial instruments and other initiatives promoted by SIDBI for adoption of clean energy solutions and energy efficiency projects. The key initiative is the incorporation of ISTSL to promote energy efficiency, renewable energy and other emerging technologies among MSMEs. India SME Technology Services Limited (ISTSL) is a public limited company incorporated under the Companies Act 1956 on 17th November 2005. It is a joint initiative of the Small Industries Development Bank of India (SIDBI) and four public sector banks including State Bank of India (SBI), Indian Bank, Oriental Bank of Commerce (OBC) and Indian Overseas Bank (IOB). ISTSL is working closely with industrial units in the MSME sector in the fields of energy efficiency (End-to-End Energy Efficiency (4E) Solutions), measurement & verification (M&V) audits, Consultancy and Technology Advisory, Renewable Energy (particularly solar) and Finance Syndication including techno-economic evaluation.

SIDBI also launched the sustainable finance scheme for SMEs to adopt renewable energy and energy efficiency technologies as part of its sustainability initiatives. Despite the initiatives, SME sectors lag behind larger industrial entities in the adoption of renewable energy technologies such as rooftop solar PV due to a number of factors, which forms the basis of this study.

This study will focus on the districts of Aurangabad, Tirupur, Jodhpur and Bangalore (Urban) for its analysis as shown in Figure 8.

**Figure 8** SME clusters considered in the assignment



These districts house SME clusters that cater to a wide range of industries. The detailed information on each cluster under the scope of this study is mentioned Table 3.

Sr.no.	District	Industries
1	Aurangabad, Maharashtra	Auto components, Printing, Pharma
2	Tirupur, Tamil Nadu	Textiles
3	Jodhpur, Rajasthan	Steel, Minerals, Handicrafts, Guar gum
4	Bangalore (Urban), Karnataka	Pharma, Packaging, IT -ITES, Electronics, Biotechnology

### 3.1. Cluster 1 : Aurangabad

Aurangabad district is located primarily in the Godavari Basin and some part towards the north west of Tapi River Basin. This district's general down level is towards south and east and north west part comes in Purna-Godavari river basins as shown in Figure 9. The Aurangabad district's north longitude (degree) is 19 and 20 and east longitude (degree) is 74 to 76.

According to the Ministry of MSMEs, Aurangabad houses more than 15,822 SMES employing 1.73 lakh people. However, apart from key industries such as automobile, several clusters such as the printing cluster are considered sick due to poor economic and market performance.

The industrial clusters are primarily located in three Maharashtra Industrial Development Corporation (MIDC) facilities namely MIDC Waluj, MIDC Chikalthana and MIDC Shendre. MIDC Waluj is the most thriving facility primarily focused on auto ancillary components supplied to large manufacturers in Aurangabad and rest of Maharashtra (Ranjangaon, Chakan).

The primary industry in the Aurangabad SME cluster is automobile based where a large variety of auto components including plastic, metal and electronic parts are manufactured and supplied to the larger automobile manufacturers located in Aurangabad or nearby Chakan Industrial area such as Bajaj Auto, Volkswagen, Tata Motors, and Mahindra.



### 3.1.1. Industrial clusters in Aurangabad

Three clusters have been identified for Ministry of MSME & One Cluster for Ministry of Commerce as shown in Table 4 .

Cluster name	Location	No of units & turnover (INR crores) (2016)	Energy consumption and rooftop solar potential	Rooftop solar adoption rate
Auto components cluster, under Ministry of MSME	Waluj	1285 30000	High	Low
Printing cluster	Chikalthana	250 70	Low	Low
Tiny engineering and allied industries cluster	Chikalthana	63 10	Low	Low
Auto cluster under IIUS scheme, Ministry of Commerce and Industries	Waluj	200 3000	Medium	Low

Marathwada Association of Small Scale Industries and Agriculture (MASSIA) and Chamber of Marathwada Industries and Agriculture (CMIA) are the primary industrial associations that represent industries in various clusters across Aurangabad. These associations work towards the welfare of its members and support development in the Marathwada region by promoting latest technologies and processes to improve efficiency and save cost. The association also represent the members' common grievances to the Government and other regulatory bodies for collective resolution.

### 3.1.2. Rooftop solar in Aurangabad SME Cluster

Maharashtra is one of the most industrialised states in India and is one of the largest market for rooftop solar projects. The key enablers for rooftop solar PV in Maharashtra are the follows

- High Industrial and Commercial tariffs (>7.5 Rs/KWh)
- Presence of a huge number of large manufacturing units and commercial establishments with very high power consumption
- Favourable solar irradiation in the state
- Tax benefits such as accelerated depreciation
- Financial and commercial instruments such as priority lending, RESCO model
- Falling PV component prices lowering CAPEX cost

A previous assignment by PWC has estimated a rooftop solar potential of 55 MW among SMEs in Aurangabad clusters. This is a significant potential considering that the study focused only on SMEs where typical project sizes vary from 5 KW to 50 KW and large power consuming units were not considered.

Aurangabad has witnessed an upswing in the number of rooftop solar projects installed in the district, particularly by large manufacturing units, malls and other commercial establishments.

However, the SME sector, as akin to other parts of the country, has lagged in adopting solar power in Aurangabad. However, growing awareness and presence of reliable system integrators and easy access to capital has led to several SMEs installing rooftop projects ranging from 5 KW to 50 KW.



An example is M/s Ashapura industries, which installed a 42 KW rooftop solar project at its plant (Figure 10) to lower the power costs and to avail accelerated depreciation benefit. The project has availed net metering facility from MAHADISCOM to export excess power generated to the grid, which is reconciled in the monthly electricity bill.

**Figure 10** 42 KW rooftop solar at of M/s Ashapura Industries



### 3.1.3. Financing of rooftop solar

Several initiatives have been adopted to improve awareness and increase the adoption of rooftop solar in the Aurangabad SME cluster. A significant initiative being 'Solar Roof Top Project for SMEs' program by Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ). Under the program, SIDBI has announced to provide loans at 8.5% to boost adoption of rooftop solar in the Aurangabad SME cluster, particularly among the energy intensive auto component industries. SBI has also unveiled several schemes to finance solar projects at attractive interest rates. As part of the initiative, MASSIA & CMIA decided to form a solar cluster to increase the awareness and motivate SMEs to avail the incentive loan scheme of SIDBI.

Besides solar specific financial instruments, many companies leverage their existing transaction relationship with banks to avail loans at attractive interest rates and faster processing time. However, a large number of SMEs still find access to finance a challenge due to inability to provide collaterals and poor credit rating.

Several private developers are offering to set up rooftop projects on OPEX basis backed by a PPA with companies with good credit history. Traditionally these developers focused on large companies with big project sizes. However, as the market has matured, more players are willing to set up rooftop projects on RESCO basis on SME premises.

Slowdown in the auto industry, net metering implementation, bill reconciliation and focus of entrepreneurs on core business are some of the other challenges faced by SMEs in the Aurangabad cluster.

## 3.2. Cluster 2 : Tirupur

Tirupur is a city in Tamil Nadu in southern India. Tirupur is the administrative headquarters of Tirupur district and the fifth largest urban agglomeration in Tamil Nadu. It is situated at the center of the South Indian Peninsula, about 450 kilometres (280 mi) southwest of the state capital Chennai and about 50 kilometres (31 mi) east of Coimbatore.

Tirupur is a major textile and knitwear hub contributing to 90% of total cotton knitwear exports from India.

Figure 11 Performance of Tirupur Cluster	
<b>Total units</b>	<b>: 35395</b>
<b>Medium &amp; Large Units</b>	<b>: 46</b>
<b>Daily employment in SMEs</b>	<b>: &gt;11,00,000</b>
<b>Turnover of SMEs</b>	<b>: USD3.5 billion (2016)</b>



The district is known as the “Knitwear capital of India” and the textile industry provides employment to over six lakh people and contributed to exports worth INR200 billion (USD3.0 billion) in 2014-15 Figure 11 briefly shows the performance of Tirupur cluster.

### 3.2.1. Industrial infrastructure and performance Total units

All the industrial estates in the district are managed by the Tamil Nadu Small Industries Development Corporation Limited (SIDCO). There are four industrial areas in the district:

- Ganapathipalayam
- Gudimangalam
- Tirupur
- SIDCO Industrial Estate, Kangeyam

In these areas, special industrial parks have been developed to support the textile industry. Nethaji Apparel Park (NAP), Tirupur Export Knitwear Industrial Complex, SIDCO Industrial Estate and J.S.Apparel Park are a few that are operational. Nethaji Apparel Park has 53 companies manufacturing knitwear for exports.

Majority of the products produced by this cluster are cotton-based knitwear products for men, women and children. These products are primarily focused on summer and spring garments.

The key activities include knitting and garment making, which constitute more than 65% of the industrial activities in the cluster.

The textiles industry in Tirupur contributes about 80% to India's hosiery exports and around 3% to total export trade. Exports from Tirupur increased at a CAGR of 8.4% from USD1.4 billion in FY05 to USD3.4 billion in Fy16. In view of the excellent performance, the cluster has been awarded the "Town of Export Excellence" status by the Government of India.

The cluster also plans to diversify from cotton-based garments to sportswear and other products to compete with countries such as China and Bangladesh.

The textile industry is highly energy intensive due to activities such as embroidery printing, knitting, dyeing and compacting, which require a large number of machines operating on electricity. Steam and power are the major utility costs for the textile industry in the region.

The power consumption depends on the size of the factory and the activities that take place such as knitting or dyeing. Typically, units have a connected power load of around 5 kVA to 1000 KVA. The dyeing activity is particularly energy intensive, since it is connected with individual and common effluent treatment plants (ETPs). The spinning segment is also energy intensive.

With a specific consumption of 0.26 KWh/Kg, a typical knitting unit with a production capacity of 600 tonnes per annum (TPA) require more than 156,000 KWh/Year. Specific energy consumption for various garment manufacturing processes (KWh/KG). In this context some companies, including large exporters, are opting in for wind energy generation and solar plants and many dyeing units are today considering cogeneration options to optimise related costs.

### 3.2.2. Rooftop solar power in Tirupur SME clusters

Tamil nadu has been at the forefront of developing renewable energy, particularly wind and lately solar for captive usage by the textile industry. The renewable purchase obligation (RPO) regulation, which mandates a solar renewable purchase obligation (RPO) of 5% (2017-18) solar power consumption has been a key driver in the rooftop solar market particularly in the industrial sector.

In addition to solar RPO, favourable net metering policies which allow the solar power generator to feed the excess power back to grid, has catalyzed solar rooftop boom in the state. The textile industry being one of the largest power consuming industry in the state has been at the forefront of adopting solar and wind technologies to reduce power cost, meet RPO and avail tax benefits. The industry was supported by generation-based incentives in the early years of growth.

In Tirupur, both large and medium scale industries are availing the benefits of solar and wind energy more than of other industrial states such as Gujarat and Maharashtra.

A good example of this practice is SRG apparel who have installed a 1 MW rooftop project in 2014, as shown in Figure 12, in addition to existing wind power projects for their captive consumption. The power generated is utilised in multiple units of SRG through open access with minimum charges and solar power banking.

**Figure 12** 1 MW Rooftop solar plant at SRG apparel



Hi-life labels installed a 95 kW solar rooftop system on their label manufacturing unit at Tirupur, as shown in Figure 13. The project was installed in 3 phases i.e. 35kW in 2012, 20kW in 2013 and 40kW in 2015. The 35 KW plant was initially installed to meet the Solar RPO mandate but was subsequently expanded as the company management realised true economic benefits of solar power including power cost and tax savings.

**Figure 13** 95 KW rooftop solar project at Hi-life Labels



### 3.2.3. Financing landscape

As a leading industrial district in the country, Tirupur houses more than 230 branches of various nationalised and local banks. The cluster firms are financed by a range of commercial banks. Term loans are provided with a moratorium on repayment of principal of 6 months to 1 year, and with a 5 to 7 year repayment period. The firms have been able to utilise their existing banking relationships to avail financing for rooftop solar projects at attractive interest rates ranging from 8.5% to 12%.

### 3.3. Cluster 3: Jodhpur

Jodhpur is the second-largest city in Rajasthan and one of the important industrial cities with a large number of big and small scale industries catering to various products and services. The district is rich in non-metallic minerals such as sandstone, rhyolite, dolomite, limestone, jasper, granite, clay, murrum, kankar, brick earth and bajri. A large number of industrial activities in Jodhpur utilizes these minerals such as stone works.

#### 3.3.1. Industrial clusters in Jodhpur

According to the Ministry of MSME, there are more than 24,000 registered industrial units in the district. Handicraft items, flexible packing material, guar gum powder, refined guar splits, guar meal, churi, wooden furniture, iron artistic furniture, rollers for bearings, conveyor belt are the major products in the district.

Cluster report from the Ministry of MSME 2015-16 indicates that there are 24,354 registered industrial units in Jodhpur employing more than 1.25 lakh daily workers. On an average, 1,000 new industries are registered in the district every year since 2012.

The industries are categorised into five main industrial clusters namely textile, handicraft, guar gum, stainless steel pattapatti / utensils, and stone processing. Details of these clusters are shown in Table 5.

Cluster name	Location	No of units & turnover (INR crores) (2016)	Energy consumption and rooftop solar potential	Rooftop solar adoption rate
S.S. Sheet & Utensils	Jodhpur City	150 3000	High	Low
Metal Wooden Handicrafts	Boranda, Jodhpur	1000 3500	Medium	Low
Gaur Gum Cluster	Phalodi	60 1000	Low	Low
Limestone	Gotan Road, Pipar, Jawasia	79 NA	Low	Low
Stone Processing cluster	Mandore, Soor Sagar, Osian, Jodhpur city	116 115	High	Medium
Textile	Pipar City	150 650	High	Medium

#### 3.3.2. Rooftop solar power in Jodhpur SME clusters

Solar rooftop projects are very prominent in Jodhpur (and entire state of Rajasthan) due to a combination of factors:

- High solar irradiation in the state (5.64 KWh/M<sup>2</sup>/Day)
- Enforcement of Renewable purchase obligation (RPO) by the state energy utilities
- High power consuming nature of industries in the district such as steel works, textiles, ceramics
- High industrial power tariff (INR6.6 /KWh)
- Benefits such as accelerated depreciation and net metering
- High level of awareness due to the presence of utility scale solar projects

RPO mandate set by Rajasthan Electricity Regulatory Commission (RERC) has been one of the biggest catalyst for the adoption of rooftop solar in the state. The renewable energy purchase obligation in Rajasthan is shown in Table 6.

Sr. No.	Year	Non solar	Solar	Total
1	2017-18	9.50%	4.75%	14.25%
2	2018-19	10.25%	6.75%	17.00%

Jodhpur Vidyut Vitran Nigam Ltd (JDVVNL) is the primary power distribution company (DISCOM) in Jodhpur. The current JDVVNL tariff for SMEs is INR6.60/KWh, which is substantially higher than the levelled cost of solar energy. This comparatively high cost of power is a key motivation for a large number of SMEs with high power consumption to adopt rooftop solar with net metering facilities. The DISCOM has implemented net metering facility at several projects in the district and has been supportive for the growth of solar rooftop projects in its service area.

#### **Rooftop solar in Jodhpur SME sector**

Among the SME sector, adoption of rooftop solar projects began in 2015 as the PV component prices fell dramatically. One of the first companies to install a rooftop solar project in the handicrafts cluster was Sushil Udyog in September 2015. The project served as inspiration for more entrepreneurs to adopt PV system to lower energy costs and save tax such as Mr. Praveen Sharma of Sharma Industries who has installed three solar projects of at three units of 60 KW, 66 KW and 20 KW at his factory units in 2016, Figure 14 shows solar rooftop at a handicrafts unit in Jodhpur.

**Figure 14** Solar rooftop at a handicrafts unit, Jodhpur



Based on positive word of mouth, since 2016, an aggregated capacity of more than 2 MW solar rooftop projects has been installed in the SME cluster by various industries. In the absence of organised RESCO players in the SME segment, an informal RESCO arrangement between SME owners have also been developed where investments are made on third party roofs to sell power to the roof owner. Such projects are carried out on local level based on relationships with the offtaker and without a credit check mechanism.

#### **3.3.3. Financing landscape**

The key financial instrument available for adoption of rooftop solar is the SIDBI sustainable finance scheme, which aims to assist MSMEs for adopting energy efficiency and renewable energy projects. The program has stipulated the following eligibility criteria:

- New/existing MSME units, according to the definition of the MSMED Act 2006, will be eligible for assistance under the scheme.



- Existing units should have satisfactory track record of past performance and sound financial position and should not be in default to institutions/banks.
- Units should have minimum credit rating of investment grade or its equivalent according to internal credit rating model.

However, several SMEs have opted to utilise their existing relationships with the banks to avail loans at favourable interest rates and payment terms. With solar PV technology maturing and the industry is better understood banking community, banks have been willing to provide loans to their existing consumers under the regular lending schemes. The typical processing time is 15 days excluding technical due diligence, which is carried out only for larger projects.

Canara bank funded the solar project installed at Sharma Industries, Jodhpur and Vyas college at an interest rate of 9.5% and a repayment period of 7 years. Sharma Industries is an existing customer of Canara bank and the company was able to leverage the relationship to avail the loan.

The banks find that a solar-specific scheme has less traction as a number of companies lack the credit scores to avail the scheme while others prefer to use the existing banking relationships.

### 3.4. Cluster 4: Bengaluru (Urban)

Bengaluru, the capital of Karnataka state, stands amongst the fastest growing cities in India. The IT industry in the city is a key growth driver of Karnataka's economy. Apart from national prominence, Bengaluru has also gained recognition globally; being ranked as the fourth-best technology hub in the world as per the UNDP Report. More than 400 out of Global Fortune 500 companies outsource their IT services from Bengaluru.

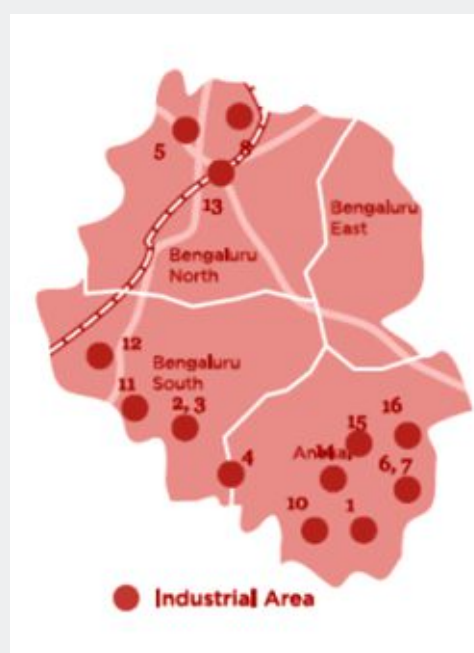
Major industrial products from the district include; IT/ITES, telecom, service health care centre, metal slitting, village heritage park, critical reactors for nuclear power plants, automobile engineering, software development, hospital research, zinc plating, cold storage & transportation, steam turbines, active pharmaceutical ingredients and aerospace components, logistics & warehousing, gem & jewellery, integrated circuits & designs in modular units.

#### 3.4.1. Industrial clusters in Bengaluru

Bengaluru is among the largest cities in India and houses a large number of industrial areas that cater to a wide range of industries as shown in Figure 15.

Figure 15 Industrial Area, Bengaluru

Sr. No	Industrial Area
1	Attibele
2	Bommasandra 1, 2 & 3 Phases
3	Bommasandra 4th Phase
4	Doddannakkundi Phase 1 & 2,
5	Electronic City Phase 2
6	Electronic City Phase 3
7	EOIZ
8	EPIP Phase 1 & 2
9	Jigani Phase 1 & 2
10	Kadugodi
11	Kumbalagadu Phase 1 & 2
12	Peenya Phase 1,2,3 & 4
13	Veerasandra
14	Yarandahalli
15	Kachanayakanahalli



These industrial areas have several large, medium and small scale industries. The MSME clusters in Bengaluru include agarbatti, rugs & duries, wood carving, shopping bag/fancy items, toys and decoration pieces, brass and copper art ware, dolls from pulp, jewellery, metalware, grass, leaf, reed and fibre, earthenware/pottery, embroidery by hand, printing of cloth by hand, wood furniture & fixtures, textile handlooms, machine tools, power loom, electronic goods, readymade garments, engineering and leather products.

Peenya in Bengaluru is, the largest SME industrial area in Asia and also the largest bio technology cluster in India. The key SME clusters in Bengaluru and their products are listed in Table 7:

Sr. No.	Cluster	Products
1	Biotech & Pharma	Genetic research, drug design and discovery centers, peptide synthesis, generics, formulations
2	Engineering	Electronics & embedded systems, electricals & insulation units, industrial instruments, home equipment, auto components, CNC machines
3	Food Processing	Research & Training institutes, advanced agriculture technology, improvement in seed varieties
4	Knowledge Based Industries	R&D Units, KPOs
5	IT, ITES	Information Technology, cloud computing infrastructure, IT/ITES, IT hardware and component manufacturing, Business Process Outsourcing (BPO), training and education centers
6	Stone industries cluster	Stone cutting & polishing, tiles
7	Plastic	Plastic products, packaging material
8	Electronic system design & manufacturing cluster	Providing technical, marketing, calibration testing and R&D services to electronic institutions
9	Others	Printing, sheet metal works, powder coating, chemicals, foundry

Bangalore SME clusters have more than 100,000 registered units employing 10 million daily workers. Every year 3,000 – 4,000 new units are registered in the clusters adding more employment opportunities. The rapid growth of industrial units in Bengaluru in the past two decades has led to a sharp increase in the power demand in the city. Industrial machinery and motors, computing and data centers, air conditioning equipments, lighting, heating etc. are key activities that form majority of the power consumption in the state.

BESCOM is the primary DISCOM catering to the industrial and residential consumers in the city. To promote adoption of solar rooftop, BESCOM introduced the widely adopted net metering policy in 2013, which was further revised in 2016.

In 2017, BESCOM hiked the power tariff for all categories by 9%, which increased the industrial tariffs by 25-30 paise/KWh. Currently, industrial tariffs range from INR6.20/KWh to INR6.75 /KWh in Bengaluru. The hike in power tariffs with potential for future price revisions, tax saving through accelerated depreciation, lowering capex cost of solar equipment provide an ideal environment for SMEs to adopt solar power on a large scale.



### 3.4.2. Rooftop solar power in Bengaluru SME cluster

In 2013, Karnataka introduced its net-metering policy which offered a tariff of INR9.56/KWh for exported units for solar rooftop projects upto 1 MW irrespective of the sanctioned load. This scheme was widely adopted in Bangalore and across the state with PPAs of more than 500 MW signed with various rooftop solar generators. The tariff was subsequently revised in 2016 to accommodate the lower price of PV panels and other components. Furthermore, the maximum capacity was fixed at 100% of the sanctioned load. The revised tariffs for net metering are as given in Table 8.

Capacity of solar rooftop & small PV power plants	Approved tariff in ₹/unit (without capital subsidy)	Approved Tariff in ₹/Unit (with capital subsidy of 15%)
1 to 10kW	7.08	6.03
Above 10kW and upto 50kW	6.61	5.63
Above 50kW and upto 100kW.	6.14	5.23
Above 100kW and upto 500kW	5.67	4.83
Above 500kW and upto 1MW	5.20	4.43

The net metering scheme, along with high tariffs and tax benefits (accelerated depreciation), has been instrumental in wide adoption of rooftop solar projects in the SME segment. In addition, a large number of export-oriented companies have been motivated to use clean solar power in a bid to lower the carbon footprint of the company and its products.

### 3.4.2. Financing landscape

Financing for rooftop solar for SMEs in Bengaluru follows a similar pattern to rest of the country where the companies obtain debt financing from existing banking partners. Several SMEs have adopted alternate solutions such as utilizing overdraft facility from banks or 100% equity in case of small system sizes. A key obstruction to several consumers is the collateral demanded by banks as security to finance the projects, since in many cases, the SMEs have their assets mortgaged for previous loans.

For companies who cannot afford the initial capital expenditure, credit facilities are being provided by system integrators such as Orb energy who has raised more than INR95 crore (USD15 million) in a part-equity and part-debt round from the Dutch development bank FMO, self-sustaining US government agency Overseas Private Investment Corporation (OPIC), African finance institution Pamiga and Germany's development finance institution DEG. Orb is planning to use the capital to expand its in-house finance facility of rooftop solar projects for SMEs. Orb's in-house platform provides finance to SMEs looking to reduce electricity costs through ownership of a rooftop solar system. To make the adoption of solar panels easier, Orb offers financing packages without collateral as many cash-constrained SMEs cannot afford the up-front costs of solar without credit. Orb is looking to cement its position in this market as a leading credit facility provider, a move that it expects will strongly increase commercial sales.

# 4. MSME Rooftop Solar PV Case Studies

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## 4.1. 100 kW rooftop solar project at S.N. Metallurgical Services, Aurangabad

### About The Company

S.N. Metallurgical Services is a leading metallurgical testing laboratory in chemical & mechanical testing field and runs a commercial heat treatment shop in the Marathwada region. The unit is headed by Mr. Shyam Choudhary. The company was established in 1999 and opened its second unit in 2007. Both the units are ISO: 9001:2008 certified from TUV India. Its testing services are accredited by the National Accreditation Board for Testing and Calibration Laboratories.

S.N. Metallurgical Services has a modern interior testing laboratory, which is equipped with all the latest testing equipment. The major machines at the facility are: tensile machine, hardness tester, rotary furnace, gas carburising line etc. Recently, it has introduced vacuum hardening process for the first time in the Marathwada region. A latest technology SQF with PLC control and SCADA system furnace is also available at the facility.

The major testing services provided by the company are tensile testing, compression testing, bend test, hardness testing, surface crack detection, impact testing, plastic & rubber testing and oil testing. In addition to testing services, S.N. Metallurgical associates also provides heat treatment services such as carburising, carbonitriding, annealing, stress relieving and induction hardening.

Total connected load of the facility is 1,300 Kw and contract demand is 980 KVA. The company website <http://www.snmet.com/> can be visited for more details about the company, its products and services.

### About Solar Rooftop Project

S. N. Metallurgical Services installed a 100 kW solar rooftop system on their heat treatment plant at M-142, MIDC, Waluj, Aurangabad – 431136. SIDBI is the project financier and the system integrator is Reylon Solar Private Limited. The 100 KW RTPV project got commissioned on 1 August 2016.

The project is executed on a truss structure at the roof and the module orientation is north to south to achieve shadow-free, south-facing array. The total roof area is approximately 1,000 square m. The modules installed are multi-crystalline of Trina make and the inverters are Eco 27.0-3-S type of Fronius make.

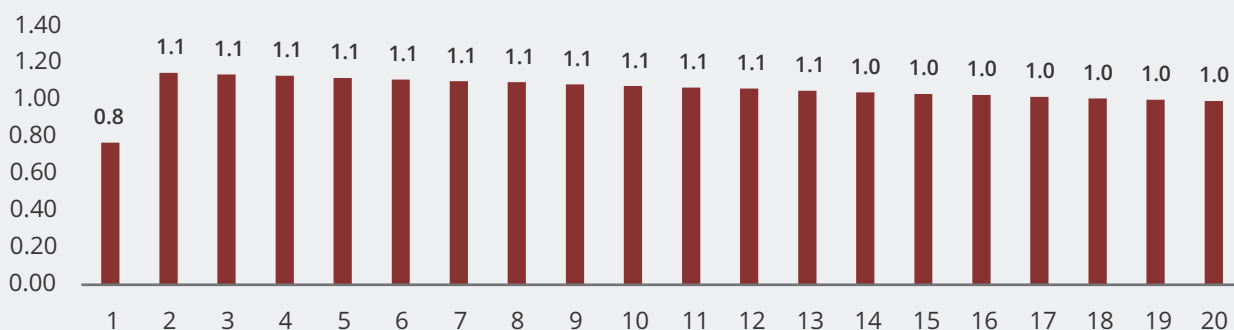
The current system of 100 KW caters to approximately 7% of the company's connected load whose total electricity requirement is approximately 250,000 units per month. The company is accruing financial benefits in terms of accelerated depreciation and savings in electricity bills. The plant is expected to generate savings of 5% on the annual electricity bill, with a payback of 9 years on the current tariff.

The Figure 16 below shows the solar project at rooftop of S. N. Metallurgical unit:

**Figure 16** Rooftop solar project at S N Metallurgical unit at Waluj, Aurangabad



**Figure 17** Electricity generation in lakhs Kw/hr units



The graph below depicts electricity generation from solar project in lakhs of units.

The annual solar generation from 100 kW solar project is approximately 1.3 lakhs Kw/hr units, which is supposed to reduce in coming years due to deration of the solar modules as shown in the Figure 17.

#### **Motivation Of Installation**

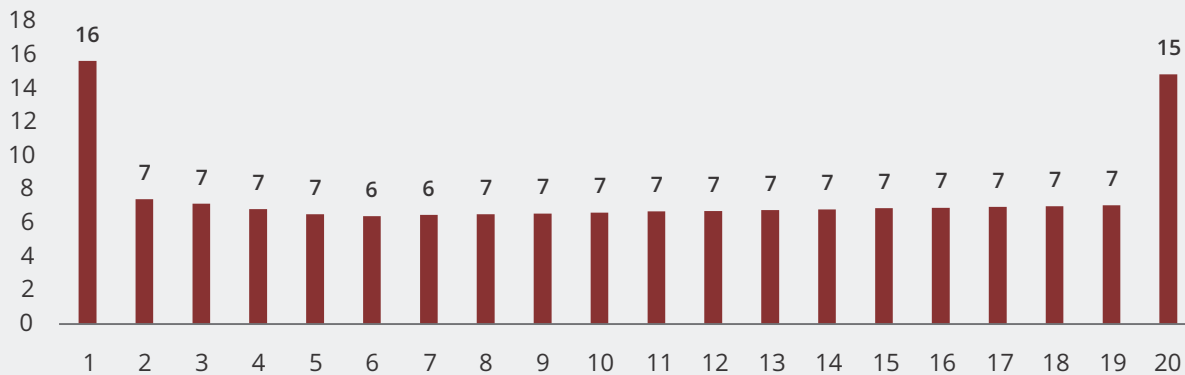
As per discussion with unit owner Mr. Choudhary, the company installed 5 kW solar project at the rooftop of its headquarters in 2013 and benefitted from electricity savings and AD benefits. His earlier good experience motivated the him to go ahead with 100 kW solar project. The company runs a heat treatment shop, which has electrical machines of as high as 100 kW load each. The electricity expense alone contributes to approximately 50% of the total expenses, which highlights the energy intensity of the plant. The Unit owner planned to install rooftop solar as one of the measures to tackle such high expenditures on electricity cost. Mr. Shyam Choudhari“Electricity expenses are 50% of our total expenses and cutting down on these improves our competitiveness in the big way. Rooftop solar project is our first step in this direction and we will continue our efforts to bring down electricity expenses”.

Currently, MSEDCL tariff charged for electricity is INR 8.5/kWh, which includes variable energy charges, wheeling charges and electricity duty. The total electricity requirement is approximately 250,000 units per month. The 100 KW plant will definitely not suffice for most of his requirements but it's a start and will surely help in bringing the expenses down to some extent. The plant is expected to generate savings of 5% on the annual electricity bill, with a payback of 6 years on the current tariff.

In the words of unit owner Mr. ShyamChoudhari–“Electricity expenses are 50% of our total expenses and cutting down on these improves our competitiveness in big way. Rooftop solar project is our first step in this direction and we will continue our efforts to bring down electricity expenses”.

In addition to savings in electricity bill, S. N. Metallurgical is also availing AD benefit of 80% to save the taxes. Figure 18 depicts total project cash flows after adjusting savings in electricity bills, tax adjustment after 80% AD benefits and O&M expenditures:

**Figure 18** Project cash flows from 100 KW rooftop solar plant



### Execution Of The Project

S N Metallurgical Services awarded the contract on turnkey basis to a local solar project integrator Reylon Solar Private Limited. The integrator had also installed 5 kW rooftop solar project at the company's headquarter and the unit owner was satisfied with the performance. Although, quotations were invited from multiple integrators for price benchmark, the project was awarded to Reylon Solar. The integrator started the installation in June 2016 and the project commissioned within two months i.e. August 2016.

The project is executed on truss structure at roof and the module orientation is north to south to achieve shadow-free, south-facing array. The solar modules are multi crystalline of Trina make and solar inverter is Fronius, Eco 27.0-3-S type. As observed during site, the execution of the project is sub-optimal. Some of the modules were under shades (figure 16) and some other modules were horizontally laid on the roof (Figure 19). This shows poor quality of installation by system integrator. There were no safety guidelines to be followed by staff while they perform cleaning and maintenance activities.



Figure 19 shows below show inverter installation and the rooftop project at S. N. Metallurgical:

**Figure 19** Inverter installation and rooftop solar project



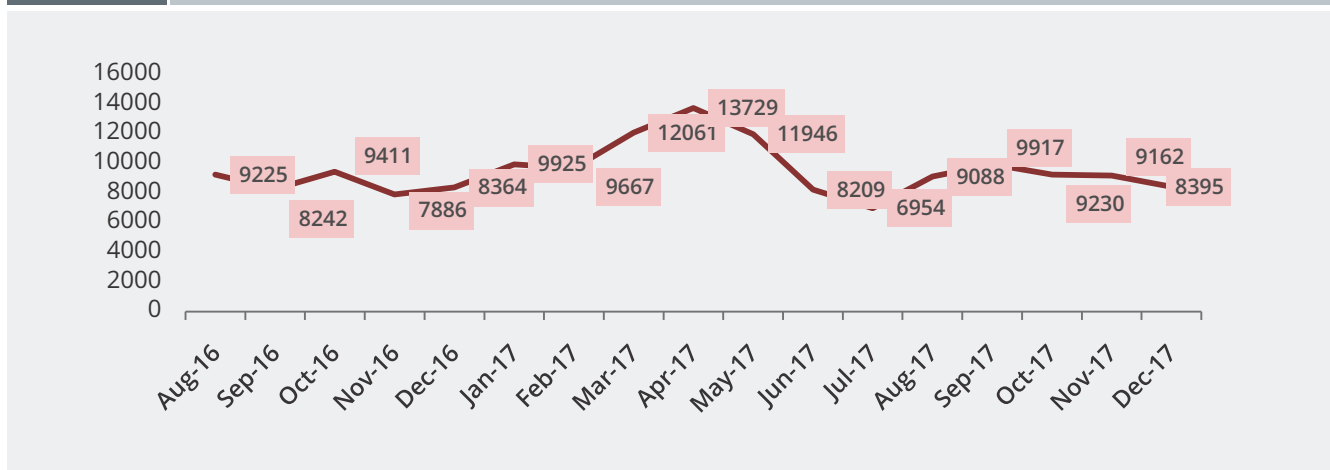
### Financing Of The Project

SIDBI Aurangabad funded S. N. Metallurgical for the solar project under privileged customer scheme. Total project cost of the 100 kW solar project is INR63 lakhs out of which SBI funded INR53.5 lakhs or approximately 85% of the total project cost. The loan terms are: 9.5% interest rate and 5 years of repayment. The bank has been regular financier of SIDBI for its business-related requirement and funded the solar project on the basis of previous good relationship and repayment history. The bank also required collateral, which are adjusted in the existing business loans of the customer. Table 9 depicts project loan terms:

Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
SIDBI	85%:15%	5 years	0 year	9.5%

### Project Performance

The solar project was commissioned in August 2016 and electricity output is in line with the expected generation, as shown in Figure 20. Solar generation from the project is 350-400 units per day however it could have been better, if better installation practices were followed. As discussed before, some of the modules were under shades (figure 16) and some other modules were horizontally laid on the roof (Figure 19). Solar panels are being cleaned twice a month by SN Metallurgical staff. Reylon Solar Private Limited has provided basic training and manuals so that S. N. Metallurgical's staff is self-sufficient to take care of regular cleaning and basic fault finding. Currently, the complete solar generation is consumed by the unit itself on regular working days. The solar project is non-operational during holidays.

**Figure 20** Monthly solar generation from 100 kW rooftop solar project


The solar project was commissioned in August 2016 and the owner is satisfied with the electricity generation of the plant. Solar panels are being cleaned once a week and washed once a month. The owner has faced no issues post commissioning of the plant and has recorded no down time till now. Moreover, the project being a rooftop project also provides glazing effect and helps in lowering the temperature of the rooms below.

#### Major Challenges Faced

Mr. Shyam Chaudhary faced a major challenge regarding financing of the plant and the owner had to put up the entire plant on his own and the loan disbursement only happened once the plant got commissioned.

The company has not applied for net metering due to the current regulations of MSEDCL. According to current norms, industrial units which apply for net-metering have to forgo INR1/kWh subsidy given to industrial units in the cluster. As electricity generation from the solar project only contributes 5% of the total electricity requirement of the plant, unit owner decided to not avail net-metering and continue receiving subsidy on the electricity imported from the grid. This results in wastage of generated electricity on holidays.

There were no specific challenges on technical part as integrator provided good EPC services and continues to support the company in O&M activities.

#### PWC Analysis

The rooftop solar project at S. N. Metallurgical has shown good demonstration effect and a lot of unit owners have visited the project. Mr. Ashok Kale, who owns an industrial unit, installed a 200 KW solar plant taking encouragement from the success of the plant.

The motivation to install came from success of 5kW solar project at company headquarters which highlights the importance of confidence building among MSMEs. Selection of technically sound integrator is a major step in this direction who can ensure good EPC work and performance of the plant later on.

MSME financing is based on unit owner's relationship with the bank and repayment history. This works well for MSMEs which have existing business loans with banks. S. N. metallurgical has more than 10 years business relationship with SIDBI Aurangabad. Still loan approval got delayed and unit owner self-funded the project. This highlights the importance of expedited loan approval from the bank. Early communication of all paper work requirement through online portal can be one such step to start with.



The financial performance of the solar project are summarised in the table below:

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	53
2	Equity IRR	12.02%
3	Project IRR (%)	10.98%
4	Payback Period (yrs.)	Project Payback: 9
5	Levelised cost of electricity (INR/kWh)	4.2

## 4.2. Installation of 40kWp Rooftop PV Plant on Ashapura Engineering Pvt. Ltd., Aurangabad

### About The Company

M/S Ashapura Engineering Pvt. Ltd. (AEPL) is an SME unit involved in manufacturing of automobile components and is situated at Suvarna Laghu Udyog Yojana, Waluj industrial area of Aurangabad. AEPL is headed by Mr. Sachin Seth. The major machines in the facility include thread forming, rolling and cutting for fastening manufacturing. The total plant connected load is 75 kW.

### About Rooftop Solar Project

In a separate assignment by GIZ, PwC had surveyed AEPL through industry associations MASSIA and CMIA. The unit was physically surveyed to assess the potential of RTPV system and prepare a feasibility analysis subsequently. This survey also served as the basis of the initial dialogue between interested units and their bankers for financing of RTPV projects. The attractive project economics encouraged Mr. Seth who installed 40 kW solar system on the roof to save on his electricity bill. The rooftop project is more than 50% of the connected load i.e. 75 kW.

State Bank of India is the project financier and Skaleup Energy Solutions Pvt. Ltd. is the integrator who provided EPC services and continues to engage in operations and maintenance activities. AEPL has also availed net metering facility from Maharashtra State Electricity Distribution Company Limited (MSEDCL).

The 40kW RTPV project got commissioned on 30 March 2017 with State Bank of India approving the loan on 26 April 2017. The RTPV system installation uses innovative super structure for mounting the module to prevent the shadow losses. The natural slope of the roof is towards north, however solar module tilt angle after superstructure is 20 degrees towards south. The solar module make is of REC 335w Twin Peak and solar inverter make is of 40kw 3 phase Growatt.

AEPL is accruing financial benefits in terms of AD and savings in electricity bills. The plant is expected to generate savings of 72% on the annual electricity bill, with a payback of 6 years on the current tariff.

In the words of unit owner Mr. Sachin Seth - "We invested in rooftop solar project to reduce our electricity bills and we are happy with the plant performance and savings"

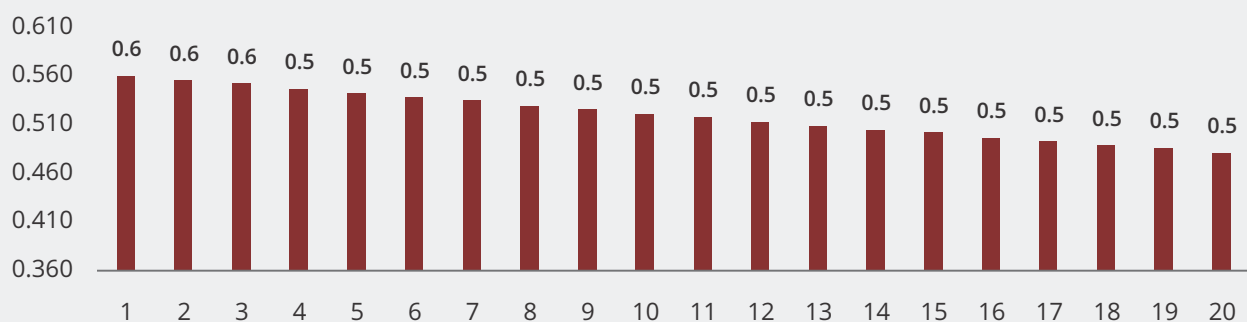
Figure 21 shows below show solar arrays at the roof of AEPL unit, Aurangabad.

**Figure 21** Rooftop solar project at AEPL unit at Waluj, Aurangabad



Figure 22 depicts electricity generation from solar project in lakhs of units.

**Figure 22** Electricity generation in lakhs of units



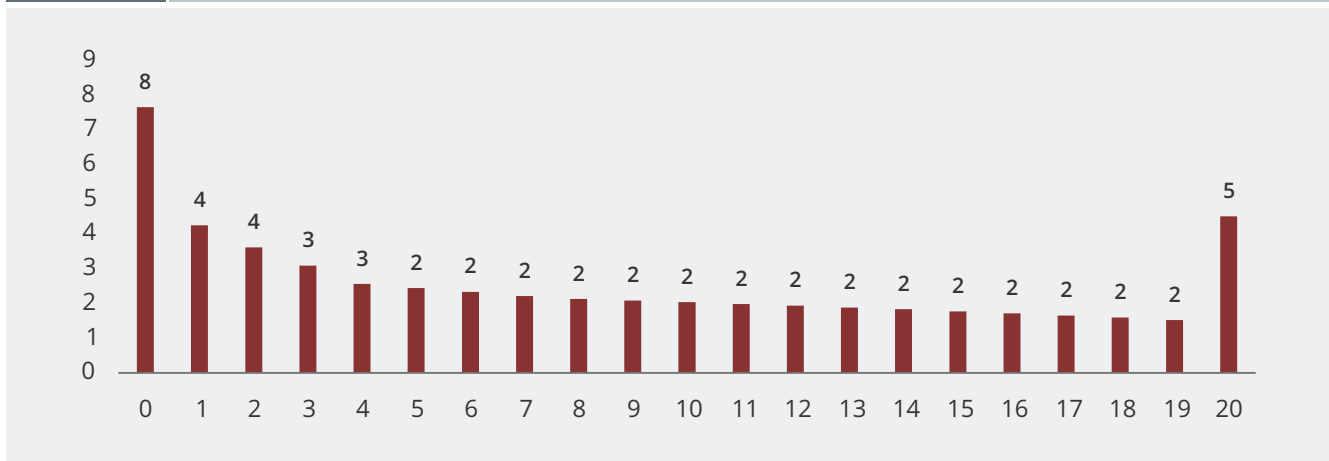
### Motivation Of Installation

According to unit owner Mr. Sachin Seth, the major rationale behind solar project installation is financial savings in form of savings in electricity bills and accelerated depreciation benefits. Currently, MSEDCL tariff charged for electricity is INR 7.68/kWh. At present, the unit has total electricity load of 70 KW. The plant is expected to generate savings of 72% on the annual electricity bill, with a payback of six years on the current tariff.

In addition to savings in electricity bill, AEPL is also availing accelerated depreciation benefit of 40% to save on taxes. During conceptualisation of the project, 80% accelerated depreciation was also the major attraction. However, it could not be availed since net metering agreement could not be signed upto March 2017 and after that the Finance Ministry slashed AD benefit to 40%.

Figure 23 depicts total project cash flows after adjusting for savings in electricity bills, tax adjustment after 40% AD benefits and O&M expenditures:

**Figure 23** Project cash flows from 40 kW rooftop solar plant



### Execution Of The Project

AEPL awarded the contract on a turnkey basis to Skaleup Energy Solutions Pvt. Ltd., which is a local solar project integrator. It was selected after discussion with multiple integrators. The integrator started the installation in February 2017 and the project was commissioned in March 2017.

The major highlight of the project execution is that a superstructure was constructed on the roof for module mounting to achieve shadow-free, south-facing array. The additional cost of superstructure was approximately INR1.5 lakhs. The natural slope of the roof is towards north; however, solar module tilt angle after superstructure is 20degrees towards south. The solar module make is of REC 335w Twin Peak and solar inverter make is of 40kw 3 phase Growatt.

Skaleup Energy Solutions Pvt. Ltd. is also entrusted with project operations and maintenance. The duration of O&M contract is one year from the date of project commissioning. The major activities carried out by the integrator to ensure the performance of the plant are: monthly solar generation data to AEPL and regular visit to AEPL for testing purpose.

AEPL has availed net metering facility from distribution licensee MSEDCL and has been accruing financial savings due to electricity bill reduction.

Figure 24 shows superstructure at the rooftop project, AEPL:

**Figure 24** Superstructure at 40 kW project to achieve shadow free south side and better generation



### Financing Of The Project

State Bank of India funded AEPL's solar project. The total project cost of 40 kW solar project is INR23.60 lakhs out of which SBI funded INR 17.48 lakhs or approximately 74% of the total project cost. The funding of the project was done on 26 April 2017. However, the plant was already commissioned on 30 March 2017. The loan terms are: 8.35% interest rate and 8 years of door-to-door tenure comprising 7 years repayment period and 1 year moratorium period. The bank has been regular financier of AEPL for its business-related requirement and funded the solar project on the basis of previous good relationship and repayment history. Table 11 depicts project loan terms:

Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
SBI	75%:25%	7 years	1 year	8.35%

### Project Performance

The solar project was commissioned in April 2017 and electricity output has exceeded the expected generation in most of the days. Expected solar generation from the project was 150-160 units per day and solar generation achieved is in the range of 160-175 units per day. Solar panels are being cleaned twice a month by AEPL workers. Skaleup Energy Solutions Pvt. Ltd. officials also monitor plant performance data and visits the solar facility once a month in order to ensure regular tests such as string check, AC side error check etc. In the initial three months, there were issues of electricity bill reconciliation. However the same has been resolved after change of meter by distribution utility. Currently, electricity bills are correctly accounting for electricity credited into the grid.

### Major Challenges Faced

As per discussions during site visit, unit owner Mr. Sachin Seth faced three major challenges in project execution i.e. financing, net metering and electricity bill reconciliation. Major hurdle in financing was paperwork, which was handled by third party hired by SBI. Requirement of all the paperwork was not communicated at initial stages which led to delays and hassles. The loan approval process became so cumbersome that Mr. Sachin Seth had almost lost hope at one point.

Availing net metering was the other major challenge faced by unit owner in project execution. The unit owner filed net metering application with construction start itself in February 2017 but meter was installed in April 2017. Delay in net-metering resulted in AEPL losing out on 80% accelerated depreciation benefit and could avail only 40% AD benefit.

For the first three months, Mr. Sachin Seth faced issues from distribution utility concerning electricity bill reconciliation. The generated electricity was credited to the grid during less captive requirement, which should have been adjusted with the consumed electricity. However, the same was not being reflected in electricity bills. This issue was caused by metering fault, which was resolved by MSEDCL officials afterwards. As per ongoing discussion with unit owner, distribution utility officials have assured that the credited electricity will be accounted for in the upcoming electricity bills.

### PWC Analysis

The 40kW solar project is one of its kind due to the superstructure at rooftop in order to achieve better utilization factor, which has also resulted in more financial savings. The good workmanship of execution was also quite evident during the site visit. The project has been performing upto the mark, since plant commissioning and there have been no technical glitches till metering point. MSMEs do not have internal technical capabilities and non-performing of plant can defeat the motivation behind installation. This highlights the importance of selecting technically sound integrator after comparing multiple quotations.

The major challenges faced during the project execution was loan financing paperwork and net-metering.



Banks and distribution utilities should take certain steps to speed up loan approval and net-metering process. Some of these steps can be training of the staff, digital platform for paper-work, follow-ups, and grievance mechanism.

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	17.48
2	Equity IRR	23.34%
3	Project IRR (%)	12.90%
4	Payback Period (yrs.)	Project payback: 6.0
5	Levelised cost of electricity (INR/kWh)	4.14

### 4.3. 102 kW rooftop solar project at B.S. Apparel, Tirupur

#### About The Company

B.S. Apparel is a garment export unit situated at Tirupur Export Knitwear Industrial Complex (TEKIC) at Coimbatore district, Tamilnadu. The unit is headed by Mr. B. Vijayaragavan. The company was founded in 1995 with the mission to reinvent knitted apparels. Its main activities include selection of raw material, knitting, processing and conversion to garments. B.S Apparel offers a comprehensive range of fabric for sportswear, contemporary, loungewear, yoga, maternity, active wear and eco-friendly performance fabrics.

B.S. Apparel aspires to grow in harmony with the environment and the company website also showcases its commitment to sustainability. It says, “We recognise the need for leaving behind a world for the next generation that is a livable, non-toxic environment. In an effort to be a part of this consciousness, we also offer our customers a line of environment-friendly products, free of toxic dyes and synthetic materials. By offering such products in our line as organic cottons, bamboo, soy and recycled products, we reflect a commitment to being a responsible corporate citizen because the best way to have an impact on the environment is to have as little impact as possible”. The company uses bamboo to make fabric. The type of bamboo used is the fast-growing variety—Moso, which can reach a mature height of 75 feet in just 45 to 60 days. This bamboo absorbs greenhouse gasses, releases oxygen, doesn't need replanting or fertilisers and its roots are very good at stabilising erosion-prone soil. Hence, they are contributing their bit towards eco-friendly measures.

They provide various facilities such as central warehousing, cutting, knitting, product development and sewing. Material such as yarn, fabric, accessories and garments are stored in the efficiently designed warehouse, which ensures easy traceability and better storage for materials. They also boast of an in-house design studio with qualified designers who are aware of worldwide fashion trends as well as meet customers' design requirements.

The major machines used by units are knitting machines and sewing machines such as overlock machines, flat seamers, bar tacking machines, zigzag machines etc. Total connected load of the facility is 112 kW.

The company website <http://bsapparelindia.com/> can be visited for more details about the company, its product and services.

#### About Solar Rooftop Project

B.S. Apparel installed a 102 kW solar rooftop system on their garment export unit at 23-27, SIDCO, Mudalipalayam, Tirupur, SIDBI is the financier of the project and Sun Capture is the system integrator. The 102 KW RTPV project was commissioned on 1 April 2015.

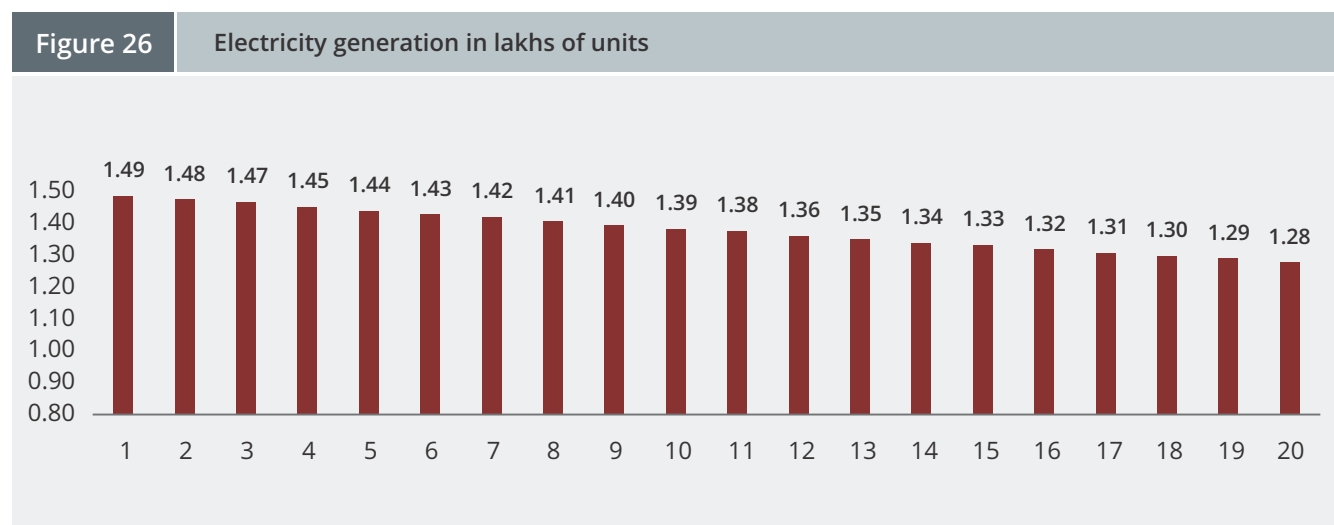
The project is executed on the company's roof top and the module orientation is from north to south to achieve shadow free south facing array. The total roof area is approximately 3,000 sq. m. The modules installed are polycrystalline of Jinko make and the inverters are STP 20,000 TL/EE type of SMA make.

The company is accruing financial benefits in terms of accelerated depreciation and tariff differential between grid and solar project tariff.

Figure 25 shows the solar project at rooftop of B S Apparels:



Figure 26 depicts electricity generation from solar project in lakhs of units.



The annual solar generation from 102 kW solar project is approximately 1.5 lakhs, which is supposed to reduce in coming years due to deration of the solar modules as shown in the Figure 26.

#### Motivation of installation

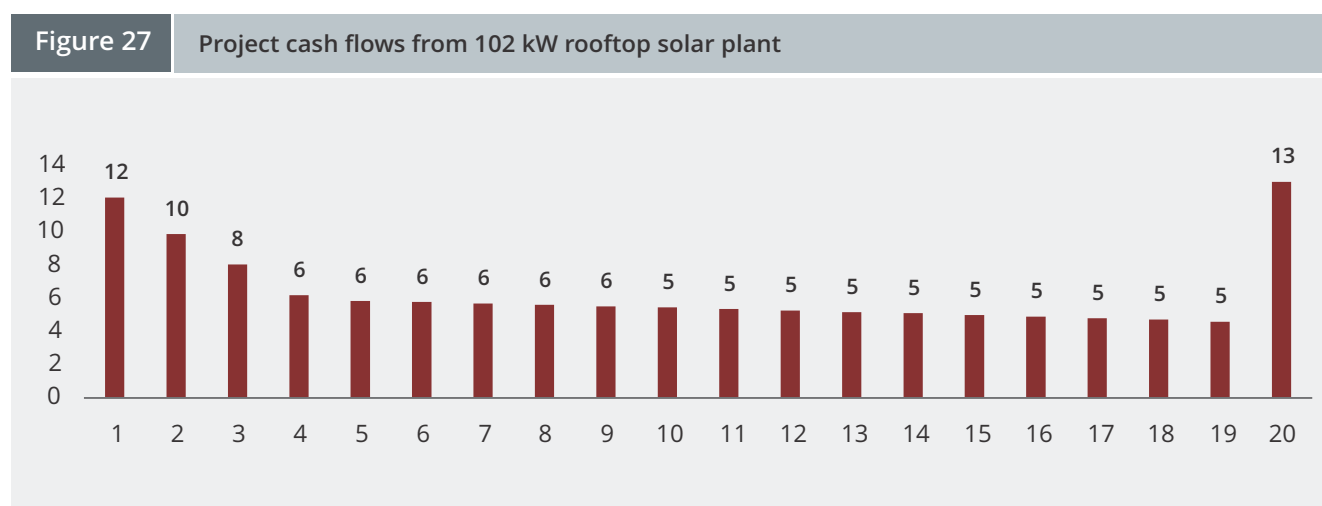
As per discussion with unit owner Mr. Vijayaragavan, green energy was the major source of motivation for installation of the power plant and to contribute something towards the planet.

The company installed 102 kW solar project at rooftop of its export unit in 2015, which accrued benefits in terms of electricity savings. B S Apparel imports electricity from Tirupur Export Knitwear Industrial Complex (TEKIC), which is an industrial estate with 180 member units—all small and tiny units and low-tension (LT) power consumers—which have located their manufacturing facilities in the TEKIC estate at Mudalipalayam near Tirupur. Mr. B. Vijayaragavan says “Green power is very important for reduction of pollution and cutting down on thermal energy helps us achieve the objective of sustainable growth in a big way”.

TEKIC has set up 5 MW wind project Mudalipalayam, near Tirupur, Coimbatore and the electricity tariff from the wind plan is INR2.7/kWh as compared to INR6.90/kWh from TNEB (TamilNadu Electricity Board). TEKIC charges INR5.95/kWh for electricity consumed and pays INR6.50/kWh for the import of electricity from BS Apparel solar project. The 102 KW plant will definitely not suffice to meet the requirements but it's a start and will surely help in bringing the expenses down to some extent.



Figure 27 depicts total project cash flows after adjusting savings in electricity bills, tax adjustments, O&M expenditures:



### Execution of the project

B.S. Apparels awarded the contract on turnkey basis to a local solar project integrator Sun Capture India Private Limited. Quotations were invited from multiple integrators for price benchmark; however, EPC work of 102 kW project was awarded to Sun Capture on the basis of competitive pricing and past EPC experience. The integrator started the installation in March 2015 and the project got commissioned within one month, i.e. April 2015.

The project is executed on the flat roof and the module orientation is north to south to achieve shadow free south facing array. The solar modules are poly crystalline of Jinko make (255 kWp each) and the inverters are string type of SMA make having STP 20,000 TL/EE specifications. The mounting structure is of seasonal tilt type with options of 120 and 300 tilts.

Figure 28 shows inverter installation and the rooftop project at B S Apparels:



### Financing Of The Project

SIDBI Tirupur funded B S Apparels for the solar project under preferred customer scheme. The total project cost of the 102 kW solar project is INR70 lakhs out of which SBI funded INR59.5 lakhs which is approximately 85% of the total project cost. The loan terms are: 13.0% interest rate and 5 years of repayment. The bank has been regular financier of SIDBI for its business-related requirement and funded the solar project on the basis of previous good relationship and repayment history. B S Apparels also provided collateral guarantee which got adjusted in the existing business loans with SIDBI.

Table 13 depicts project loan terms:

Table 13		Project loan terms		
Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
SIDBI	85% - 15%	5 years	0 year	13%

### Project Performance

The solar project was commissioned in April 2015 and electricity output is in line with the expected generation, since the commissioning. Expected solar generation from the project was 400 units per day and solar generation achieved is in the range of 380-420 units per day in most part of the year. O&M for the project was awarded to Inspire after O&M was carried out by Sun Capture for the initial year. Solar panel are being cleaned regularly twice a month by the O&M contractor. Inspire officials also monitor plant performance data and visit the solar facility on a quarterly basis on their own, in order to ensure regular tests such as string check, AC side error check etc. Inspire will also make annual visit to ensure regulatory compliance of the solar project.

B.S. Apparels have an Annual Maintenance Contract (AMC) with Inspire for a fee of INR50,000. However, they have not provided any kind of plant performance warranty to B.S. Apparels.

The solar project was commissioned in April 2015 and owner is satisfied with the electricity generation of the plant. Solar panels are being cleaned regularly once in 15 days and the inverters are being shut off on national holidays to avoid wastage of electricity, since there is no provision of net metering. The owner faced some concerns post commissioning of the plant as there was frequent breakdown due to earthing issues, which has been resolved now. There is a weekly power shedding for 10-15 minutes and a monthly power shedding for a whole day. Moreover, the project being a rooftop project also provides cooling effect and lowers the temperature of the rooms below.

### Major Challenges Faced

Mr. B. Vijayaragavan faced a major challenge regarding financing of the plant, which got delayed from the bank and the owner had to put up the complete plant on its own equity and the loan disbursement only happened after 40 days of the commissioning of the plant. Another major concern of the owner is unattractive loan terms i.e. high rate of interest on the loan, which is 13% (very high for solar installations) and only 5 years of repayment period even under the preferred customer scheme.

As per current norms, TNEB does not allow export of electricity into the grid for LT consumers; hence, many interested people are unable to put up rooftop solar PV plants. B.S. Apparel procures electricity from TEKIC and does not have any net metering facility; hence, solar project remains shut down during holidays.

There were no specific challenges on execution of the project as the integrator provided good EPC services. The plant is running smoothly and generating expected electricity as the O&M contractor is providing efficient and timely services.

### PWC Analysis

The rooftop solar project at B.S. Apparels has shown good demonstration effect and several unit owners have visited the project. The motivation for installation primarily came from the owner's zeal to install green power and his drive to reduce the pollution rather than the financial savings from electricity generation. Selection of technically sound integrator and a reciprocative O&M contractor is a major step in this direction, which can ensure good EPC work and performance of the plant later on.

MSME financing is based on unit owner's relationship with the bank and repayment history. This works well for MSMEs who have existing business loans with MSMEs. There is a need to bring down the interest rate for solar installations, which is very high at 13% as compared to other parts of the country. Moreover, the loan approval process needs to be expedited as unit owner had to depend on self-funding and the disbursal happened only

after 40 days of the commission of the plant. Early communication of all paper work requirement through online portal can be one such step to start with.

Furthermore, TNEB needs to make some provisions for LT consumers such that they can feed the electricity into the grid, which is a major obstacle preventing people from installation of solar plants even when they are interested to do so.

The financial performance of the solar projects is summarised in the table 14:

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	60 Lakhs
2	Equity IRR	11.36%
3	Project IRR (%)	11.20%
4	Payback Period (yrs.)	6.97
5	Levelised cost of electricity (INR/kWh)	4.06

#### 4.4. 95 kW (35kW + 20kW + 40kW) rooftop solar project at Hi-Life Labels, Tirupur

##### About The Company

Hi-Life Labels is a cloth label manufacturing unit situated at Tirupur, Tamil Nadu. The company was founded in 1986 by Mr. Saravanasamy Mahendiran at Dharapuram. It was relocated to Tirupur during 1987 and now all manufacturing activities are carried out at Tirupur and Karur in Tamil Nadu, India. The company manufactures and supplies woven, printed labels, stickers, offset printed tags, folders, paper bands, EAS stickers, polyester woven motifs, woven calendars, wall hangings, tea coasters, miniature carpets and eco-friendly cotton bags. Hi Life Labels has a wide range of machines such as flexo, letterpress and offset printing machines, online UV coating, die cutting, lamination, corona treatment, hot foil stamping to facilitate both sides printing on self-adhesive paper (pressure sensitive) and labels. Total connected load of the facility is 100 kW. The company is committed to clean and green environment. It operates windmills of 2x250Kva and rooftop solar plant of 95Kwp. They generate 300% more green energy than the requirement and the excess energy is supplied to the electricity grid.

The company website <http://www.hilifelabels.in/> can be visited for more details about the company, its product and services.

##### About Solar Rooftop Project

Hi-Life Labels installed a 95 kW solar rooftop system on their label manufacturing unit at 218, Palladam Kunnangalpalayam Pirivu, Tirupur, Tamil Nadu. The project was installed in 3 phases i.e. 35kW in 2012, 20kW in 2013 and 40kW in 2015. Union Bank of India is the project financier of the project and Solar Corona Energy Pvt. Ltd. is the system integrator.

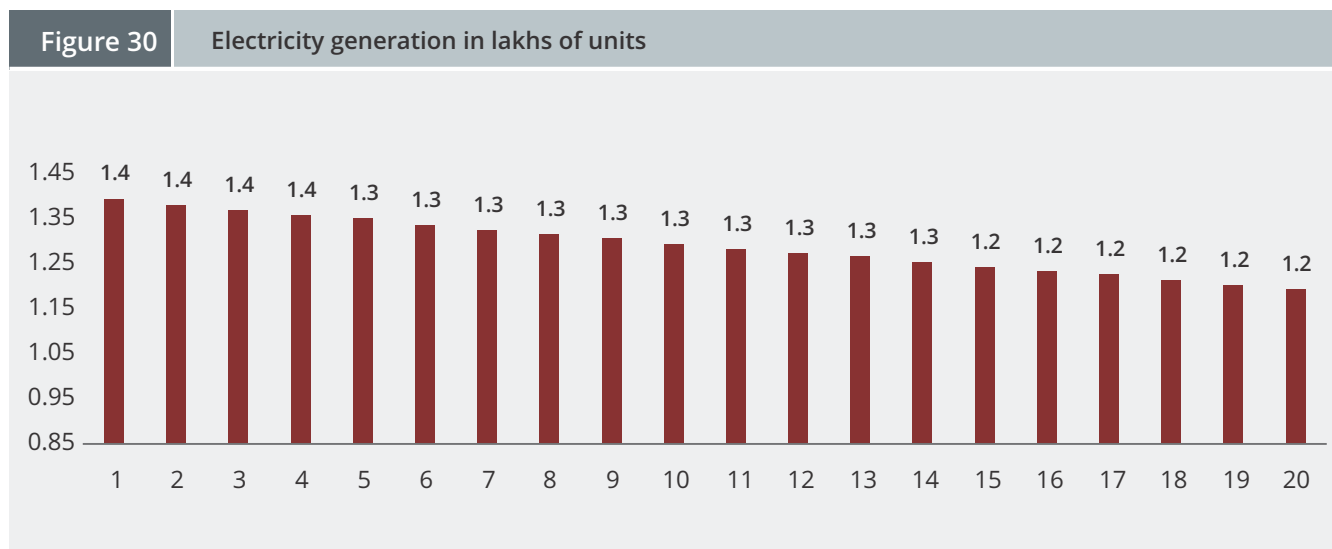
The project is executed on the metal shed roof with a southward slope of 8 to 10 degrees. Total rooftop area is 400 sq.m. The modules installed are of two type i.e. monocrystalline modules of Renesola make and Polycrystalline module EMMVEE make, respectively. Inverters installed are string type of Refusol make.

The company is accruing financial benefits in terms of accelerated depreciation and tariff differential between grid and solar project tariff.

Figure 29 shows the solar project at rooftop of Hi-life labels:



Figure 30 depicts electricity generation from solar project in lakhs of units.



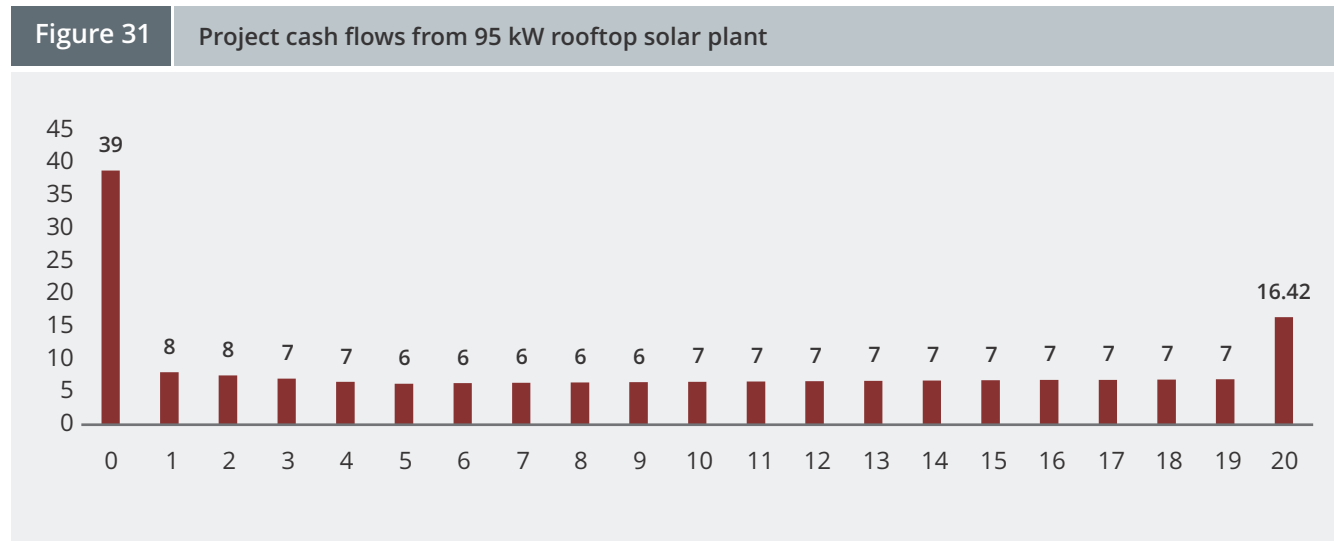
The annual solar generation from 95 kW solar project is approximately 1.38 lakhs, but that is supposed to reduce in coming years due to deration of the solar modules as shown in the graph above.

#### Motivation of Installation

Mr. Mahendiran, unit owner says “We installed first solar project of 35 kW to meet regulatory compliance by TNEB to meet 6% Solar RPO. Good plant performance and diesel savings motivated us to expand up to 95kW. Currently, we are planning to go for an additional 15 kW capacity.” As per discussion with Mr. Mahendiran, the motivating factor behind the first 35kW solar project installation in 2012 was TERC's regulatory compliance. However, he decided to expand the project in the next few years as a result of his savings from reduced diesel bills, AD benefits and green image of the company. In 2012-13, load shedding in the Tirupur industrial cluster was quite frequent hence, industries were dependent on diesel generator to secure electricity for operational needs. The company installed an aggregate of 95 kW solar project at the rooftop of its export unit in three phases i.e., 35kWp 2012, 20kWp 2013 and 40kWp 2015. The overall value proposition of the rooftop solar project convinced the unit owner to expand even further and discussions on an additional 15kW solar project are going on between him and EPC players.



Figure 31 depicts total project cash flows after adjusting savings in electricity bills, tax adjustment, O&M expenditures:



### Execution of the project

Hi-Life Labels awarded the contract on turnkey basis to a local solar project integrator, Solar Corona India Private Limited. Quotations were invited from multiple integrators for price benchmark; however, EPC work of the project was awarded to Solar Corona on the basis of good rapport. Solar Corona executed the first project of 35 kW with good workmanship. Hence, EPC for remaining project capacity was also awarded to them. The integrator started the installation in March 2015 and the project got commissioned within one month i.e. April 2015.

The project is executed on the metal sheet roof and the module orientation is north to south at 8-10 degrees to achieve shadow free south facing array. The modules installed are of two type i.e. monocrystalline modules of Renesola make and Polycrystalline module EMMVEE make respectively. String type inverters of Refusol make are installed.

The inverters are string type of Refusol make. The solar project has fixed type concrete GI Vertical mounting structure

Figure 32 shows inverter installation and the rooftop project at Hi-Life Labels:



### Financing Of The Project

Union Bank of India, Tirupur funded Hilife labels for the solar project. Total project cost of 95 kW solar project is 95 Lakhs and SBI funded Rupees 80.75Lakhs which is approximately 85% of the total project cost. The loan terms are: 11.5% interest rate and 5 years of repayment. The loan was approved within 5 working days of filing application. The bank has been regular financier of UBI for its business related requirement and funded the solar project on the basis of previous good relationship and repayment history. Hilife labels also provided collateral guarantee which got adjusted in the existing business loans with UBI.

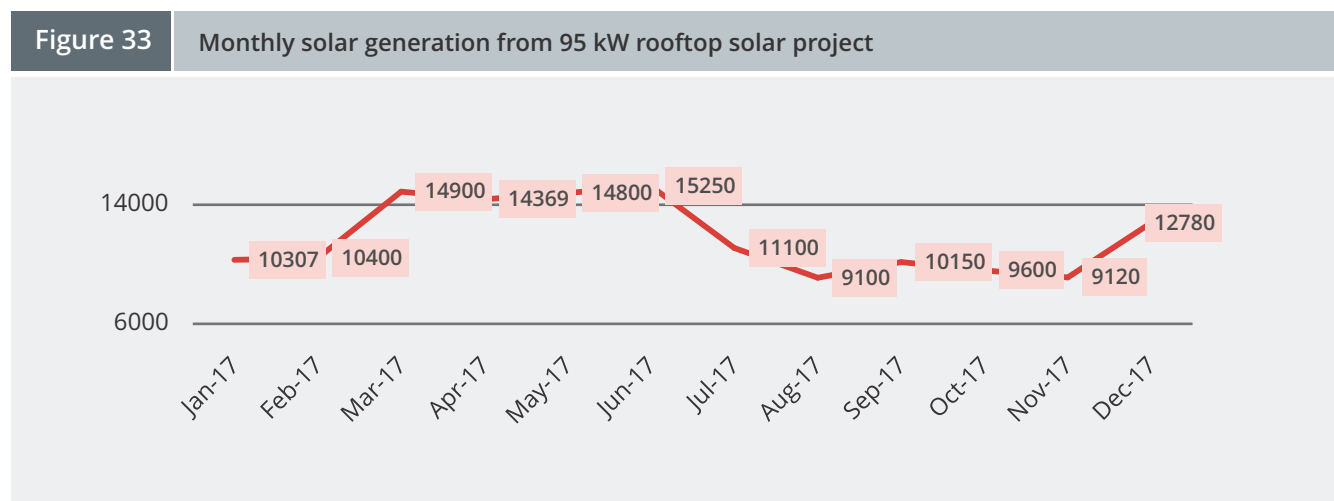
The table 15 below depicts project loan terms:

Table 15		Project loan terms		
Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
Union Bank of India	85% - 15%	5 years	0 year	11.5%

### Project Performance

The aggregated solar project capacity of 95kW has been operational since 2015 and electricity output is in line with the expected generation. Total solar generation achieved from the project is 450+ unit per day during summers. Officials from solar project EPC Solar Corona visit the unit every quarter to do checks such as electrical connections, generation details, load side problems etc.

Hilife label takes care of the module cleaning which happens twice a month. The solar generation figure for calendar year 2017 is shown in Figure 33.



### Major Challenges Faced

The solar project is being used as captive and net-metering facility is not available. Hence, the electricity generation on public holidays and weekly unit holidays are not utilised. The plant generally runs for 330 days a year hence solar generation for remaining part of the year goes down the drain. As per current norms, TNEB does not allow export of electricity into the grid for LT consumers this results in financial losses to the company as electricity gets wasted. Many interested people are unable to avail net metering facility. There were no specific challenges on execution of the project as the integrator provided good EPC services.

### PWC Analysis

HiLife Labels installed 35kW rooftop solar project in Tirupur when there were no success stories of solar project and few solar integrators. The unit owner Mr. Mahendiran went ahead with the project to meet 6% solar purchase obligation as per Tamil Nadu Solar Energy Policy of 2012. He decided to expand the project in



upcoming years as a result of his good experience, savings from reduced diesel bills, AD benefits and green image of the company. There were no specific financial or technical challenges in project execution and commissioning. The unit owner also mentioned his plan to add 15 kW solar capacity, however, he was unaware of the recent decline in solar EPC prices. In such case, it becomes important to get solar EPC quotation from multiple solar integrators. Furthermore, TNEB needs to make net metering provisions for LT consumers so that they can feed the excess electricity generated into the grid, since that is a major obstacle preventing industrial consumers from installation of solar plants even when the value proposition is strong.

The financial performance of the solar project are summarised in Table 16.

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	95
2	Equity IRR	10.01%
3	Project IRR (%)	10.20%
4	Payback Period (yrs.)	8.40
5	Levelised cost of electricity (INR/kWh)	5.02

#### 4.5. 66 kW rooftop solar project at Sharma Industries, Jodhpur

##### About The Company

Sharma Industries is an award winning manufacturer, supplier and exporter of Indian handicrafts, contemporary and modern furniture, jewellery items, decorative and gift articles. The company was founded by Mr. LN Sharma and is currently being managed by his sons, Mr. Manoj Sharma and Mr. Praveen Sharma. Its present activities includes manufacturing and exports of high quality contemporary furniture, giftware, accessories in wrought iron and wood. The company presently operates 4 manufacturing units in Jodhpur. All four units have been fitted with solar rooftop systems to cater to its captive demand.

As manufactures of wood and wrought iron good, they house a large team of artisans like blacksmiths for Forging and Hot working, arc and gas welders, machine man and Machiavellian painters. The key activities that consume power include wood and metal cutting, grinding, polishing, and heating ovens apart from lighting and cooling.

The company website <http://sharmaindustry.com/> can be visited for more details about the company, its product and services.

##### About Solar Rooftop Project

Mr. Praveen Sharma is an experienced investor in renewable energy projects, having realized the economic and environmental benefits of solar power much before it became popular. Sharma industries has installed rooftop solar projects at all four manufacturing units of the company. The project covered in this case study is a 66 KW solar rooftop project with net metering on Unit 3 of Sharma Industries located at 115, Tanawra, Sangariya, Jodhpur, Rajasthan. The project was financed by Canara bank and commissioned by Pioneer power systems. The project was commissioned on 1st September, 2016 and net metering permission was received on 27 October, 2016.

Due to the unfavorable orientation of the roof, the project is executed with an elevated module mounting structure to achieve true south orientation. True south orientation allows the project to maximize its CUF (Capacity Utilization Factor) thus offsetting the higher cost of elevated module mounting structure. The modules installed are polycrystalline of Trina make and the inverters are Zerversolar maker.

The 66 KW system caters to 45% of the company's connected load whose total electricity requirement is primarily met through the solar project. Infact, in certain months where the load is lesser than peak season, the

generation and export of solar power exceed the imported energy from the grid thus highlighting the benefit of net-metering. The company is accruing financial benefits in terms of accelerated depreciation and savings in electricity bills.

The annual solar generation from 66 kW solar project is approximately 98000 units which is partly consumed at site. The excess generation is exported into the power grid under the net metering scheme. The imported and exported units are reconciled at the end of each month to arrive at the net power bill.

Figure 34 shows the solar project at rooftop of Sharma Industries Unit 3:

**Figure 34** 66 KW rooftop solar project at Sharma industries Unit 3 - Jodhpur



#### Motivation of Installation

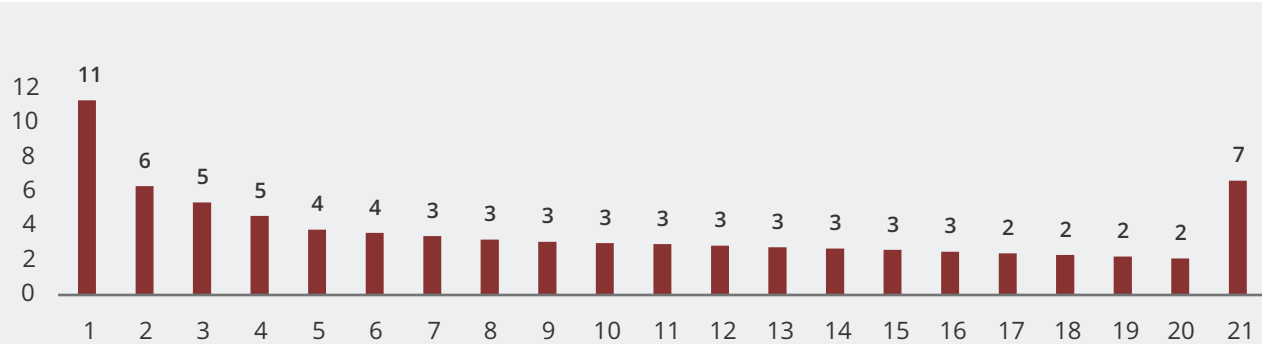
As per discussion with unit owner Mr. Praveen Sharma, savings was the major source of motivation for installation of the power plant along with the contribution towards the planet to keep it green.

The company installed 66 kW solar project at rooftop of its unit 3 in 2016 which accrued benefits in terms of electricity savings. This was the chief motivation factor for the owner as most of his expenses were due to electricity costs of the unit. He was pleased that along with the savings in monetary terms he could also contribute towards the environment through clean energy generation. As electricity used in oven, dryer and other machinery contributed the highest share of utility expenses, Mr. Sharma planned to install rooftop solar as one of the measures to tackle such high expenditures on electricity cost.

Currently, JDVVNL tariff charged for electricity is Rs. 6.50/kWh whereas the unit cost of energy through solar installations comes out to Rs. 3.11/kWh resulting in the saving of almost Rs. 3.39/kWh for Sharma Industries. The total electricity requirement of the unit is approximately 162500 kWh/year. The 66 kW plant does not suffice to all of the electricity requirements but has surely helped in bringing the expenses down to a significant extent. The plant generated savings of more than 97921 units (approximately INR705, 000/annum) on the annual electricity bill last year, translating into a payback of 6.09 years on the current tariff.

Figure 35 depicts total project cash flows after adjusting for savings in electricity bills with a projected inflation of 2% in tariffs, tax adjustment, O&M expenditures:

**Figure 35** Project cash flows from 66 kW rooftop solar plant



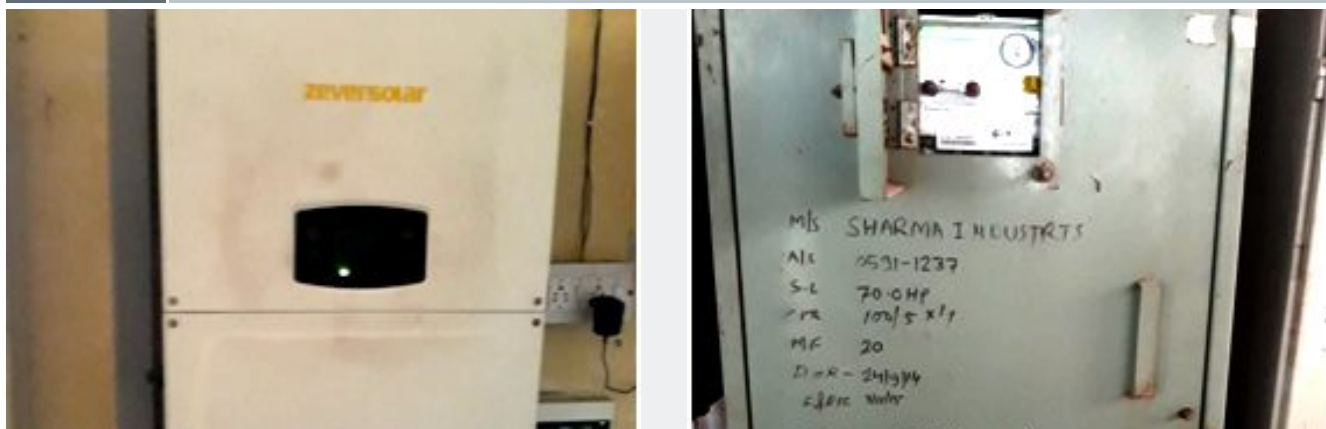
### Execution of the project

Sharma Industries awarded the contract on turnkey basis to a Jaipur based solar project integrator named Pioneer Power Systems. The integrator was recommended by one of the unit owners' contacts and was selected based on the technical expertise. The integrator had prior experience in installation of multiple rooftop and ground mounted solar projects with cumulative rooftop installations of more than 15 MW, and more than 200 MW ground mounted projects with major presence in Rajasthan. Quotations were invited from multiple integrators for price benchmark however EPC work of 66 kW project was awarded to Pioneer. The unit owner is satisfied with the quality of installation and components supplied by the integrator. The integrator had to submit test certificates for all the critical components. As a prudent measure, the payment terms were set such that the final payment of 10% was subject to the plant performance monitored over a duration of one year. The performance of the plant has been in line with the expectation and the final payment has been released to the integrator. The integrator started the installation in July 2016 and the project got commissioned within one month i.e. August 2016.

The project is executed on the roof with an elevated structure to obtain true south orientation to maximize the generation. The solar modules are poly crystalline of Trina make, TSM -315 (315 kWp each) and the inverters are string type of Zerversolar make with individual rating of 15 KVA. The module manufacturer is a Tier-1 manufacturer. The modules are mounted on the roof shed using aluminum structure, thus ensuring longer life. The data from the plant can be accessed remotely and is routinely monitored along with other three plants at Sharma Industries HQ. Moreover, adequate safety measures like lightening protection rods, walkways and fire extinguishers have been provided to ensure worker and plant safety. The integrator has also provided water hoses at regular intervals for easy cleaning of modules.

Figure 36 shows inverter installation and the rooftop project at Sharma Industries:

**Figure 36** Inverter installation and net meter installation of Unit-2 rooftop projects



### Financing Of The Project

Canara Bank, Jodhpur funded Sharma Industries for the solar project not specifically under any scheme pertaining to Solar but just as a regular MSME customer. Total project cost of 66 kW solar project is 52 Lakhs and Canara Bank funded Rupees 39 Lakhs which is approximately 75% of the total project cost. The loan terms are: 9.5 % interest rate and 8 years of repayment period. The bank has been a regular financier of MSMEs for its business related requirements and funded two solar projects, another one being at Vyas College. The bank has been proactive to lend for solar projects and carried out local advertisement campaigns and customer meetings to encourage financing for solar. However, no major interest was shown from the cluster regarding solar installations. They also requested the Head office to make a solar specific financing product enabling ease in financing but of no avail. Canara Bank did not carry out technical due diligence due to small size of the projects. The loan was disbursed to Sharma Industries within 10-15 days of their application and simultaneous to their project installation and 1 year repayment has already been done.

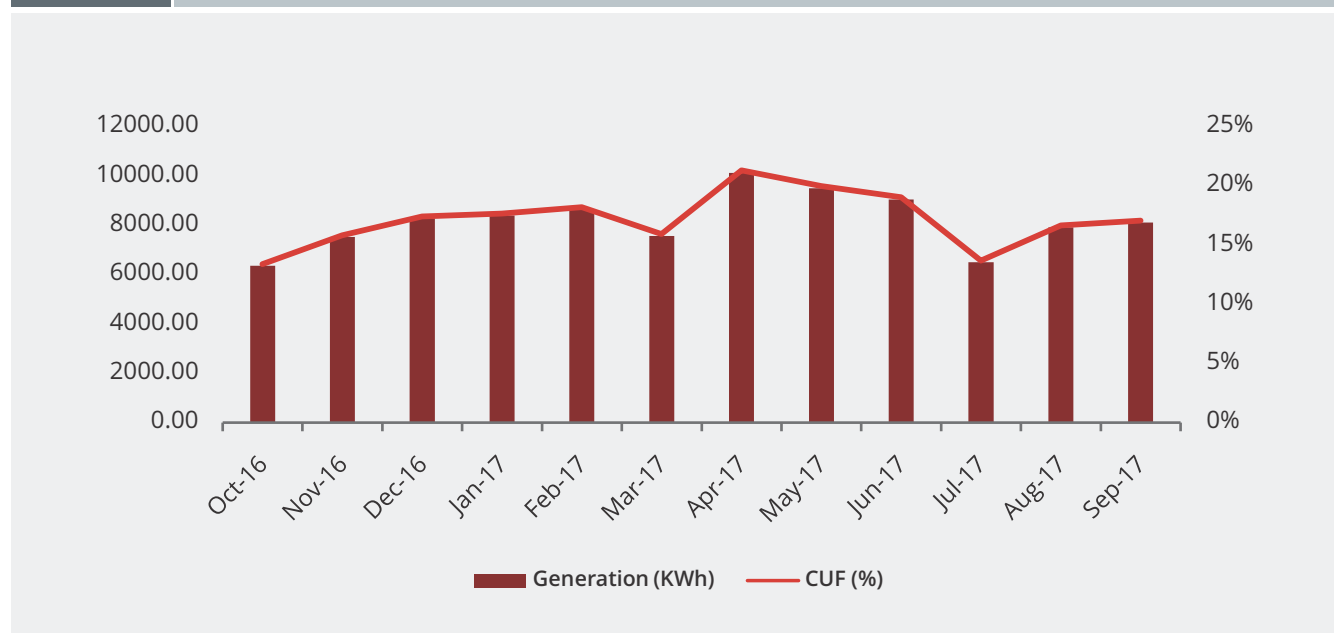
Table 17 depicts project loan terms:

Table 17		Project loan terms		
Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
Canara Bank	25:75	7 years	0 year	9.5%

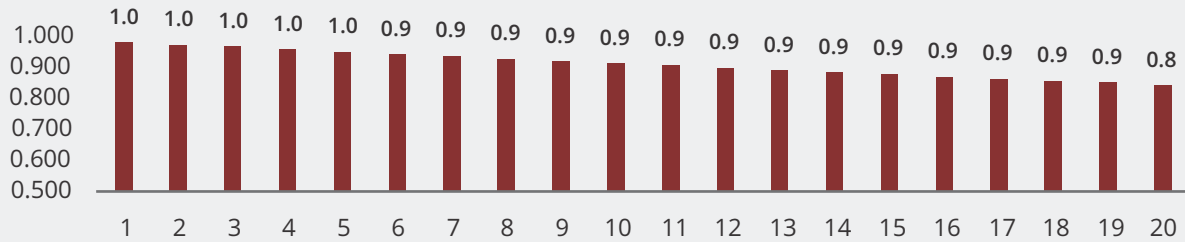
### Project Performance

The solar project was commissioned in August 2016 and electricity output is in line with the expected generation since the commissioning. The plant performance has been satisfactory and the actual generation is meeting the expected figures of 7000 – 9000 units per month (as shown in Figure 37). O&M for the project was not awarded to a third party firm and a qualified electrician has been employed full time to take care of the O&M through his labor to save cost. Solar panels are being cleaned regularly on a half monthly basis and remote monitoring is done which ensures damage control in case of any malfunctions. One person is specifically engaged for remote monitoring who monitors plant performance data on a regular basis.

Figure 37 Monthly solar generation from 66 kW rooftop solar project



**Figure 38** Annual solar generation from 66kW rooftop solar project



The solar project has performed beyond expectations and owner is extremely satisfied with the electricity generation of the plan. In Mr. Sharma's words, this project has helped him in lowering his electricity expenses by 55–60%. Moreover, the project being a rooftop project also provides glazing effect and helps in lowering the temperature of the rooms below.

The owner said that he definitely recommends solar rooftop project to the people who come to visit his plants as the saving are enormous and he has also availed the AD benefits from the plant. He generally expects 18% IRR from his investments which he is effectively getting from these solar plants. The projects have a high demonstration effect in the vicinity, with many unit owners visiting the plant to examine the working of a rooftop solar plant. As a consequence, 1.5 – 2 MW has already been installed by the people who have visited the site.

#### Major Challenges Faced

Mr. Praveen Sharma didn't face any major challenge regarding financing of the plant, which got disbursed during the installation within 10–15 days of his application for the loan and the officials from Canara Bank were very supportive in ensuring effective disbursement of the credit.

One of the major concerns is that since the plant is situated in a rural area outside Jodhpur, the local substation officials do not have the necessary meter reading equipments to take readings from the net meter. Owing to this, the bills are prepared manually. The issue was put up with the DISCOM HQ in Jodhpur. The DISCOM officials responded promptly and issued an internal note for procurement of suitable meter reading instruments, which will be available within 2 or 3 months.

The other issue which arose was the shutdown of inverter which started clipping automatically as soon as they attained 30% output. This was noted in the initial stage itself without any significant losses due to effective remote monitoring by Mr. Sharma. The problem got rectified immediately with the support from the developer, which was excellent.

Mr. Sharma also stressed on the fact that reduction in Accelerated Depreciation (AD benefits) from 80% to 40% by the government may slow down the in deployment of solar rooftop plants, even though the interest regarding the same is massive. There were no specific challenges on technical part and even during execution of the project as the integrator provided good EPC services.

#### PWC Analysis

The rooftop solar project at Sharma Industries has shown good demonstration effect and a lot of people have visited the project. Another 1.5 – 2 MW has already been installed in the vicinity by the people who have visited his plants. A 500 KW project has been installed on DPS, another 250 KW on a chemical and mineral factory nearby and a 200 KW at Thar and a 200kW at Thar Industries.

The motivation for installation came from the electricity savings through installation which the owner has realized to be in the range of 60–65%. In addition to the savings, the owner wants to make his unit run on 100% green power since his unit is Export based and the major market of his handicraft items is Europe, and the 100%



green label on the items will further enable him in marketing his products more efficiently, creating a positive impression and diversifying his business to fresh unexplored markets.

The support from government regarding regulatory procedures is exemplary, similarly at the nodal agency. There is no delay in response to applications as they now have a web based totally efficient system and they even resolve the queries through Twitter based response.

Further, banks need to be a lot more serious regarding financing of KW scale solar projects, funding for such projects is very limited despite conducting many awareness programs for solar in Jodhpur. There are a lot of people who want to install rooftop solar projects but are unable to do so owing to cash flow constraints and limited support from banks make them drop the idea. Banks need to develop a specific credit instrument dedicated to financing of solar projects, which is still not available in Jodhpur.

The financial performance of the solar project is summarized in the table 18:

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	39 Lakhs
2	Equity IRR	17.34%
3	Project IRR (%)	12.67%
4	Payback Period (yrs.)	6.09
5	Levelised cost of electricity (INR/kWh)	INR 3.11/KWh

#### 4.6. (33+33) kW rooftop solar project at Sharma Industries, Jodhpur

##### About The Company

Sharma Industries is an award winning manufacturer, supplier and exporter of Indian handicrafts, and is based out of Jodhpur. It manufactures contemporary and modern furniture, jewellery items, decorative and gift articles. It is an export oriented unit catering to European market, and was founded by Mr. L.N Sharma. His sons, Mr Manoj Sharma and Mr. Praveen Sharma manage the company now. Sharma Industries was felicitated by a National Award from Government of India which was presented by the President of India for the year 1987. The company presently operates four manufacturing units in Jodhpur, with a total area of more than 7500 square meters. All the four units have been fitted with solar rooftop systems to cater to their captive demand.

As manufacturers of wood and wrought iron good, they house a large team of artisans like blacksmiths for Forging and Hot working, arc and gas welders, machine man and Machiavellian painters. The key activities that consume power include wood and metal cutting, grinding, polishing, and heating ovens apart from lighting and cooling. The company also has significant investments in wind and solar power plants in Rajasthan.

Total connected load of the facility is 140 HP. The company website <http://sharmaindustry.com/> can be visited for more details about the company, its product and services.

##### About Solar Rooftop Project

Sharma Industries installed a (33+33) kW solar rooftop system on their unit at C-436/437, Marudhar Industrial Area, Jodhpur, Rajasthan. The unit is also known Unit no. 2, and the project is based on net metering mechanism. Sharma Industries has four manufacturing units in Jodhpur, and it has installed rooftop solar projects on all of them. Canara Bank is the project financier of the project and the system integrator is Pioneer Power systems. The (33+33) KW RTPV project got commissioned on 31 August, 2016, and the net metering application was received on 28 September, 2016.

The project has been executed on the GI shed roofs of the two sub-units in Unit 2, with individual capacities of 33kW on each sub-unit. The first sub-unit has a flat shed roof, and the module mounting structure are facing true south with 25° inclination towards true south. The second sub-unit has an east west facing slope, and the

structures have been installed on these slopes with MMS facing south in this case as well. The inclination with the horizon is the same as the first sub-unit. The modules installed are polycrystalline of Trina make and the inverters are of Zeversolar make.

The 66 KW system caters to around 60% of the company's connected load whose total electricity requirement is primarily met through the solar project. The annual electricity consumption of the unit is approximately 1,70,000 units. Infact, in certain months where the load is lesser than peak season, the generation and export of solar power exceed the imported energy from the grid thus highlighting the benefit of net-metering. The company is accruing financial benefits in terms of accelerated depreciation and savings in electricity bills.

The annual solar generation from 66 kW solar project is approximately 1,12,000 units which is partly consumed at site. The excess generation is exported into the power grid under the net metering scheme. The imported and exported units are reconciled at the end of each month to arrive at the net power bill.

Figure 39 shows the solar project at rooftop of Sharma Industries Unit 3:

Figure 39

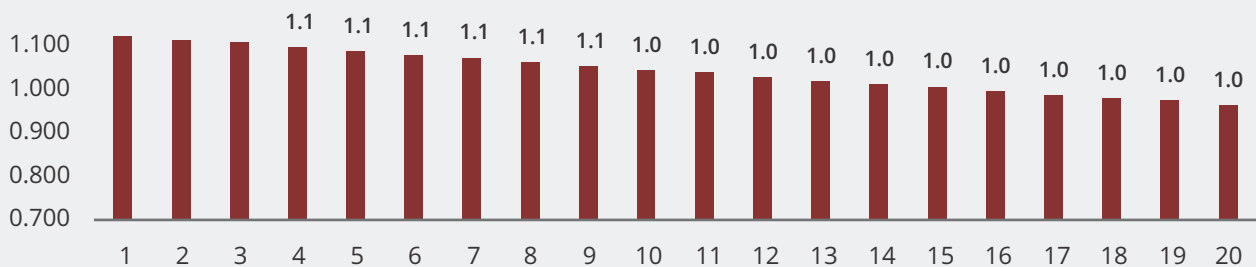
Rooftop solar project at Sharma Industries in Jodhpur



Figure 40 depicts electricity generation from solar project in lakhs of units.

Figure 40

Electricity generation of Unit-2 rooftop solar project on Unit-2 of Sharma Industries



### Motivation of Installation

As per discussion with unit owner Mr. Praveen Sharma, after the introduction of net metering regulations in 2015, one of his contacts M/S Sushil Udhyog was the first unit to install solar rooftop in Jodhpur. Mr. Sharma visited the unit and became convinced on the viability of solar rooftop systems for his units. Thereafter, he decided to install the solar rooftop systems on all the four units. The major driver behind the installation of solar rooftop projects was the savings due to reduction in grid electricity consumption, coupled with accelerated depreciation. Moreover, being an export based industry, maintaining a green image also strengthened the

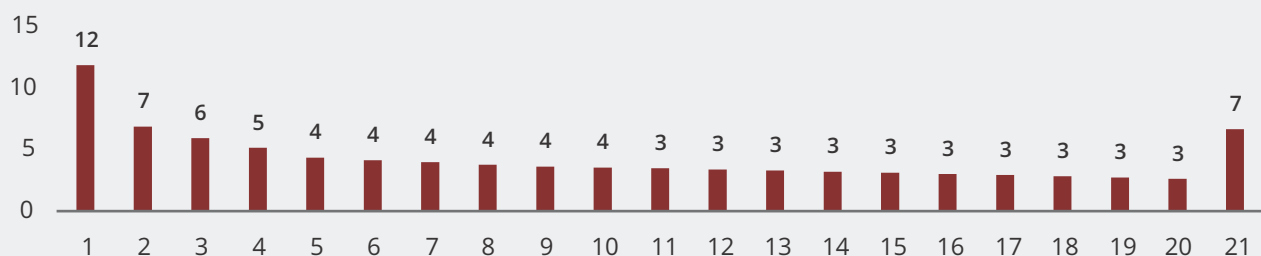
business case of solar rooftop for his units. In fact, the group proprietors have a very positive outlook towards renewable energy, with investments in utility scale wind and solar project. The group has an existing portfolio of (3 x 0.6MW) wind power plants and (0.63MW +2.2MW) solar power plants in Rajasthan.

The company installed 33kW+33kW solar project on the rooftop of its unit 2 in 2016 which accrued benefits in terms of electricity savings. This was the chief motivation factor for the owner as electricity is one of the major operating expenses. He was pleased that along with the savings in monetary terms he could also contribute towards the environment through clean energy generation. As electricity used in Oven, dryer and other machinery contributed the highest share of utility expenses, Mr. Sharma planned to install rooftop solar as one of the measures to tackle such high expenditures on electricity cost.

Currently, JDVNL tariff charged for electricity is Rs. 6.50/kwh whereas the unit cost of energy through solar installations comes out to rs. 3.11/kwh resulting in the saving of almost rs. 3.39/kwh for Sharma industries. The total electricity requirement of the unit is approximately 170000 kwh/year. The 66kw plant does not suffice to all of the electricity requirements but has surely helped in bringing the expenses down to a significant extent. The plant generated savings of more than 1, 12,000 units (approximately INR 7, 28,000/annum) on the annual electricity bill last year, translating into a payback of 5.1 years on the current tariff. Sushil udyog was the first unit in the vicinity on which rooftop solar was commissioned in September'15. The unit owner Mr. Praveen Sharma took inspiration from it and installed solar rooftop in 2016. one of his acquaintances provided him the requisite consultation about usage of solar PV energy.. A lot of people visit his plants for guidance and consultation seeing the successful operation of his plants. Figure 41 depicts total project cash flows after adjusting for savings in electricity bills with a projected

inflation of 2% in tariffs, tax adjustment, O&M expenditures:

**Figure 41** Project cash flows (INR Lakhs) from (33+33) kW rooftop solar plant



### Execution of the project

Sharma Industries awarded the contract on turnkey basis to an integrator Pioneer Power Pvt. Ltd. The integrator had prior experience in installation of kW scale rooftop solar projects and unit owner was satisfied with its works. Quotations were invited from multiple integrators for price benchmark however EPC work of (33+33) kW project was awarded to Pioneer Power. The integrator started the installation in July 2016 and the project got commissioned within a short duration of one month i.e. August 2016.

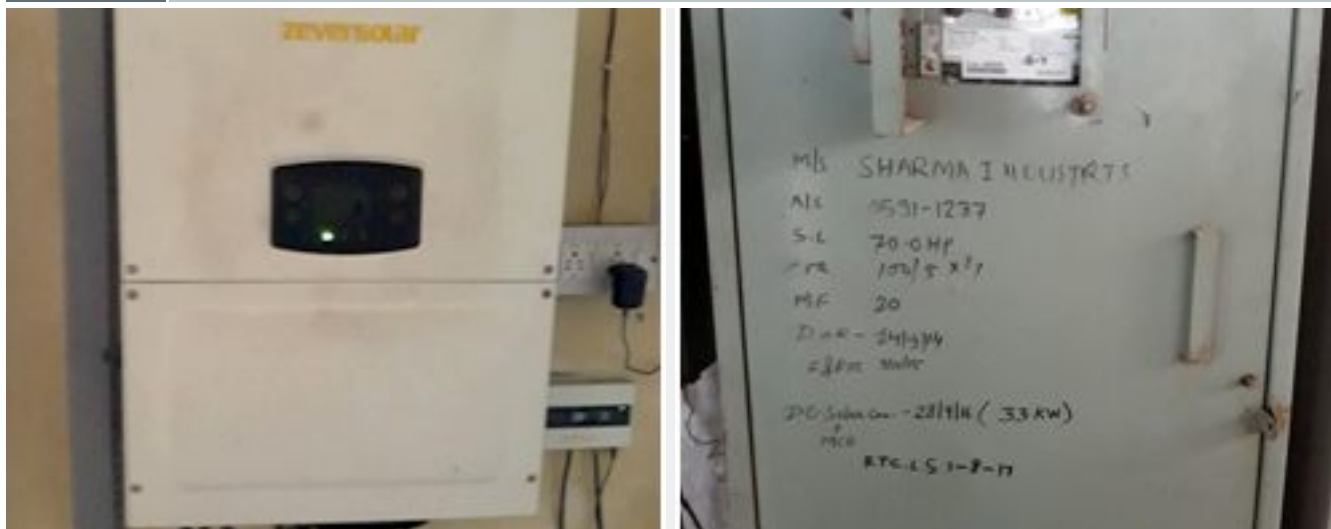
The unit owner is satisfied with the quality of installation and components supplied by the integrator. The integrator had to submit test certificates for all the critical components. As a prudent measure, the payment terms were set such that the final payment of 10% was subject to the plant performance monitored over a duration of one year. The performance of the plant has been in line with the expectation and the final payment has been released to the integrator. The integrator started the installation in July 2016 and the project got commissioned within one month i.e. August 2016.

Pioneer was responsible for complete design, supply, installation, liaising, operation and maintenance of plant. The project is executed on a flat metal sheet roof on the sub-unit 1 (C-436) and on east-west sloping metal sheet roof on sub-unit 2 (C-437). The integrator had maintained a south facing orientation in both the cases, and the modules were tilted at 25° to achieve optimal generation. The solar modules are poly crystalline of Trina

make, TSM - 315 (315 kWp each) and the inverters are string type of Zeversolar make with individual rating of 15 KVA. The module manufacturer is a Tier-1 manufacturer. The modules are mounted on the roof shed using aluminum structure, thus ensuring longer life. The quality of installation is good, from both structural and electrical point of view. The quality of the material supplied by the integrator is also satisfactory, backed by relevant test reports for critical components. The data from the plant can be accessed remotely and is routinely monitored along with other three plants at Sharma Industries HQ. Moreover, adequate safety measures like lightening protection rods, walkways and fire extinguishers have been provided to ensure worker and plant safety. The integrator has also provided water hoses at regular intervals for easy cleaning of modules.

Figure 42 shows inverter installation and the rooftop project at Sharma Industries:

**Figure 42** Inverter installation and net meter installation of Unit-2 rooftop projects



### Financing Of The Project

Canara Bank, Jodhpur funded Sharma Industries for the solar project not specifically under any scheme pertaining to Solar but just as a regular MSME customer. Total project cost of 66 kW solar project is 52 Lakhs and Canara Bank funded Rupees 39 Lakhs which is approximately 75% of the total project cost. The loan terms are: 9.5 % interest rate and 8 years of repayment period. The bank has been a regular financier of MSMEs for its business related requirements and funded two solar projects, another one being at Vyas College. The bank has been proactive to lend for solar projects of existing customers and carried out local advertisement campaigns and customer meetings to encourage financing for solar. However, no major interest was shown from the cluster regarding solar installations. The bank manager had also sent forth a proposal to the Zonal HQ to try to start a separate solar rooftop cell and a solar specific loan product, but it is still under consideration. Canara Bank did not carry out technical due diligence due to small size of the projects. The loan was disbursed to Sharma Industries within 10-15 days of their application and simultaneous to their project installation and 1 year repayment has already been done.

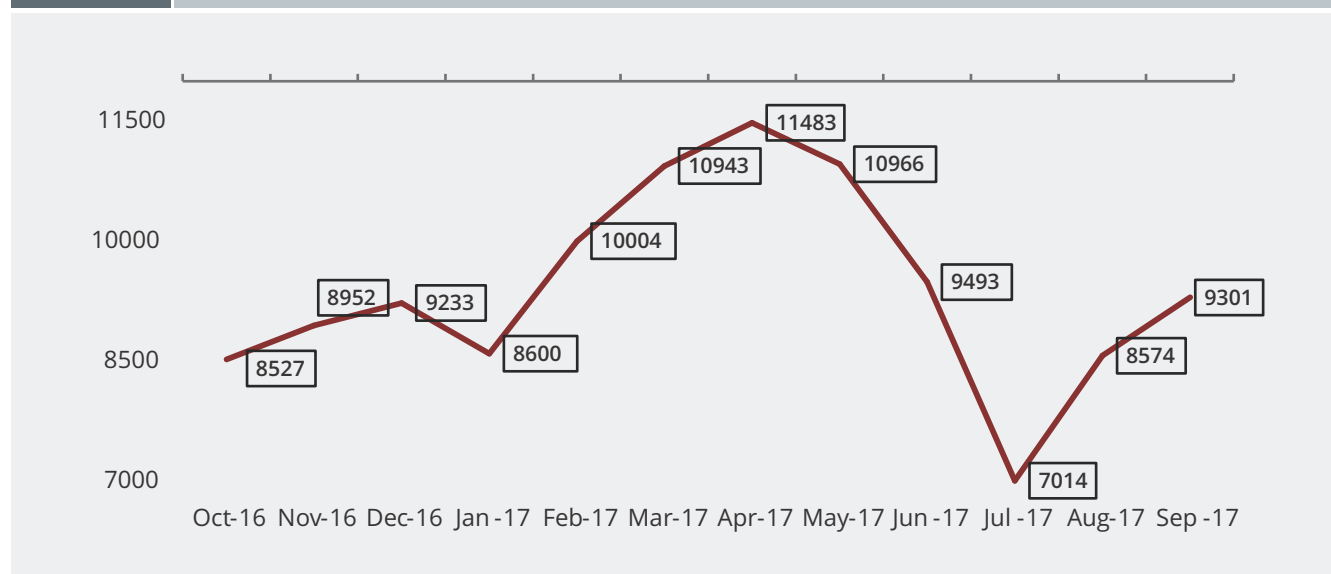
Table 19 shows project loan terms :

Table 19		Project loan terms		
Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
Canara Bank	25:75	7 years	0 year	9.5%

### Project Performance

The solar project was commissioned in August 2016 and electricity output is in line with the expected generation since the commissioning. Expected solar generation from the project was 300–350 units per day and the actual generation achieved is in this range. O&M for the project wasn't awarded to any company and the company has engaged an electrician full time that takes care of the O&M. Solar panel are being cleaned regularly on a half monthly basis and remote monitoring is done which ensures damage control in case of any malfunctions. One person is specifically engaged for remote monitoring only. They also monitor plant performance data on a regular basis for any faults or dip in performance.

**Figure 43** Monthly solar generation from (33+33) kW rooftop solar project



The solar project has performed beyond expectations and owner is extremely satisfied with the electricity generation of the plant. Solar panels are also being cleaned regularly. In Mr. Sharma's own words, this project has helped him in lowering his electricity expenses by 60–65%. Moreover, the project being a rooftop project also provides glazing effect and helps in lowering the temperature of the rooms below.

The owner said that he definitely recommends solar rooftop projects to the people who come to visit his plants as the saving are enormous and he has also availed the AD benefits from the plant. He generally expects 18% IRR from his investments which he is effectively getting from these solar plants. The plants have generated greater interest in solar PV within the cluster, and around 1.5–2MW plants have been installed in the vicinity post the installation.

### Major Challenges Faced

Mr. Praveen Sharma didn't face any major challenge regarding financing of the plant, which got disbursed during the installation within 10–15 days of his application for the loan and the officials from Canara Bank were very supportive in ensuring effective disbursement of the credit.

A key concern which arose was the shutdown of inverter which started clipping automatically as soon as they attained 30% output. This was noted in the initial stage itself without any significant losses due to effective remote monitoring by Mr. Sharma. The problem got rectified immediately with the support from the developer, which was excellent.

Mr. Sharma also stressed on the fact that reduction in Accelerated Depreciation (AD benefits) from 80% to 40% by the government will be a prime hurdle in deployment of solar rooftop plants, even though the interest regarding the same is massive. There were no specific challenges on technical part and even during execution of the project as the integrator provided good EPC services.



### PWC Analysis

The rooftop solar project at Sharma Industries has shown good demonstration effect and a lot of people have visited the project. Another 1.5 – 2 MW has already been installed in the vicinity by the people who have visited his plants. A 500 KW project has been installed on DPS, another 250 KW on a chemical and mineral factory nearby and a 200 KW at Thar.

The motivation for installation came from the electricity savings through installation which the owner has realized to be in the range of 60–65%. Due to prior experience in renewables, the owners followed many prudent practices in vendor selection, contracting, performance benchmarking, O&M, quality control and financing. This has also translated in performance of the plant in line with the expected generation scenario, and the owner did not face any major challenges during project execution and operation. This highlights the need to disseminate best practices for installation of rooftop solar plants for industries and conducting awareness sessions.

In addition to the savings, the owner wants to make his unit run on 100% green power since his unit is Export based and the major market of his handicraft items is Europe, and the 100% green label on the items will further enable him in marketing his products more efficiently, creating a positive impression and diversifying his business to broader markets.

The support from government regarding regulatory procedures has been very good, similarly at the nodal agency. There is no delay in response to applications as they now have a web based totally efficient system and they even resolve the queries through Twitter based response.

Further, banks need to be a lot more serious regarding financing of KW scale solar projects, funding for such projects is very limited despite conducting many awareness programs for solar in Jodhpur. There are a lot of people who want to install rooftop solar projects but are unable to do so owing to cash flow constraints and limited support from banks make them drop the idea. While it is easy for an existing customer to avail loans for rooftop solar plant installation, it is very difficult for new customers to seek financing for rooftop solar projects from banks. Suitable capacity development measures taken at the branch level will help a lot to remove this disparity in financing, as the bank officials will be more confident to assess independent projects. Banks need to develop a specific credit instrument dedicated to financing of solar projects, which is still not available in Jodhpur.

The financial performance of the solar project is summarized in the table 20:

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	39 Lakhs
2	Equity IRR	31.54%
3	Project IRR (%)	15.47%
4	Payback Period (yrs.)	5.10
5	Levelised cost of electricity (INR/kWh)	INR 3.28/ kWh

## 4.7. 100 kW (50kW + 50 kW) rooftop solar project at Somu Group, Bengaluru

### About The Company

The Somu Group, headquartered in Bangalore, is involved in manufacturing of specialty fine chemicals, specialty solvents, pharma intermediates, agro intermediates, cosmetic ingredients and nutraceutical ingredients. It was started in 1973, by Mr. C. Somashekhar (Chairman and MD). The firm is also engaged in importing and acting as distributors for petrochemical solvents, industrial chemicals and packaging products including specialization in hydrogenation under high pressure, esterification and extraction processes.

The Somu Group is divided into 8 different verticals catering to the needs of various industrial segments like pharmaceutical, electronics, construction, chemical, resins, adhesives, paints and coating, engineering, printing, animal feed, sericulture, pesticides and other allied industries. The group has many units primarily spread across Karnataka. It has installed two solar rooftop projects of 50kW each, in one of the units of Somu Solvents & Chemical Co. in Bangalore. The total connected load of the facility is 18 kW. The project has been generating excess of clean energy which is being entirely exported to the grid with very little consumption taking place at the unit.

The company website <http://www.somugroup.com/index.html> can be visited for more details about the company, its product and services.

#### **About Solar Rooftop Project**

Somu Group installed a 100 kW solar rooftop system on their unit near BTM layout, Bangalore, Karnataka. The project was commissioned in 2 phases i.e. 50 kW in 2016 and 50kW in 2017. Although both units were installed at the same time, but the second unit started functioning only in 2017 due to delays attributed to regulatory factors as explained later. The project was originally funded by Axis Bank (however, later HSBC took over the entire loan portfolio looking at the progress of the company) and Global Energy Solutions (GES) is the system integrator.

The facility comprises of warehouses for chemicals and a small office, with space lighting as the major load type. The overall connected electrical load is only 18kW, due to which electricity consumption at the facility is negligible in comparison with the generation from the solar rooftop projects. Due to this, a significant portion of the electricity generated by the rooftop solar plants is fed into the grid, thus generating revenue.

Both the projects have been executed on metal sheds with south facing slope of ~7 degrees and north facing slope of ~5 degrees respectively. The modules are mounted flush with the roof-shed. Total rooftop area for both the projects is 1200 sqm. The modules installed are monocrystalline modules of HHV Solar make: HST 310M. Additionally, string type inverters of Sunny Tripower (SMA STP 20000TL-30) make are installed.

The company is planning to seek financial benefits in terms of accelerated depreciation from this year.

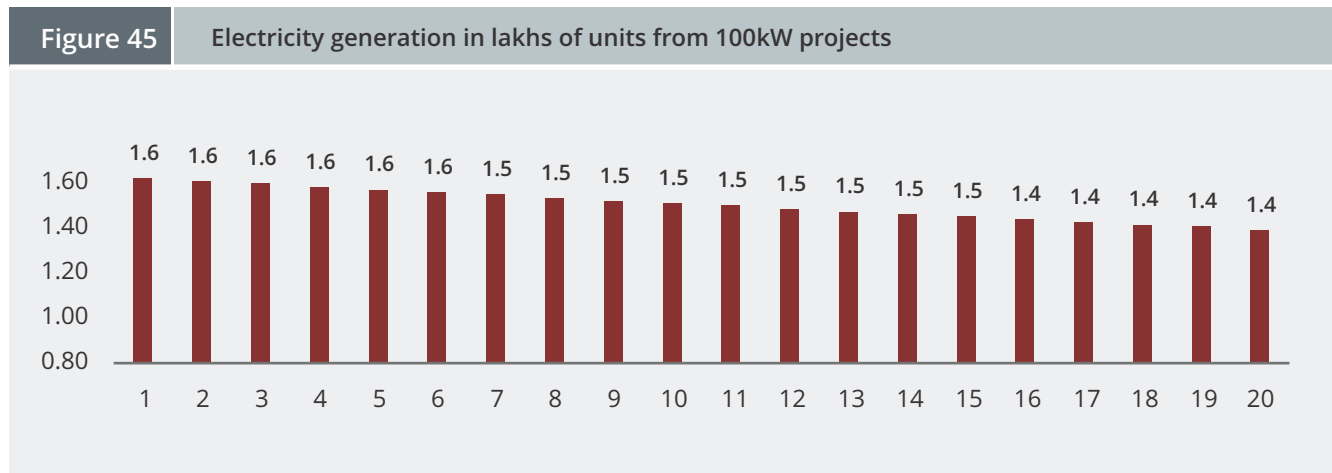
Figure 44 shows the solar project at rooftop of Somu Group:

**Figure 44**

Rooftop solar project at Somu Group packaging unit near BTM layout, Bangalore



Figure 45 depicts electricity generation from solar project in lakhs of units.

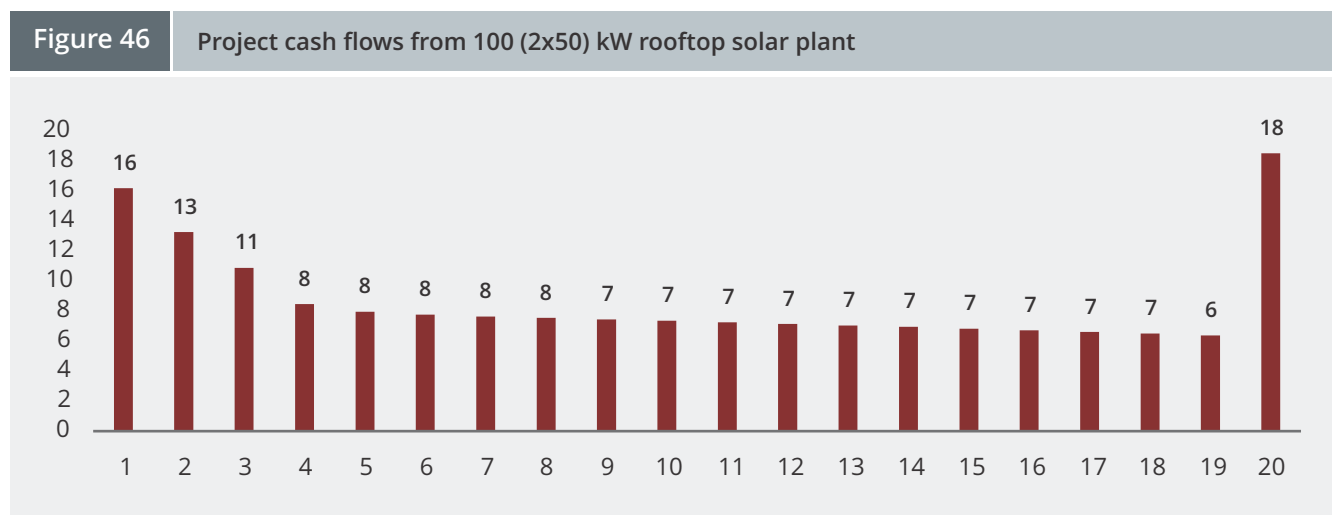


The annual solar generation from solar project is approximately 81,200 kWh per system which is supposed to reduce in coming years due to deration of the solar modules as shown in the Figure 46.

#### Motivation of Installation

As per discussion with the unit owner Mr. Praveen Somashekhar, the motivating factor behind the solar project installation (100 kW) was the attractive solar tariff offered, which made a prudent business proposition. Auxiliary consumption marks a very small proportion of the total solar generation output, and almost the entire energy is fed to the grid. Second, the accelerated depreciation (AD) benefit ensuring tax saving was one of other the key drivers to head for the solar project. (However, they have not been able to claim AD benefit for the second project up to now due to late commissioning of the project, but will do so in the current year). Moreover, the projects were also installed from the point of view of stepping stone for future implementation of solar rooftop projects on other units of Somu Group. Mr. Parmeshwaran, Finance Manager, Somu Group says “For the company, the project return is not a big concern, but payback period should be reasonable to accommodate the high upfront capital investment done initially. The ideal period should be 3-4 years, with an upper threshold limit of 5 years. This was company's first clean energy footprint and hence to a degree the management was initially apprehensive about the solar project performance and payback period as they had no prior technical expertise in this field. However, the unit owner decided to go ahead with a pilot project owing to attractive revenue generating proposition, AD benefits and green image of the company. Currently, each of the solar rooftop project (50 kW) is meeting a different load requirement, 13 kW and 5 kW respectively.

Figure 46 depicts total project cash flows after adjusting savings in electricity bills, tax adjustment, O&M expenditures:



### Execution of the project

Somu Group awarded the contract on turnkey basis to a project integrator named Global Energy Solutions (GES). GES is based out of Bangalore, and has an expertise of installing more than 2 MW rooftop solar projects. GES was responsible for complete design, supply, installation, liaising, operation and maintenance of plant. Somu Group did not undertake a comprehensive procurement process for selection of integrator and GES was directly awarded the contract based on good rapport. The integrator started the installation of the cumulative capacity of 100kW in March 2016 and installed the project within one month i.e. April 2016. However, the actual generation began in Aug, 2016 for the first project, followed by second project in 2017, which was delayed due to regulatory reasons.

The project is executed on the metal sheet roof and the module orientation is north and south at 5 and 7 degrees respectively to achieve shadow free south facing array. The modules are Mono crystalline and HHV Solar –HST 310M make. The module manufacturer is based out of Bangalore, thus ensuring good quality control while manufacturing and service when required. String type inverters of SMA (STP 20000TL-30) make are installed, which have been imported from Germany. The modules are mounted flush with the roof shed on aluminum rafters, while ensuring waterproofing of the shed. The quality of installation is good, from both structural and electrical point of view. The quality of the material supplied by the integrator is also satisfactory, backed by relevant test reports for critical components. project integrator has also ensured supply of excellent quality material prima facie. The data from inverter can be accessed remotely to keep a track of solar plant performance remotely. However, safety measures seemed inadequate for a rooftop solar project, and walkways, lightning arrestors, staircase etc need to be installed to ensure worker and plant safety. The other issue encountered at the site was of provision of water hoses on the roof to ensure ease in module cleaning.

Figure 47 shows the solar panel and the rooftop project at Somu Group:

Figure 47

Mounting structure and module installation at Somu Group, Packaging Unit



### Financing Of The Project

Axis Bank provided for the solar project. Total project cost for cumulative capacity of 100 kW solar project was INR 1 Crore and Axis funded INR 75 Lakhs. The loan terms were 11.5% interest rate and 5 years of repayment. The loan was approved within 2 weeks of filing application due to existing business relationship of Axis Bank with the Somu Group. The existing business loans provided enough collateral cover to absorb the solar rooftop project. The financing of the solar rooftop projects along with the entire portfolio of Somu Group was taken over by HSBC shortly after installation. The repayment history of the project has been excellent with no defaults. The table below depicts initial project loan terms:

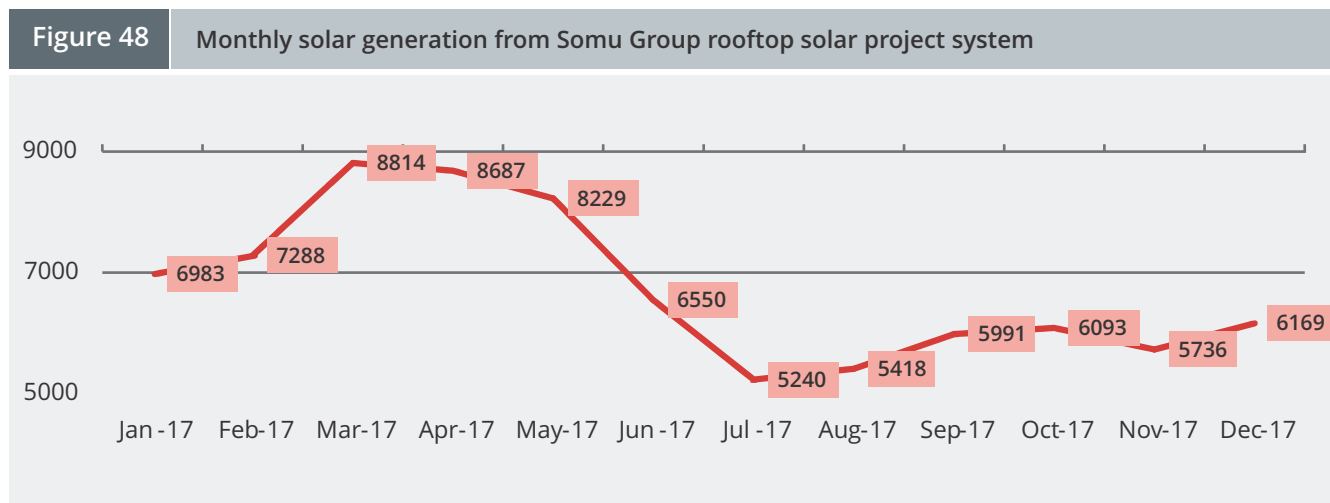


Financier	Debt: Equity ratio	Repayment period	Moratorium period	Interest rate
Axis Bank	75%:25%	5 years	6 months	10.5%

### Project Performance

The electricity generation for the aggregated solar project capacity of 100 kW is better than the expected generation. The peak generation takes place between 10 am – 3 pm. The AMC contract for the project is for a period of 2 years, and is taken care by the project integrator GES.

The GES officials take care of the module cleaning which happens twice a month. However, at the time of site visit, a lot of dirt was accumulated on the solar panels impacting the performance of the projects, and it was felt that the cleaning frequency should be monitored diligently. Also, there was significant shading on the solar panels owing to outgrowth of trees in the north. The owner was informed about the same, and asked to prune the trees twice a year for generation improvement. The solar generation figure for calendar year 2017 are shown in Figure 48.



### Major Challenges Faced

As discussed, the solar project was executed in 2 phases (50kW+50 kW) with both projects receiving separate tariff rates. This was due to the sudden change in policy and regulatory framework which stipulated that only 50 kW can be installed per meter in an LT connection. Hence, 2 separate RR numbers were required to be submitted to BESCO for the 2 solar projects, as opposed to a single project of capacity 100 kW initially. The first project of 50kW was executed with the existing RR, whereas the processing of the RR for the second project by BESCO took considerable time, enormous amount of delays leading to other unit generating almost after 10 months. By the time second project was commissioned, there was a revision in existing tariff resulting in considerable change in the tariff rates (Reduction from Rs 9.56/unit to Rs 6.61/unit for the second project). Surprisingly, the second 50 kW unit which was commissioned around the same time as the first was not connected to the grid for almost an year. This impacted the financial viability of the second project. It has also impacted the group's internal plan to expand the solar rooftop to other units of the group (apart from warehouses) where load requirement is higher. The requirement of high upfront capital is also a constraint for the group to go ahead with the future expansion plans.



### PWC Analysis

Somu Group installed 100 kW rooftop solar project in the Somu Packaging Unit in Bangalore which was company's very first intervention in clean energy space. The unit owner, Mr. Somu Somashekhar went ahead with the project due to attractive tariffs, AD benefits and to build green image of the company. Post commissioning of the project, there were challenges faced primarily on the regulatory front, like reduction in the tariff for the second project. The responses from the BESCO have also not provided clarity due to frequent changes in policy. Due to a lackadaisical response from the Discom, the grid connection of the second phase of the project was almost delayed by a year resulting in huge losses for the company. However, on the generation front the performance has been satisfactory, along with competent operation and maintenance practices and inspections from time to time. In the long run, the company might look to install solar rooftop for factories as well, but still upfront cost remains a major barrier.

The financial performance of the solar project are summarized in the table 22.

Sr.No.	Parameter	Value
1	Loan size (in INR lakhs)	75
2	Equity IRR	10.82%
3	Project IRR (%)	10.12%
4	Payback Period (yrs.)	7.67
5	Levelised cost of electricity (INR/kWh)	4.8

# 5. Bankers' perspective

## 5.1. SIDBI

SIDBI was set up to act as principal financial institution for the promotion, financing and development of the micro, small and medium enterprise (MSME) sector. The business strategy of SIDBI is to address the financial and non-financial gaps in the MSME eco-system. Financial support to MSMEs is provided by way of :

- (a) indirect/refinance to banks/financial institutions for onward lending to MSMEs and
- (b) direct finance in niche areas such as risk capital, sustainable finance, receivable financing, service sector financing, etc. As on 31 March 2017, SIDBI has made cumulative disbursements of about INR4.80 lakh crore benefitting about 350 lakh persons. By this way, SIDBI would be complementing and supplementing efforts of banks/FIs in meeting diverse credit needs of MSMEs.

SIDBI provide financial assistance to MSME units under different schemes. These schemes are given below:

- **Schemes under manufacturing and service sector are given below:**

- Direct credit scheme
- Privileged customer scheme
- Secured business loan to MSMEs (SBL)
- Working capital/WCTL to MSMEs
- Asset backed assistance to service sector entities
- Asset light scheme for service sector entities

- **Schemes to be considered under Risk Capital sector are given below:**

- Growth capital and equity assistance scheme (GEMS)
- Start-up assistance scheme

In direct financing, SIDBI offers specific financial product for sustainable development of MSMEs. The objectives of the financial product are to enable climate and environment-friendly investments to promote energy saving in the MSME sector, reduce the emission of greenhouse gases, especially carbon dioxide (CO<sub>2</sub>) to contribute towards climate change mitigation and support MSMEs towards development, up-scaling, demonstration and commercialization of innovative technology-based project.

**The major beneficiaries of the financial product can be:**

- MSMEs planning to invest in:
  - Energy saving investments in plant and machinery/production processes in order to reduce carbon footprint and enhance profitability.
  - Cleaner production and emission reduction measures, waste management and common effluent treatment plant (CETP) facilities.
- Energy service companies (ESCOs) providing solutions for EE/CP/renewable energy.
- Original equipment manufacturers (OEMs), who manufacture energy efficient/cleaner production/green machinery/equipment for MSMEs.

**The financing schemes under sustainable development are:**

- JICA Phase 3: Scheme for energy saving projects in the MSME sector.
- Sustainable finance scheme (SFS) for sustainable development projects, which have significant impact towards energy efficiency/cleaner production but not covered under the international/bilateral lines of credit.

- Financing end-to-end energy efficiency investments in MSMEs (4E financing scheme).

### 5.1.1. SIDBI Aurangabad

SIDBI Aurangabad is one of the pioneer banks in MIDC Waluj cluster, which is active in MSME financing. It has a portfolio of 70 clients in the cluster. The bank has been active in rooftop solar financing, since last couple of years. It received 3 applications for rooftop solar project funding by December 2017 and funded two solar projects i.e. funding for 10 kW solar project to Accrete Electromech Private Limited and funding for 100 kW solar project to S. N. Metallurgical Associates. The third applicant backed out citing loss of interest in solar project. The bank funded these units under 4E scheme and privileged customer scheme, respectively. The bank does not have any different loan due diligence for rooftop solar project and the loans for RTPV are disbursed considering the past experience with MSME client and repayment history in the previous loans. SIDBI Aurangabad branch does not take any third party assistance for due diligence purpose. Currently, SIDBI Aurangabad branch does not have any specific marketing initiative to disburse rooftop solar loans and the loans are disbursed as per current networking of relationship managers with existing clients. According to discussions with the bank official, SIDBI Aurangabad does not perceive any specific risk in rooftop solar sector and looks forward to increase loans in this category.

Table 23		Questionnaire for Bank
General Details		
1	Name and location of the bank branch: SIDBI, Aurangabad	
2	Applications received for rooftop solar projects in MSME: 3	
3	Applications approved : 2	
4	Total rooftop solar portfolio in capacity & value of the branch: 110 kW total capacity funded	
5	Rooftop solar lending products: 4E, Smile	
6	General loan terms in rooftop lending i.e. interest rate, repayment period, moratorium period: 8.5% to 10%, 5 to 7 years repayment period.	
7	Loan due diligence: Does the bank have specific guidelines? – Not as such Due diligence is carried out at branch level or corporate office level? – Branch level Any third party assistance for due-diligence purpose, details if any: No	
8	General time taken (from application receipt upto disbursement): 3- 4 weeks	
9	Risk perception of bank towards lending in rooftop solar space: Bank is proactive in rooftop solar funding and no specific risk is perceived in rooftop solar projects.	
10	Bank's perspective on lending to MSME: Bank has many loan products for MSMEs, generally collateral is required for loans.	
11	Major constraints/challenges in loan disbursement to RTPV projects: Not as such	
12	Major loan product marketing initiatives: Relationship manager approach the units and network	
13	Any internal initiatives for financing of solar projects: Capacity building/workshop/training etc. No specific workshop or training for rooftop solar loans.	

### 5.1.2. SIDBI Tirupur

SIDBI Tirupur has financed multiple solar and wind projects, which include five wind mills and four ground mounted solar project with aggregated 1.5 MW project capacity. The bank received two applications for rooftop solar project funding in December 2017 and funded both of them. These projects are: 102 kW solar project at B. S. Apparel and aggregated rooftop solar projects of 300 kW capacity at Clifton Exports. The bank funded these units under their privileged customer scheme and SMILE scheme respectively. The bank does not have any different loan due diligence for rooftop solar project and the loans for RTPV are disbursed considering the past experience with MSME client and repayment history in the previous loans. Any third-party assistance is not taken for due diligence purpose. Due diligence of loan under INR2 crore is carried out at branch level and loans above INR2 crores are referred to the regional level. Analysis of promotor profile and regular cash flows from core business are important aspects in loan disbursal. Currently, SIDBI Tirupur branch does not have any specific marketing initiative to disburse rooftop solar loans and the loans are disbursed as per current networking of relationship managers. According to discussions with the bank official, SIDBI Tirupur does not perceive any specific risk in the rooftop solar sector and looks forward to increase loans in this category.

Table 24 Questionnaire for Bank	
General Details	
1	Name and location of the bank branch: SIDBI, Tirupur
2	Applications received for rooftop solar projects in MSME: 2
3	Applications approved : 2
4	Total rooftop solar portfolio in capacity & value of the branch:
5	Rooftop solar lending products: Preferred customer scheme
6	General loan terms in rooftop lending i.e. interest rate, repayment period, moratorium period: 10%-13%, 5-7 years repayment period
7	Loan due diligence: Does the bank have specific guidelines? – Not as such Due diligence is carried out at branch level or corporate office level? – Branch level Any third party assistance for due diligence purpose, details if any: No
8	General time taken in from application receipt up to disbursal 6 - 7 weeks
9	Risk perception of bank towards lending in rooftop solar space: Bank is proactive in rooftop solar funding and no specific risk is perceived in rooftop solar projects
10	Bank's perspective on lending to MSME: Bank has been lending to its MSME client for their business requirements. Past experience with MSME and relationships are major criteria
11	Major constraints/challenges in loan disbursal to RTPV projects: Not as such
12	Major loan product marketing initiatives:
13	Any internal initiatives for financing of solar projects: Capacity building/workshop/training etc. No specific workshop or training for rooftop solar loans

## 5.2. Canara Bank

Canara Bank is recognised as a leading financial conglomerate in India with as many as ten subsidiaries/sponsored institutions/joint ventures in India and abroad. Canara Bank has a strong pan-India presence with 6k+ branches and 10k+ ATMs, catering to all segments of an evergrowing clientele accounts base of 8.05 crore. Canara bank provides banking services in various segments such as personal banking, corporate banking, NRI banking and MSME banking. Canara Bank has specific policy to cater to MSME business requirements. The bank has identified branches, which have substantial exposure to the MSME sector as SME-focussed branches and SME-designated branches to increase its credit exposure to the MSME sector. Simplified application and online submission with tracking facility has also been introduced to serve MSME clients. The bank has also introduced cluster-based approach to lending in which area or cluster-specific schemes are introduced giving due consideration to potential benefit of MSMEs. The major financial products in MSME banking are: cluster-specific schemes, general schemes including working capital and equipment financing, subsidy-linked schemes, credit facilities, export advances etc. The bank does not have any specific financial products for renewable energy loan requirement of MSMEs.

### 5.2.1. Canara Bank Jodhpur

Canara Bank has lent to corporate clients for various business requirements in the Jodhpur cluster. The bank does not have any specific financial product pertaining to solar power; however, it has forayed in to this segment. The bank has funded two clients to set up rooftop solar projects i.e., Sharma industries and Vyas College. Sharma industries has set up 162 kW aggregate rooftop solar projects at its five units. The project capacities are 10 kW, 33 kW, 33 kW, 20 kW and 66 kW. The bank does not have any different loan due diligence for rooftop solar project and the loans for RTPV are disbursed considering the past experience with the MSME client and repayment history in the previous loans. Any third party assistance is not taken for due diligence purpose. Currently, Canara Bank Jodhpur branch does not have any specific marketing initiative to disburse rooftop solar loans and the loans are disbursed as per current networking of relationship managers. As per discussions with the bank official, the bank does not perceive any specific risk in the rooftop solar sector and looks forward to increase loans in this category.

Table 25		Questionnaire for Bank
General Details		
1	Name and location of the bank branch:	Canana Bank, Jodhpur
2	Applications received for rooftop solar projects in MSME:	2
3	Applications approved :	2
4	Total rooftop solar portfolio in capacity & value of the branch:	
5	Rooftop solar lending products:	Preferred customer scheme
6	General loan terms in rooftop lending i.e. interest rate, repayment period, moratorium period:	10%-13%, 5-7 years repayment period
7	Loan due diligence: Does the bank have specific guidelines? – Not as such Due diligence is carried out at branch level or corporate office level? – Branch level Any third party assistance for due diligence purpose, details if any:	No
8	General time taken in from application receipt up to disbursal	6 - 7 weeks
9	Risk perception of bank towards lending in rooftop solar space:	Bank is proactive in rooftop solar funding and no specific risk is perceived in rooftop solar projects



General Details		
10	Bank's perspective on lending to MSME: Bank has been lending to its MSME client for their business requirements. Past experience with MSME and relationships are major criteria	
11	Major constraints/challenges in loan disbursement to RTPV projects: Not as such	
12	Major loan product marketing initiatives:	
13	Any internal initiatives for financing of solar projects: Capacity building/workshop/training etc. No specific workshop or training for rooftop solar loans	
Project specific details		
Sr. No.	Parameters	Details
1	MSME name & Address	Sharma Industries
2	Unit owner	Praveen Sharma
3	Project capacity	66 KW
4	Year of commissioning	2016
5	Project cost	52 Lakhs
6	Debt-equity ratio	25:75
7	Type of financing (Recourse- Non recourse)	Recourse
8	Business Model – Resco/capex	Capex
9	Status of project during loan approval	Simultaneously
10	Type of lending (Bridge financing/ full period)	Full period
11	Loan terms: repayment period moratorium period, interest rate	9.5%
12	Current status of loan repayment	Timely repayment

### 5.3. Union Bank of India

Union Bank of India is one of the largest government owned banks of India (the Government owns 63.44% of its share capital). It is listed on the Forbes 2000, and has assets worth USD 13.45 billion. The Bank now operates through more than 4,200+ branches and 7,000+ ATMs across the country. The bank provides banking services in various segments such as personal banking, corporate banking, NRI banking and MSME banking etc. The bank also releases MSME policy every year since 2009. The policy covers guidelines and instructions to lending to MSME sector, MSME priority sector lending, and bank's initiative for stepping up credit to MSMEs etc. The bank also has business banking branches (BBB) with specific focus on extending finance and other services to MSME sector. The bank has multiple schemes designed to cater MSME loan requirement such as working capital loan, plant & machinery, expansion etc. UBI also has cluster-specific loan scheme for various industrial clusters such as textile, timber, footwear, auto ancillary etc. UBI does not have any specific loan product to cater to fund requirement to set up a renewable energy project for MSME.

#### 5.3.1. UBI Tirupur

UBI Tirupur has lent to corporate clients for variety of business requirement in the Tirupur textile cluster. As indicated by bank officials, there has been a definite surge in interest for solar projects and bank is under discussion with couple of clients for solar project loans. The bank does not have any specific financial product pertaining to solar power; however, it has forayed in this segment. The Bank has funded Hi Life

Labels for rooftop solar project installation. The bank does not have any different loan due diligence for rooftop solar project and the loans for RTPV are disbursed considering the past experience with MSME client and repayment history in the previous loans. Collateral is necessary in most of the MSME loan cases. Any third party assistance is not taken for due diligence purpose. Currently, UBI Tirupur branch does not have any specific marketing initiative to disburse rooftop solar loans and the loans are disbursed as per current networking of relationship managers. As per discussions with the bank official, the bank mitigates risk in the rooftop solar sector by ensuring collateral attachment while approving the loan. The branch is positive about increase in credit growth in rooftop solar segment in the future.

Table 26		Questionnaire for Bank
General Details		
1	Name and location of the bank branch: UBI, Tirupur	
2	Applications received for rooftop solar projects in MSME: One application from Hi-Life Labels	
3	Applications approved: Application approved.	
4	Total rooftop solar portfolio in capacity & value of the branch: <100 kW	
5	Rooftop solar lending products: No loan product specific to rooftop lending	
6	General loan terms in rooftop lending i.e., interest rate, repayment period, moratorium period: 10%-13%, 7-9 years repayment period	
7	Loan due diligence: Does the bank have specific guidelines? – Not as such Due diligence is carried out at branch level or corporate office level? – Branch level Any third party assistance for due diligence purpose, details if any: No	
8	General time taken (from application receipt up to disbursement): 6 - 7 weeks	
9	Risk perception of bank towards lending in rooftop solar space: Bank is proactive in rooftop solar funding and no specific risk is perceived in rooftop solar projects	
10	Bank's perspective on lending to MSME: Bank has been lending to its MSME client for their business requirements. Past experience with MSME and relationships are the major criteria	
11	Major constraints/challenges in loan disbursement to RTPV projects: Not as such	
12	Major loan product marketing initiatives:	
13	Any internal initiatives for financing of solar projects: Capacity building/workshop/training etc. No specific workshop or training for rooftop solar loans	

#### 5.4. Axis Bank

Axis Bank Ltd. is the third largest of the private sector banks in India offering a comprehensive suite of financial products. The bank has its head office in Mumbai and registered office in Ahmedabad. It has 3,500+ branches, 14,000+ ATMs, and 9 international offices. It offers the entire spectrum of financial services large and mid-size corporates, SME, and retail businesses. The major services include retail banking, corporate banking, treasury, international banking, SME business etc.

The SME business of the bank comprises three business groups—medium enterprises (MEG), small enterprises (SEG) and supply chain finance (SCF) which as on 31 March, 2016 comprised 40%, 46% and 14% of total SME advances, respectively. The bank extends working capital, term loan, trade finance and project finance facilities to SMEs for their various financing needs. During FY16, various products and process changes were implemented. 'SME Dealer Power' launched during FY16 offers comprehensive financing facility to the dealers

of various companies in the country for efficient management of working capital and other business requirements. Another newly launched product 'Exim Power' offers financing facilities to SMEs engaged in export/import activities and showcase bank's commitment towards 'Make in India' initiative.

The bank has also adopted an industrial cluster-based financing as an important strategy towards ensuring manufacturing credit flow in the SME sector. As part of this initiative, important clusters have been identified across various sectors and awareness has been created within the bank's teams to focus more on these identified clusters in the coming years. The SME portfolio of the Bank constituted 13% of the bank's total advances as on 31 March 2016 and grew by 8% to INR44,869 crores from INR41,507 crores last year. Special initiatives have been undertaken during fiscal 2016 to promote lending to the priority sector, which includes product and marketing initiatives. Currently the bank operates from 51 SME centres and 9 SME cells, across the country to service customers effectively covering around more than 1,500 branches.

Table 27		Questionnaire for Bank
General Details		
1	Name and location of the bank branch: Axis, Bangalore	
2	Applications received for rooftop solar projects in MSME: One application from Somu industries, currently ongoing discussion to give loan to a poultry farm for solar project in form of business loans	
3	Applications approved: Application approved.	
4	Total rooftop solar portfolio in capacity & value of the branch: <100 kW	
5	Rooftop solar lending products: Axis bank Bangalore branch extends loan for solar projects under general business loans only, reason being that renewable loans get approved at central office which takes a lot of time	
6	General loan terms in rooftop lending i.e. interest rate, repayment period, moratorium period: 10%-13%, 5-7 years repayment period	
7	Loan due diligence: Does the bank have specific guidelines? – Not as such Due diligence is carried out at branch level or corporate office level? – Branch level, renewable loan due-diligence is carried out at central office level Any third party assistance for due-diligence purpose, details if any: No	
8	General time taken (from application receipt up to disbursal): 6 - 7 weeks	
9	Risk perception of bank towards lending in rooftop solar space: Bank has no risk perception for rooftop solar projects however they are extending loans for solar projects under financial products meant for general business loans	
10	Bank's perspective on lending to MSME: Bank has been lending to its MSME client for their business requirements. Past experience with MSME and relationships are the major criteria	
11	Major constraints/challenges in loan disbursal to RTPV projects: Not as such	
12	Major loan product marketing initiatives: No marketing initiative for rooftop solar loans	
13	Any internal initiatives for financing of solar projects: Capacity building/workshop/training etc. No specific workshop or training for rooftop solar loans	

## 6. Conclusion and Key Messages

The Government of India has set an ambitious target of achieving 100 GW of solar generation of which 40 GW capacity is expected to be achieved from solar rooftop installations by different stakeholders. Hence, there is an increased thrust on promoting solar rooftop in India. Among the different targeted segments, especially micro, small and medium enterprise (MSMEs) have tremendous potential for the use of solar rooftops due to technical and economic feasibility in most enterprise facilities. Despite the significant role played by MSMEs, the lack of adequate need-based finance poses an obstacle to growth. GIZ programme 'Responsible enterprise finance (II)' has been designed with an objective to enable MSMEs to have better access to inclusive and responsible finance. The major activities of the program are: implementation of effective sustainability standards for the finance sector, dissemination of responsible finance products and services for MSMEs and creation of conducive business environment for financing of inclusive business models. In line with the same, this study aims to document case studies and best practices in rooftop solar projects at MSMEs and increase awareness about successful solar project which act as confidence building measures to entrepreneurs and other MSME unit owners.

As part of the assignment, the PwC team prepared rooftop solar project case studies, which covered discussions held with unit owners, project financier, project integrator and industrial cluster association. The document covers seven case studies which are: two unit case studies at MIDC Waluj cluster (Aurangabad), two unit case studies at Tirupur textile cluster (Tamil Nadu), two unit case studies at Jodhpur handicraft cluster (Rajasthan) and one case study at Bangalore. Major sections to be covered in case study were MSME details, rooftop solar project information, motivation of installation, project execution, financing of the project, major challenges and finally PwC analysis, which covers the salient aspects of the case study.

For case study preparation, the PwC team identified solar project on MSME premises after discussions with stakeholders such as GIZ, SIDBI and utilizing PwC network in the industry. Site visits were conducted to assess installation and execution of the solar project information such as workmanship, roof-type, mounting structure, pictures etc. We held discussions with stakeholder, which include unit owner, system integrators, bankers and industry associations.

On the basis of stakeholder discussions, desktop research and site visits, the following key messages can be derived from the study:

- **Availing net-metering and unaccommodating state regulations are the major pain point**

Most of the unit owners faced challenges in availing net metering during solar project execution. These challenges are of various kind such as delay on part of net-meter installation after application submission, transparency and clarity on the process, lack of distribution licensee support and questionable competence of the officials etc. Delay in net-metering on part of distribution licensee affects financials of the project as well. In case of 40 kW project at Ashapura Engineering Private Limited 80% AD was the major attraction during project conceptualization; however, it could not be availed since net-metering agreement could not be signed upto March 2017 after which the Finance Ministry slashed AD benefit to 40%.

Issues related to state regulations also pose challenges for unit owners who are otherwise interested in solar project installation. In Tamil Nadu, TNEB does not allow export of electricity into the grid for LT consumers; hence, many interested people are unable to install rooftop solar PV plants. B S Apparel procures electricity from TEKIC and does not have any net metering facility; hence, solar project remain shut down during holidays. Closure of plants on holidays results into 15% to 20% less savings vis-à-vis when plant is in operation for complete year. In Maharashtra, industrial units who apply for net-metering have to forgo INR1/kWh subsidy

given to industrial units in the cluster. S N Metallurgical Associates has not applied for net metering due to the current regulations of MSEDCL.

- **Industrial cluster association can take initiatives to facilitate solar projects**

Initiatives taken by industrial associations in the cluster go a long way in facilitating MSMEs. Associations can organise workshops to convey awareness about solar power, expected benefits, tackling technical and regulatory challenges etc. Industrial associations can also negotiate better with Government and regulatory authorities, since they carry more bargaining power than any individual industrial unit. Good solar activities in Waluj MIDC cluster can be attributed to initiatives taken by associations at certain extent. Associations can also adopt a more active role to enable industries to go for renewable power. Tirupur Export Knitwear Industrial Complex (TEKIC) is a good example. TEKIC has set up 5 MW wind project Mudalipalayam, near Tirupur, Coimbatore and the electricity tariff from the wind plan is INR2.7/kWh compared to INR6.90/kWh from TamilNadu Electricity Board (TNEB). TEKIC charges INR5.95/kWh for electricity consumed and provides INR 6.50/kWh for the import of electricity from industrial unit. TEKIC also allows net-metering to LT consumers who are not allowed net-metering by TNEB. As per current norms, TNEB does not allow export of electricity into the grid for LT consumers; hence, many interested people are unable to put rooftop solar PV plants. TEKIC has enabled its member industries to go for net-metering with LT connection as well.

- **System integrator selection is of utmost importance**

MSMEs do not have internal technical capabilities and non-performing of plant can defeat the motivation behind installation. This highlights the importance of selecting technically sound integrator after comparing multiple quotations. System integrator with sound technical experience would ensure good workmanship during project execution and sustained performance after commissioning. The integrator is also responsible for educating system owner about regular cleaning, preliminary fault identification, regular testing and ensuring grid compliance etc. MSMEs do not have man power and resources to go legal in case system is not performing as per the signed contract; however, MSME owner can rely on system integrator depending upon good project execution history.

In order to ensure technically capable system integrator, MSMEs should go for multiple quotations during integrator selection phase. Multiple quotations help in comparing technical bids, services provided and bargaining on the price point. Many MSMEs are not aware of list of system integrators available at MNRE and SNA sites. These integrators are rated on the basis of their technical and financial capabilities. MSMEs, if aware of such sources by means of association initiatives, can easily go ahead for multiple quotation based selection process.

In addition to this, association can take a more active role such as centralized procurement. This will reduce overall purchase cost, increase participation by bigger system integrators who have better technical capabilities and past experience. Association can also develop draft contract with clauses on system specification and minimum performance requirement. This can be used as a reference point by MSMEs as they do not have internal capacity to prepare a strong legal contract.

- **MSMEs endeavour to have green image**

Green image is one of the major motivating factors for MSMEs to go for solar project installation. This is majorly applicable for MSMEs who have multinational clients and the motivation of green energy is driven by the purchasing behaviour and/or contractual requirement of these clients. B S Apparel and HiLife Labels are motivated to have export-oriented textile business located at Tirupur cluster and both of these companies are motivated to go solar in order to keep green image. This is a sound indication of how procurement behaviour of a large corporate affects the decision making of its suppliers. Large corporates can prefer suppliers who have renewable targets. This step will be a good starting point with an ultimate objective of attaining green supply chain.



- **MSME Banking needs to go a long way**

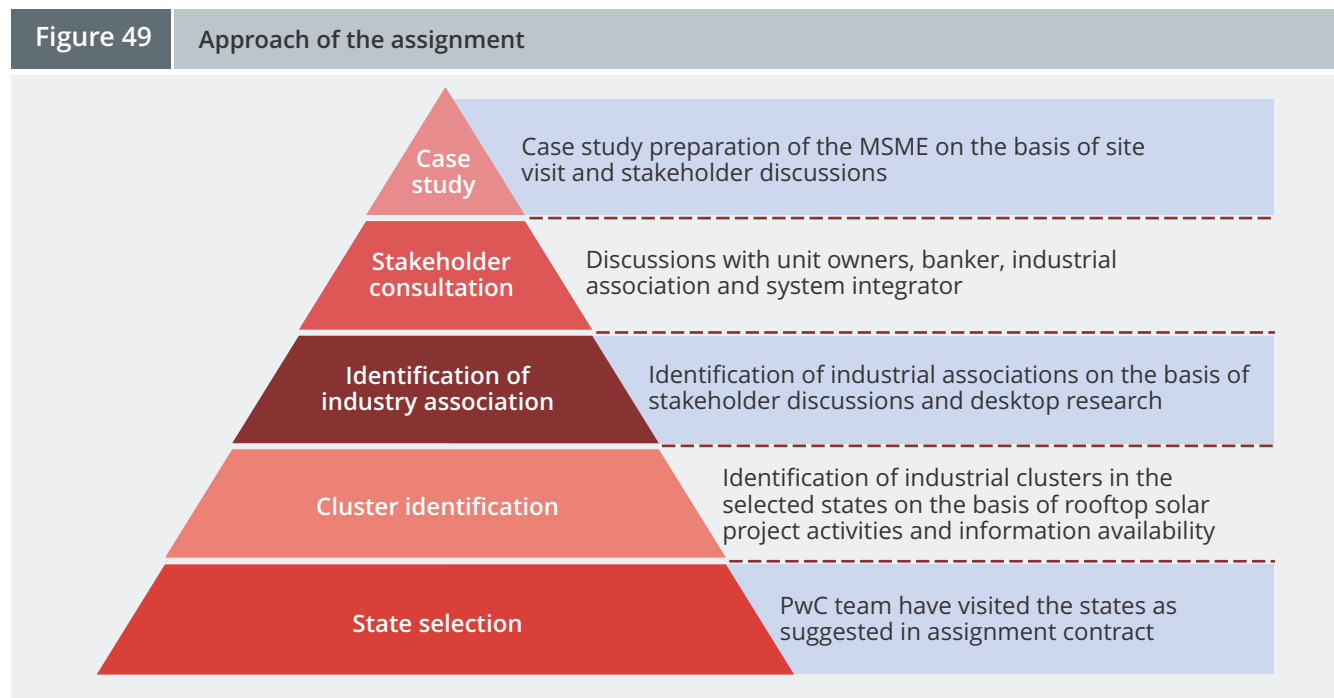
Currently MSME banking runs on the basis of rapport between client and the bank which has established on the basis of previous loan repayment history of MSME. This works well for the companies who are already doing regular business with the bank however the new companies who seek loans, especially for non-business requirement such as rooftop solar project, face challenges as banks perceive higher risk in this proposition. Infact, solar project with good rationale in terms of generation and tariff savings does not affect loan due diligence which is heavily reliant on promotor's existing business relationship with Bank and provision of collateral. A key obstruction to several consumers is the collateral demanded by banks as security to finance the projects, since in many cases, the SMEs have their assets mortgaged for previous loans. Importance of collateral and existing business relationship is so much that banks do not give much weightage to technical feasibility which raises question on current due-diligence process of banks. As per our discussion, banks do not have internal capability to assess rooftop solar loans as well hence some training program in this direction will surely help in loan assessment.

In addition to lack of training, local branches also do not have specific marketing and promotional efforts to increase solar loan credit growth. In current times when solar projects have strong value proposition due to tariff savings, AD benefits and green image, banks should put more resources in actively promoting solar to their clientele.

# 7. Appendix

## 7.1. Methodology of The Assignment

Since PwC has been engaged by GIZ earlier in conducting the assessment study of potential and assessing the availability of finance in the selected clusters of Bhiwadi, Aurangabad and Gurgaon, the team had hands-on experience working with MSMEs and analysing the need for solar rooftop PV in the MSME sector. In the current assignment, PwC followed a bottom-up approach to prepare the case studies for the best possible SME units where solar rooftop PV is installed. The methodology used in the assignment is represented below:



### Methodology of case study preparation

PwC team prepared major sections to be covered in case study, which included MSME details, rooftop solar project information, motivation of installation, project execution, financing of the project, major challenges and finally PwC analysis, which covers salient aspects of the case study. The broad flow of case study preparation is shown below:

- **Identification of rooftop solar project for case study preparation**

PwC team identified solar project on MSME premises after discussions with stakeholders such as GIZ, SIDBI and utilizing PwC network in industry.

- **Site visit to assess installation and execution of the solar project**

PwC team visited solar project site to gather general plant information such as workmanship, roof-type, mounting structure, pictures etc.

- **Discussions with stakeholder**

- Unit owner: PwC team met with unit owners to understand their motivation of installation, experience with banker, system integrator and distribution utility, EPC selection and any major challenges faced during the project.
- System integrator: We met system integrators to collect technical information related to installation, electrical work and operation & maintenance.

- Banker: We met with project financier to understand their overall outlook on rooftop solar lending, loan due diligence, risk perception, general loan terms, marketing initiatives and training programs of staff for solar credit growth.
- Industry association: PwC team met industrial associations in the clusters to understand cluster level efforts to promote solar power, expectations from government and financiers, challenges and any cluster level initiatives to increase awareness of solar power.

## 7.2. Questionnaires

### 7.2.1. S. N. Metallurgical Associates, Aurangabad

Table 28 Questionnaire for industrial unit		
General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	SN Metallurgical Associates
2	Unit owner & Contact Details	Shyam Choudhari
3	Type of Industry	SSI Service Industry
4	Products	Heat Treatment Service Provider
5	Address	M-142, MIDC, Waluj, Aurangabad – 431136
6	Nodal person details	Ravindra Allat
7	Roof ownership	Self
8	Website (if any)	Website (if any)
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	19.85, 75.32
2	System size (kW)	100 KWp
3	Roof type	Truss structure
4	Orientation	North to South
5	Type of MMS (material, tracking)	Shed
6	Orientation & tilt	No tilt
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	Maharashtra
2	Connection Type & Voltage (kV)	H.T.
3	Grid Availability (%)	100%
4	Connected Load (kW)	1300 KW
5	Machinery/Load details	900 KW
6	Transformer (kVA)	980 KVA

Technical Details		
Sr. No.	Parameters	MSME 1
7	Annual Solar Generation (kWH)	1,10,000
8	Energy Charges	INR 8.5/unit
9	Backup Source Details	DG set
10	Module Type & Make	Trina, Multi crystalline
11	Inverter Type & Make	Fronius, Eco 27.0-3-S type
12	Works Start Date	06.06.2016
13	Commissioning Date	01.08.2016
Installation		
Sr. No.	Parameters	MSME 1
1	Business Model (Capex/Opex/Leased)	Capex
2	Mode of Metering (Net/Gross)	Net Metering applicable
3	Installation Date	01.08.2016
4	Government Incentive Details (subsidy, rebates, tax exemption)	No subsidy, 80% depreciation in first year
5	Liaising Contractor	Reylon Solar Private Limited
Execution		
Sr. No.	Parameters	MSME 1
1	System Integrator Details & Experience	Reylon Solar Private Limited
2	Issues faced post commissioning & rectification time	No issues till now
3	Commissioning support by equipment manufacturer	5 years
4	Demonstration effect of solar plant	Yes. Mr Ashok Kale installed 200 kW project at his unit after visiting the facility
Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
2	Player participation & procurement stages	4 quotation from EPC players
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	By system integrator
2	Major O&M activities & spare support	No spare parts (Cleaning once a week, shampoo cleaning once a month)

Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	63 lakhs
2	Mode of funding	Non-recourse
3	Financing Bank	SIDBI
4	Approved amount & lending terms	85% loan amount at a rate of 9.5% per annum
5	AD availed	Yes
6	Repayment record	Good
7	Payback (Project & Entity)	6 years

### 7.2.2. Ashapura Engineering Private Limited, Aurangabad

Table 29 Questionnaire for industrial unit

General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	Ashapura Engineering Pvt. Ltd.
2	Unit owner & Contact Details	Mr. Sachin Sheth
3	Type of Industry	Auto component
4	Products	Auto components
5	Address	22, Suvarna Laghu Udyog, Near Truck Terminus,, Waluj, MIDC, Aurangabad, Maharashtra 431136
6	Nodal person details	Mr. Sachin Sheth
7	Roof ownership	Self
8	Website (if any)	NA
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	19.826875, 75.245328
2	System size (kW)	40 kW
3	Roof type	Slope in the north
5	Type of MMS (material, tracking)	Fix
6	Orientation & tilt	South 20 Degree
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	MSEDCL
2	Connection Type & Voltage (kV)	LT – 80



Technical Details		
Sr. No.	Parameters	MSME 1
3	Grid Availability (%)	95%
4	Connected Load (kW)	75 kW
5	Machinery/Load details	70 KW
6	Transformer (kVA)	100KVA
7	Annual Solar Generation (kWH)	42048kWh
8	Energy Charges	7.68/kWh
9	Backup Source Details	No backup
10	Module Type & Make	REC 335w Twin Peak
11	Inverter Type & Make	40kw 3 phase Growatt
12	Works Start Date	Feb 2017
13	Commissioning Date	March 2017
14	General System Design	South Facing Elevated
Installation		
Sr. No.	Parameters	MSME 1
1	Business Model Motive of installation (savings, environment, tax cuts, etc)	Savings in electricity bill
2	Business Model (Capex/Opex/Leased)	Capex
3	Mode of Metering (Net/Gross)	Net metering
4	Government Incentive Details (subsidy, rebates, tax exemption)	Not applicable
5	Regulatory Procedures	Net metering application
6	Net metering status	Net metering obtained
7	Application Date	10/02/2017
8	Installation Date	14/4/2017
9	Government Incentive Details (subsidy, rebates, tax exemption)	Tax Exemption
10	Liaising Contractor	Skaleup Energy Solutions Pvt Ltd
11	Feedback on regulatory processes, government support & nodal agency role	AEPL faced challenges in obtaining net metering and currently there are net-metering reconciliation issues as well.
Execution		
Sr. No.	Parameters	MSME 1
1	System Integrator Details & Experience	Skaleup Energy Solutions Pvt Ltd
2	Issues faced post commissioning & rectification time	Lack of MSEDCL support in metering
3	Commissioning support by equipment manufacturer	Yes

Execution		
Sr. No.	Parameters	MSME 1
1	Feedback on best practices and challenges during execution	Structure work at site to have south facing arrays is a good practice to achieve better CUF.
2	Demonstration effect of solar plant	Many unit owners in the cluster visited the rooftop solar project, however none has gone ahead with the RTPV yet.
Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
2	Learnings & Issues (if any)	No issues as such.
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Skaleup Energy Solutions Pvt Ltd
2	AMC cost	1000/KW
3	Major O&M activities & spare support	Yes
4	Role & training of unit staff for solar plant O&M	Yes
Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	23.60 Lakhs
2	Mode of funding	Debt Equity
3	Financing Bank	State Bank of India
4	Approved amount & lending terms	17.48 Lakhs
5	AD availed	Yes
6	Savings	Savings in electricity bills
7	Payback (Project & Entity)	5 years
8	Feedback on loan appraisal & application process	Lots of hassles in paperwork. AEPL did not have good experience with third party which was handling loan related paperwork for SBI

**Table 30** Questionnaire for industrial unit

General Details	
1	Name and location of the bank branch: SBI Aurangabad
2	Applications received for rooftop solar projects in MSME:3 applications received so far in solar domain; Shivam industries – 100 kW ,Ashapura – 40 kW , Rucha industries is under discussion for 2 MW project
3	Applications approved : 2 (Shivam industries – 100 kW , Ashapura – 40 kW)

General Details	
4	Total rooftop solar portfolio in capacity & value of the branch: Approximately 80 Lacs exposure for cumulative solar capacity of 140 kW.
5	Rooftop solar lending products: SBI- World Bank programme
6	General loan terms in rooftop lending i.e. interest rate, repayment period, moratorium period: Varies with project and promotor
7	Loan due diligence: Does the bank has specific guidelines?- For loans more than 1 crore, Lender engineer services are taken. Due diligence is carried out at branch level or corporate office level? – Branch level Any third party assistance for due-diligence purpose, details if any: For loans more than 1 crore, Lender engineer services are taken.
8	General time taken in from application receipt upto disbursal: 3-4 weeks
9	Risk perception of bank towards lending in rooftop solar space: Bank does not perceive any additional risk in solar projects.
10	Bank's perspective on lending to MSME: Bank is quite proactive for RE loans but collateral is required from the client.
11	Major constraints/challenges in loan disbursal to RTPV projects: No internal capacity to assess technical aspects of the loan.
12	Major loan product marketing initiatives: No separate initiative at branch level to promote rooftop loan project
13	Any internal initiatives for financing of solar projects: capacity building/ workshop/ training etc. SBI head office organises training in Delhi. A training was conducted by TERI on the similar lines. SBI Aurangabad people also attended the training.

### 7.2.3. BS Apparel, Tirupur

Table 31 Questionnaire for industrial unit

General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	BS Apparel
2	Unit owner & Contact Details	B. Vijayaragavan
3	Type of Industry	Export Unit
4	Products	Hosiery Garment Export
5	Address	23-27, SIDCO, Mudalipalayam, Tirupur
6	Nodal person details	B. Vijayaragavan
7	Roof ownership	B. Vijayaragavan
8	Website (if any)	www.bsapparelindia.com
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	11.043331, 77.312633
2	System size (kW)	102 KWp

Plant Information		
Sr. No.	Parameters	MSME 1
3	Building Height	20 feet
4	Roof Type	Flat
5	Roof Area (m2)	3048
6	Orientation	North to south (seasonal tilt structure – 2 tilts at 120 and 300)
7	Type of MMS (Material, Tracking)	MS square pipe (galvanised)
8	MMS nos.	42
9	Shading in Array Area	Nil
10	Orientation & Tilt	Tilt
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	TEKIC
2	Connection Type & Voltage (kV)	415 V
3	Grid Availability (%)	100%
4	Connected Load (kW)	112 KW
5	Machinery/Load details	112 KW
6	Annual Solar Generation (kWH)	1,45,000
7	Annual Grid Consumption (kWH-Export & Import)	1,45,000
8	Energy Charges	INR 5.95/unit – Import   INR 6.50/unit – Export
9	Backup Source Details	
10	Module Type & Make	Jinko, Polycrystalline
11	Inverter Type & Make	SMA – String
12	Works Start Date	01.03.2015
13	Commissioning Date	01.04.2015
12	General System Design	South Facing Elevated
Installation		
Sr. No.	Parameters	MSME 1
1	Business Model (Capex/Opex/Leased)	Capex
2	Motive of installation	Savings
3	Mode of Metering (Net/Gross)	Gross
4	Installation Date	01.04.2015
5	PPA Details	TEKIC PPA
6	Regulatory Procedures	Not Required
7	Liaising Contractor	Sun Capture

Execution		
Sr. No.	Parameters	MSME 1
1	System Integrator Details & Experience	Sun Capture (2 Years)
2	Demonstration effect of solar plant	Good
Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
2	Player participation & procurement stages	
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Inspire
2	Performance benchmarks	No
Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	70 lakhs
2	Mode of funding	Recourse
3	Financing Bank	SIDBI
4	Approved amount & lending terms	85% of the project cost, 5 years repayment period and 13% interest rate
5	AD availed	Yes
6	Repayment Record	Good
7	Payback (Project & Entity)	6.97 years

#### 7.2.4. Hilife Labels, Tirupur

**Table 32** Questionnaire for industrial unit

General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	Hi-Life Labels
2	Unit owner & Contact Details	Mahendran
3	Type of Industry	Textile
4	Products	Labels for Clothes
5	Address	218, PalladamKunnangalpalayamPirivu, Main St, NP Nagar, Veerapandi, Tirupur, Tamil Nadu 641605
6	Nodal person details	Mahendran



General Information		
Sr. No.	Parameters	MSME 1
7	Roof ownership	HI- LIFE LABELS
8	Website (if any)	www.hilifelabels.in
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	11.05, 77.32
2	System size (kW)	40kW + 35kWp + 20kWp
3	Building Height	30 Feet
4	Roof Type	RCC with Metal Sheet Raising
5	Roof Area (m2)	400
6	Orientation	South Slope
7	Shadow free area (m2)	670
8	Rough layout	
9	Type of MMS (Material, Tracking)	On the Concrete GI Vertical Structure, Aluminum Profiles on the powder quoted Metal Sheet
10	Orientation & Tilt	Towards South, 8-10 Degree
11	Pitch	As per Module Pitch
12	MMS nos.	1 Set of GI Structure 1 Set of Aluminum
13	Shading in array area	NA
14	Array area pictures	Enclosed
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	TNEB
2	Connection Type & Voltage (kV)	415V
3	Grid Availability (%)	100%
4	Connected Load (kW)	100kVA
5	Machinery/Load details	Ask consumer
6	Transformer (kVA)	Ask Consumer
7	Annual Solar Generation (kWH)	138900
8	Annual Grid Consumption (kWH-Export & Import)	Captive Consumption No Net Metering
9	Energy Charges	NA
10	Backup Source Details	DG
11	Module Type & Make	Monocrystalline & Polycrystalline, Renesola EMMVEE

Technical Details		
Sr. No.	Parameters	MSME 1
12	Inverter Type & Make	String, Refusol
13	Works Start Date	35kWp 2012 20kWp 2013 40kWp 2015
14	Commissioning Date	In the same year
15	General System Design	
Installation		
Sr. No.	Parameters	MSME 1
1	Motive of installation (savings, environment, tax cuts, etc)	Under Green Energy Concept as they are making product for most of the MNC's and also minding of Global warming
2	Business Model (Capex/Opex/Leased)	Capex
3	Mode of Metering (Net/Gross)	Captive
4	PPA details (developers, offtake, structure, rate, security, tenure)	NA
5	Regulatory Procedures	NA
6	Net metering status	NA
7	Application Date	NA
8	Installation Date	NA
9	Government Incentive Details (subsidy, rebates, tax exemption)	NA
10	Liaising Contractor	NA
11	Feedback on regulatory processes, government support & nodal agency role	NA
Execution		
Sr. No.	Parameters	MSME 1
1	System integrator details & experience	Solar Corona Energy Pvt Ltd, 4 years
2	Quality (Observation on site visit)	Yes frequently
3	Civil	Good
4	Electrical work	Good
5	Structural work	Good
6	Issues faced post commissioning & rectification time	DG Synchronization
7	Commissioning support by equipment manufacturer	YES
8	Feedback on best practices and challenges during execution	Very Effectively done
9	Pictures of installation	Enclosed
10	Demonstration effect of solar plant	Yes Good

Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
2	Player participation & procurement stages	Very Effectively
3	Performance benchmark & security in contract	Very Effectively
4	Misc. contract terms (payment terms, mode, defect liability, etc)	NA
5	Learnings & issues (if any)	
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Consumer Own
2	AMC cost	NA
3	Major O&M activities & spare support	Consumer Own
4	Performance benchmarks	NA
5	Role & training of unit staff for solar plant O&M	As per customer request Solar Corona will provide
6	O&M manager	NA
7	Maintenance of O&M logs & manuals	Consumer Own
8	O&M learning & issues	NA
Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	Rs.95.00 Cumulative
2	Mode of funding	Term Loan
3	Financing Bank	UBI

### 7.2.5. 66kW solar rooftop project, Sharma Industries, Jodhpur

**Table 33** Questionnaire for industrial unit

General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	Sharma Industries
2	Unit owner & Contact Details	Praveen Sharma
3	Type of Industry	Manufacturing & Export Unit
4	Products	Contemporary furniture, giftware, accessories in wrought iron and wood
5	Address	G-115, C, M. I. A., Phase 2, Basni, Jodhpur-342005, Rajasthan
6	Nodal person details	Praveen Sharma

General Information		
Sr. No.	Parameters	MSME 1
7	Roof ownership	Praveen Sharma
8	Website (if any)	www.sharmaindustry.com
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	26.233047, 73.005512 and 26.218897, 72.996082
2	System size (kW)	66 KWp
3	Building Height	8 meter
4	Roof Type	Metal Sheet, Slant roof
5	Type of MMS (Material, Tracking)	Aluminium
6	MMS nos.	Lott
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	JDVNL
2	Connection Type & Voltage (kV)	HT, 11 kV
3	Grid Availability (%)	100%
4	Connected Load (kW)	150 HP
5	Annual Solar Generation (kWH)	97,921
6	Annual Grid Consumption (kWH- Import)	1,62,500
7	Energy Charges	INR 6.5 Rs/KWh
8	Module Type & Make	Trina, Polycrystalline (TSM -315)
9	Inverter Type & Make	Zeversolar
10	Works Start Date	June.2016
11	Commissioning Date	August.2016
Installation		
Sr. No.	Parameters	MSME 1
1	Business Model (Capex/Opex/Leased)	Capex
2	Motive of installation	Savings
3	Mode of Metering (Net/Gross)	Net Metering
4	Installation Date	August 2017
5	Government Incentive Details (subsidy, rebates, tax exemption)	Accelerated Depreciation
6	PPA Details	NA
7	Regulatory Procedures	

Installation		
Sr. No.	Parameters	MSME 1
8	Liaising Contractor	Pioneer Power Systems
Execution		
Sr. No.	Parameters	MSME 1
1	System integrator details & experience	Pioneer Power Systems
2	Issues faced post commissioning & rectification time	Yes frequently
3	Quality	Good
4	Civil Work	Good
5	Electrical Work	Good
6	Structural Work	DG Synchronization
7	Commissioning support by equipment manufacturer	YES
8	Pictures of installation	Attached
9	Demonstration effect of solar plant	Yes Good
Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Self
2	Performance benchmarks	NA
Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	52 lakhs
2	Mode of funding	Non-recourse
3	Financing Bank	Canara Bank
4	Approved amount & lending terms	39 Lakhs, 9.5% Interest, 8 Years term
5	AD availed	Availed
6	Financing Bank	Good
7	Total Project Cost	Payback (Project & Entity)



### 7.2.6. 2 x 33 kW solar rooftop project, Sharma Industries, Jodhpur

**Table 34** Questionnaire for industrial unit

General Information		
Sr. No.	Parameters	MSME 1
1	Name of MSME	Sharma Industries
2	Unit owner & Contact Details	Praveen Sharma (Mob: 8046031654)
3	Type of Industry	Manufacturing & Export Unit
4	Products	Contemporary furniture, giftware, accessories in wrought iron and wood
5	Address	G-115, C, M. I. A., Phase 2, Basni, Jodhpur-342005, Rajasthan
6	Nodal person details	Praveen Sharma
7	Roof ownership	Praveen Sharma
8	Website (if any)	www.sharmaindustry.com
Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	26.233047, 73.005512 and 26.218897, 72.996082
2	System size (kW)	(33+33) KWp
3	Building Height	8 meter
4	Roof Type	Metal Sheet, Slant roof
5	Roof Area (m <sup>2</sup> )	2500
6	Orientation	South/E-W facing
7	Type of MMS (Material, Tracking)	Aluminium
8	Orientation & Tilt	South Facing, 25°
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	JDVNL
2	Connection Type & Voltage (kV)	HT, 11 kV
3	Grid Availability (%)	100%
4	Connected Load (HP)	140
5	Transformer (kVA)	150
6	Annual Solar Generation (kWH)	1,12,000
7	Annual Grid Consumption (kWH-Export & Import)	1,70,000
8	Energy Charges (INR/kWh)	6.50
9	Module Type & Make	Trina, Polycrystalline (TSM -315)
10	Inverter Type & Make	Zeversolar

Technical Details		
Sr. No.	Parameters	MSME 1
11	Works Start Date	Jul 2016
12	Commissioning Date	Aug 2016
Installation		
Sr. No.	Parameters	MSME 1
1	Business Model (Capex/Opex/Leased)	Capex
2	Motive of installation	Savings
3	Mode of Metering (Net/Gross)	Net Metering
4	Installation Date	Sept 2016
5	Government Incentive Details (subsidy, rebates, tax exemption)	Accelerated Depreciation
6	PPA Details	NA
7	Regulatory Procedures	
8	Liaising Contractor	Pioneer Power Systems
Execution		
Sr. No.	Parameters	MSME 1
1	System integrator details & experience	Pioneer Power Systems, 15MW+ Rooftop Solar; 200MW+ Utility Solar Projects
2	Issues faced post commissioning & rectification time	Good
3	Quality	Good
4	Civil Work	Good
5	Electrical Work	Good
6	Structural Work	Good
7	Commissioning support by equipment manufacturer	Good
8	Pictures of installation	Attached
9	Demonstration effect of solar plant	Good
Procurement & Contracting		
Sr. No.	Parameters	MSME 1
1	Mode of execution (Turnkey/Multiple contracts)	Turnkey
2	Player participation & procurement stages	Based on recommendation and technical expertise
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Self
2	Performance benchmarks	Annual generation of 1500kWh/kW

Project Financing		
Sr. No.	Parameters	MSME 1
1	Total Project Cost	52 lakhs
2	Mode of funding	Non-recourse
3	Financing Bank	Canara Bank
4	Approved amount & lending terms	39 Lakhs, 9.5% Interest, 8 Years term
5	AD availed	Availed
6	Repayment record	Good
7	Payback (Project & Entity)	7 Years

### 7.2.7. Somu Industries, Bangalore

**Table 35** Questionnaire for industrial unit

Plant Information		
Sr. No.	Parameters	MSME 1
1	Geographical coordinates	12.51N 77.34E
2	System size (kW)	50kW X 2nos
3	Building Height	20ft
4	Roof Type	Metal Sheet (industrial)
5	Roof Area (m2)	1200Sq Mtr
6	Orientation	1. North 5° C 2. South 7° C
7	Shadow Free Area (m2)	1200 SqMtr
8	Type of MMS (Material, Tracking)	Aluminum Rafters
Technical Details		
Sr. No.	Parameters	MSME 1
1	DISCOM	BESCOM
2	Connection Type & Voltage (kV)	415V
3	Grid Availability (%)	90%
4	Connected Load (HP)	13kW, 5kW
5	Machinery/Load details	Lighting Load
6	Annual Solar Generation (kWH)	81,200 kWH per system
7	Annual Grid Consumption (kWH-Export & Import)	Export 81,200kWH, Import 2,880kWH
8	Energy Charges (INR/kWh)	4.90/- Per Unit
9	Module Type & Make	Mono crystalline, HHV Solar –HST 310M
10	Inverter Type & Make	String inverter, SMA STP 20000TL-30
11	Works Start Date	2 May 2016
12	Commissioning Date	25th August 2016

Installation		
Sr. No.	Parameters	MSME 1
1	Mode of Metering (Net/Gross)	Net Metering
2	PPA Details (Developers, Offtake, Structure, Rate, Security, Tenure)	PPA with BESCO at a tariff of Rs. 9.56 for 1st 50kW and at Rs. 7.08/- for 2nd 50kW
3	Net metering status	Connected to the Grid since 1 year
4	Application Date	10 March 2016
5	Installation Date	Started on 2nd April 2016
Execution		
Sr. No.	Parameters	MSME 1
1	System integrator details & experience	Global Energy Solutions
Operation & Maintenance		
Sr. No.	Parameters	MSME 1
1	O&M Agency	Global Energy Solutions
2	AMC cost	
3	Major O&M activities & spare support	Module cleaning, inspections of cables & Connectors, SPD etc
4	O&M Manager	Mr. Dharani

### 7.3. Brief rooftop solar policies for the selected states

#### 7.3.1. Rajasthan

Rajasthan receives maximum solar radiation intensity in the country and is therefore, one of the leading solar energy hubs in India. The State Government of Rajasthan instituted the Rajasthan Solar Energy Policy in 2011 catering to solar rooftop, off-grid and ground-mounted solar plants. The policy was revised in 2014 and Rajasthan Renewable Energy Corporation (RREC) is the nodal agency implementing the policy. Key features of the financial, technical and regulatory aspects of the revised 2014 solar policy are highlighted below.

Table 36	Policy features
Regulatory body involved	RREC
Metering	Net/Gross
Capacity limits	1 kWp to 1 MWp
Registration fees	LT Single Phase-Rs200, LT 3 Ph- Rs 500 HT-11KV-Rs 1000 , HT-33Kv-Rs 2000 Security Deposit for Solar PV plant <ul style="list-style-type: none"> <li>● Domestic - Rs 100/kW</li> <li>● Non Domestic and others - Rs. 200/kW</li> </ul> The amount of security for Eligible Consumer other than the owner of the premises, shall be double of the amount as mentioned above. The security deposit shall not bear any interest

Application fees	LT Single Phase-Rs200, LT 3 Ph- Rs 500 HT-11KV-Rs 1000 , HT-33Kv-Rs 2000 Security Deposit for Solar PV plant <ul style="list-style-type: none"> <li>• Domestic - Rs 100/kW</li> <li>• Non Domestic and others - Rs. 200/kW</li> </ul> The amount of security for Eligible Consumer other than the owner of the premises, shall be double of the amount as mentioned above. The security deposit shall not bear any interest
Timeframe for commissioning	Within 180 days
Distribution transformer capacity	The cumulative capacity to be allowed at a particular distribution transformer shall not exceed 30% of the capacity of the distribution transformer
Sanctioned load constraint	The maximum Rooftop PV Solar Power Plant capacity to be installed at any Eligible Consumer premises shall not be more than 80% of the sanctioned connected load/contract demand of the consumer.
Special provisions	None
Banking	Exempted
Wheeling charges	Exempted
Electricity duty	Exempted

### 7.3.2. Gujarat

Gujarat launched a solar energy policy in 2009 and achieved a cumulative capacity addition in excess of 1,000 MW. Gujarat Energy Development Agency (GEDA) is the state agency that oversees renewable energy programs in the state. GEDA revised the policy and released an updated document in 2015. The policy covers solar energy installations in the form of solar rooftop, off-grid and ground mounted plants. The policy also details out sector-specific schemes, pertaining to domestic, captive, commercial and industrial use. Specifically for solar rooftop installations, industrial, commercial and other consumers shall be provided with two options for contractual arrangement as a part of promotion for rooftop solar systems:

- Type 1: shall utilise only the 'energy' attribute of the generated solar energy from the rooftop solar PV system, and not utilise the 'renewable' attribute for RPO or REC.
- Type 2: shall utilise both the 'energy' as well as the 'renewable attribute' of the generated solar energy.

Key features of the financial, technical and regulatory aspects of the revised 2014 solar policy are highlighted below.

Table 37	Policy features
Regulatory body involved	GEDA
Metering	Net
Capacity limits	1 kWp to 1 MWp
Type of metering	Bi-directional meter of same accuracy class as the Consumer's meter existing before installation shall be used. For captive consumption and commercial and industrial of Type 2, ABT-compliant meter must be used

Tariff	<ul style="list-style-type: none"> <li>Residential and Government Net import: Consumer's existing tariff shall apply Net export: Any surplus energy generated and exported after adjustment of consumption at the end of the billing cycle shall be purchased DisCom at APPC rate</li> <li>Captive consumption <ul style="list-style-type: none"> <li>Not applicable for self-consumption</li> <li>Any surplus solar energy not consumed by consumer as per Energy Accounting shall be purchased (a) at APPC rate if the renewable attribute on solar energy is given to DisCom. (b) 85% of APPC rate if renewable attribute is not given to the DisCom.</li> </ul> </li> <li>Type 1 Net import: Consumer's existing tariff shall apply Net export: Any surplus energy generated and exported after adjustment of consumption at the end of the billing cycle will be purchased DisCom at APPC rate</li> </ul>
Sanctioned load constraint	Residential and government consumers - Up to a maximum of 50% of Consumer's sanctioned load.
Special provisions	
Banking	<ul style="list-style-type: none"> <li>Residential and Government Consumers -Not applicable - Banking of energy shall be allowed within one billing cycle of the consumer.</li> <li>Industrial and commercial consumer- Type 1</li> </ul>
Wheeling charges	<ul style="list-style-type: none"> <li>Residential and Government Consumers -Not applicable</li> <li>For projects not under REC – 50% of wheeling charges as applicable to Open access consumers</li> <li>For projects under REC – Wheeling charges as applicable to Open access consumers</li> </ul>
Electricity duty	Exempted
CDM	100% retained by the Consumer

### 7.3.3. Tamil Nadu

Tamil Nadu State Government instituted the Tamil Nadu Solar Energy Policy in 2012 to achieve grid parity and generate 3,000 MW of solar energy through solar rooftop, ground mounted and off-grid installations. Specifically for solar rooftop sector, the Government proposed a generation-based incentive mechanism (GBI) of INR2 per unit for first two years, INR1 per unit for next two years and INR0.5 per unit for the subsequent two years for all plants installed before 31 March 2014. Under this scheme, the government targeted a capacity addition of 50 MW in solar rooftop space. Tamil Nadu Energy Development Authority (TEDA) is the apex body governing the renewable energy program in the state. Net metering mechanism is available for solar energy projects however, net metering injection is not eligible for REC's in the state. Other key features of the financial, technical and regulatory aspects of the solar policy are highlighted below.

Table 38	Policy features
Regulatory body involved	TEDA
Metering	Net



Type of metering	Bi-directional meter of same accuracy class as the TANGEDCO service connection meter or as specified by TNERC.	
Tariff	If the import of energy by the consumer is more than the export in a billing cycle, the net energy consumed has to be billed by the Distribution Licensee as per the tariff in force applicable to that category of consumers. Export of energy in excess of the consumption of the consumer in a billing cycle shall be carried forward to the next billing cycle.  The settlement period for final settlement of net metered energy shall be 12 months period from August-July. Carry forward of energy will not be allowed to the next settlement period in the following year.	
Registration fees	INR 100. The eligible consumer will bear all costs related to setting up a photovoltaic system including metering and interconnection costs. The eligible consumer has to pay the actual cost of modifications and upgrades to the service line required to connect photovoltaic system in case it is required.	
Application fees		
LT connectivity	<b>Capacity range</b>	<b>Connecting voltage</b>
	Upto 4 kW	240V – single phase or 415V – three phase at the option of the consumer
	Above 4kW and upto 112kW	415V – three phase
	Above 112kW	At HT/EHT level
Distribution transformer capacity	Rooftop solar/solar systems shall be restricted to 30% of the distribution transformer capacity.	
Power evacuation for rooftop PV projects	<b>Solar PV System Size</b>	<b>Connecting voltage</b>
	<10 kWp	240 <sup>v</sup>
	10 kWp to 15 kWp	240 <sup>v</sup> / 415 <sup>v</sup>
	15 kWp to 100 kWp	415 <sup>v</sup>
	>100 kWp	11kV
Special provisions	<ul style="list-style-type: none"> <li>• Solar energy generators only have to pay 30% of the transmission, wheeling, scheduling and system operation charges that are applicable to conventional power generators</li> <li>• Exemption from Demand Cut to the extent of 100% of installed capacity</li> <li>• Single window clearance</li> </ul>	
Banking	Banking for a period of 12 month commencing from April 1st, 2016 to 31st March	
Wheeling charges	Exempted	
Electricity duty	Exemption of Electricity Duty for 5 years for using solar power from projects of self-consumption/sale to utility	

### 7.3.4. Karnataka

Karnataka Solar Energy Policy 2011–2016 was released in 2011. The Government revised the policy and the latest version Karnataka Solar Energy Policy 2014–21 came into effect to harness the estimated potential of 10 GW solar energy potential in the state. The state is one of the few that allow gross and net metering for solar energy-based projects. Some key features of the financial, technical and regulatory aspects of the solar policy are highlighted below.

Table 39	Policy features
Regulatory body involved	KERC
Metering	Net metering (Non domestic consumers) Gross metering (Domestic consumer)
Type of metering	Metering shall be in compliance with CEA (installation and operation of meters) regulation 2006, the grid code, the metering code and other relevant regulations issued by KERC/CERC
Tariff	The surplus energy injected shall be paid for by DISCOMs at a tariff determined by KERC
Capacity limits	1 kW – 500 kW (Net metering) In case the installed capacity of a solar plant exceeds 500kW, then the tariff determined for the megawatt scale will be applicable to such plants.
Registration fees	<ul style="list-style-type: none"> <li>• Upto and inclusive of 5kWp- Rs 1000; 2) Above 5kWp and below 50kWp (67Hp/59kVA)- Rs 2000; 3) Above 50kWp (67Hp/59kVA) and upto 500kWp- Rs 5000</li> </ul>
Application fees	<ul style="list-style-type: none"> <li>• Upto and inclusive of 5kWp- Rs 500 ; 2) Above 5kWp and below 50kWp (67Hp/59kVA)- Rs 1000; 3) Above 50kWp (67Hp/59kVA) and upto 500kWp- Rs 2000</li> </ul> Power Purchase Agreement on Rs. 200/- stamp paper
Distribution transformer capacity	Solar rooftop PV systems with installed capacity of 50 kW and above shall be connected at 11 kV distribution systems.
Power evacuation	Evacuation from 1 kW upto 5 kW installed capacity of solar rooftop PV shall be at single phase 230 volts Evacuation from 5 kW upto 50 kW installed capacity shall be at 3 phase 415 volts level
Special provisions	Deemed industry status, exemption from obtaining pollution clearances
Banking	<ul style="list-style-type: none"> <li>• Banking charges 2%</li> <li>• Captive projects under REC mechanism – Monthly Banking</li> <li>• ESCOM shall pay at APPC rate to the company for the banked energy remaining unutilised at the end of every month</li> <li>• Captive and Third Party not under REC mechanism – Yearly Banking</li> <li>• ESCOM shall pay at 85% of the latest feed-in tariff determined by Karnataka Electricity Regulatory Commission for relevant category of RE power to the company for the banked energy remaining unutilised at the end of the FY</li> </ul>
Wheeling charges	Exempted

Electricity duty	Exempted
CDM	<ul style="list-style-type: none"> <li>• 100% of gross proceeds on account of CDM benefit are to be retained by the project developer in the first year</li> <li>• In the second year, the share of distribution licensees shall be 10%, which shall be progressively increased by 10% every year till it reaches 50%</li> </ul>

### 7.3.5. Maharashtra

Maharashtra Renewable Energy Policy was instituted by the state government and is administered by Maharashtra State Electricity Distribution Company Limited (MSEDCL).

Table 40	Policy features
Regulatory body involved	MSEDCL
Metering	Net
Type of metering	Net meter conforming to CEA standards
Capacity limits	PV systems less than 1 MW are eligible
Registration fees	INR1,000 for all DisComs except Reliance. In case of Reliance, for loads < 5KW the charges are Rs 500.
Application fees	The Eligible Consumer shall bear all costs related to setting up of Rooftop Solar photovoltaic system excluding metering and interconnection costs.
Time frame for commissioning	
Distribution transformer capacity	The cumulative capacity of all Rooftop Solar PV systems under net metering arrangements connected to a particular Distribution Transformer shall not exceed 40% of its rated capacity
Special provisions	<ul style="list-style-type: none"> <li>• Exemption from Supervision charges for evacuation</li> <li>• Deemed industrial status</li> <li>• Exemption from E-duty for captive power plants for 10 years from the date of commissioning</li> </ul>
Wheeling charges	Exempted
Electricity duty	Electricity duty will not be levied for 10 years for solar projects under this policy if power is for captive use

