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Drivers and Challenges for Rooftop Solar Loans to Small and Medium Enterprises in India

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A CPI Report

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About US-India Clean Energy Finance

US-India Clean Energy Finance (USICEF) aims to drive access to energy in underserved regions of India, by supporting early stage development of distributed solar power projects. A partnership between the Indian Ministry of New and Renewable Energy, the Overseas Private Investment Corporation (OPIC), and a consortium of foundations, USICEF provides project preparation support that will catalyze long-term debt financing for distributed solar power from OPIC and other international financial institutions.

About Climate Policy Initiative

With deep expertise in policy and finance, Climate Policy Initiative works to improve the most important energy and land use practices around the world. Our mission is to help governments, businesses, and financial institutions drive growth while addressing climate risk. CPI works in places that provide the most potential for policy impact including Brazil, Europe, India, Indonesia, and the United States.

CPI's India program is registered with the name, "Climate Policy Foundation" under Section 8 of the Companies Act, 2013.

Executive Summary

India needs to accelerate the growth of its rooftop solar sector. Of the 40 GW of rooftop solar installations targeted by 2022, the country has only achieved 2 GW to-date. This slow progress may hinder the country's ability to reach its overall solar targets and meet its energy demand.

Presently in India, there are two dominant business models for rooftop solar: the capital expenditure (CAPEX) model, which has an approximate 75% of market share, and the renewable energy supply company (RESCO) model, which accounts for 22% of rooftop installations. These models work fine for larger commercial and industrial (C&I) players who have access to upfront capital, or can obtain commercial loans. However, rooftop solar remains constrained among smaller C&I players, micro, small and medium enterprises (MSME), and residential customers due to lack of financial resources and inability to access debt.

A CAPEX model with a commercial loan for the off-taker is a potential solution for these categories of customers. This model has proven effective with large scale implementation across Europe and the U.S.

This proposed model is similar to the existing the CAPEX model, where the customer makes the upfront payment to finance the solar assets. This payment is, however, financed by a mix of the customer's own equity and a commercial loan taken directly by the customer.

In this report, we assess the viability of the CAPEX loan model with a focus on the MSME sector, identify barriers to uptake, and recommended policy solutions to these barriers.

Through secondary research and interviews, we draw the following conclusions:

1. **There are several factors that could lead to a significant demand for the CAPEX loan model.** The barriers to the CAPEX cash (i.e., lack of capital) and the RESCO model, such as lack of equity with smaller developers and difficulty in raising debt for MSMEs, are some of the factors that can encourage the uptake of the CAPEX loan model.

   On the demand side, the model is primarily driven by a cost imperative as the installation cost of solar energy has decreased significantly and has become cheaper than procuring from the grid in most of Indian states.

   While developers may find it difficult to raise funds for projects targeting MSMEs and unrated clients, the customers themselves can leverage their existing banking relationships to raise debt for solar installation. This is another major driver.

   Customers can also take advantage of accelerated depreciation, offsetting their tax liabilities in the initial years.

2. **However, there are barriers and challenges that need to be addressed to expand the possible use of the model.** The biggest barrier that the model faces for MSME clients is perceived lack of creditworthiness due to lack of credit information/ratings. This barrier is further aggravated by the high transaction cost/time of MSME rooftop loans due to their small size, decreasing their attractiveness to lenders. Lack of awareness on the part of MSMEs and perceived performance risk of solar generation are other important barriers that can limit the expansion of the model's use.

   According to the lenders, MSMEs are often over-leveraged in terms of their borrowing, which makes it difficult for them to borrow for solar installations. MSMEs themselves may be unwilling to invest a sizeable portion of their capital (through equity or taking additional debt) in a non-core business activity that ties up capital for long periods of time.

3. **Market solutions could help overcome these barriers.** We identify and prioritize policy solutions for key barriers in Table ES1, based on factors of potential impact and implementation feasibility. These solutions cater specifically to the top two barriers identified in the study. The other barriers, although important, need further research and discourse. CPI, through its future work, intends to continue to work and delve deeper to find potential solutions to these barriers.

There are also certain other policy solutions, like increasing the limit for net-metered solar plants and devising clear timelines for benefits, that could help create a more favorable environment for rooftop solar. Coupled with the solutions discussed above, these solutions could open more opportunities for solar uptake in the MSME sector.

Table ES 1: Prioritized list of solutions for the CAPEX loan model

SOLUTIONS	RANKS
A mandatory operations and maintenance (O&M) contract, preferably with the Engineering, Procurement and Construction (EPC) contractor or otherwise with an established O&M player, is a solution that could ensure a certain minimum performance of the solar plant. It can also give enough comfort to lenders and off-takers for uptake of solar projects under the said model.	1
A guarantee with the EPC contractor, based on certain pre-set conditions, can provide a minimum generation guarantee for a defined period in the power-purchase agreement (PPA). Such a guarantee can give both the lender and the off-taker an assurance on a project's performance by assuring superior quality of the equipment for the off-takers.	2
MSMEs are considered as a high credit risk sector for lending, lenders are therefore reluctant for project-based lending to the sector. **A partial risk guarantee fund** to support uptake of solar power projects can reduce the credit risk associated with solar projects and can therefore lead to more financing in the sector.	3
Most MSMEs generally lack awareness about the technical and economic viability of solar energy. **Focused awareness campaigns** can lead to extended reach within the sector and hence create more market opportunities.	4
A **Standardized solar loan product**, having well defined assessment procedures, information requirement, risk categories and standard templates will make it easier for lenders to collect information and assess the projects, thereby reducing the transaction time and cost.	5
Several insurance companies have come up with **standalone solar insurance** to cover risks associated with the solar plants. This ensures customers of certain performance standards, thereby covering generation risk while developers can mitigate construction and operation risks associated with the project.	6

Contents

1. Introduction

In 2015, India announced an ambitious goal of increasing its renewable power capacity to 175 gigawatts (GW) by 2022, with 100 GW of solar, 60 GW of wind, 10 GW of bioenergy and 5 GW of small hydro. This would require a fivefold increase in renewable power capacity over the next seven years, making India a clean energy leader. India has also set its year-on-year targets, which charts a roadmap to achieve the 2022 goals.

Of the targeted 100 GW of solar installations, 40GW of power is assigned to rooftop solar and the remaining 60GW to large and medium-scale solar power grid projects. This ambitious target would require around $100bn (INR6.5tn) of investment (Cleantechnica, 2015).

While India's large-scale solar installation track record is respectable – with about 20 GW of installations as of March 2018 – the rooftop solar sector has had a slower start.

However, in the past year the rooftop solar sector has added almost 1 GW of capacity, accounting for 50 per cent of the entire installed rooftop capacity to date. **The growth can be attributed to the cost of rooftop solar power dropping below the cost of commercial and industrial power in most states.** These costs have declined significantly over the past few years, up until mid-2017, leading to lower tariffs in successive auctions for rooftop project allocations. Government incentives and policies to push rooftop solar installations have also contributed to the growth during the past year.

Due to increased competition in the solar power market and low solar panel prices, it has become cheaper to set up rooftop systems than before.

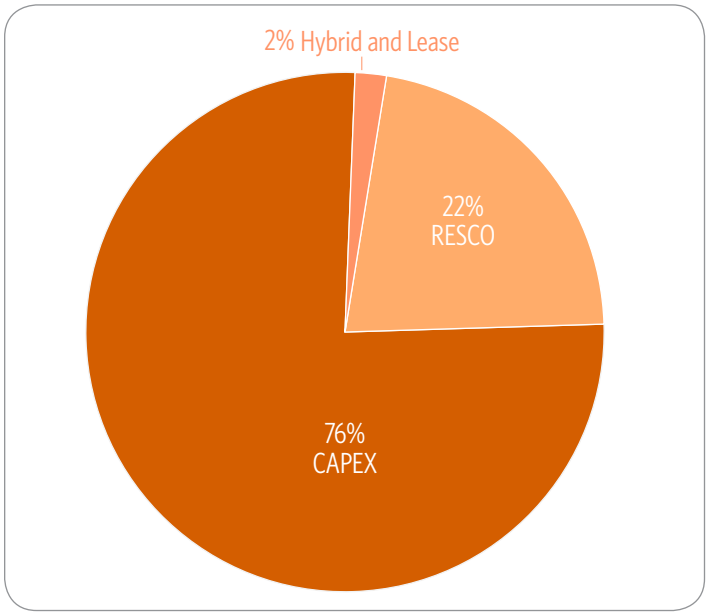
Currently, a majority of rooftop solar installations in India are in the commercial and industrial segment, but these are mostly with large corporations and high-credit rated entities. This is mainly because the customers in this segment have higher power requirements, have the required space, financial strength, and have achieved economies of scale. While smaller entities offer huge potential for rooftop solar, they typically do not have high enough credit ratings and/or often lack the financial track record to access finance under the two predominant rooftop solar business models in the market. For the market to move forward, and for India to come close to meeting its renewable energy goals, it is essential to find a solution to address these financing barriers faced by MSMEs (CPI, 2018).

Although the business case was strong, financing was difficult to come by in the past. In solar plants, the largest capital investment goes towards the installation of solar panels and must be made upfront. At current prices, this amounts to an investment of about Rs. 50 million per MW (World Bank, 2017)

1.1 Dominant business models in rooftop solar: CAPEX and RESCO

The Indian rooftop solar market has three key consumer sectors: commercial, industrial, and residential. 74% of current rooftop solar plants are commercial and industrial (C&I) installations, while only 26% are residential installations (Climate Policy Initiative, 2016). This is because the C&I consumers pay higher rates for grid electricity than the residential sector. Due to greater potential savings in cost of electricity, the C&I sectors have adopted rooftop solar power more quickly than the residential sector.

Figure 1: Rooftop PV share in FY 2017



Source: Bloomberg Energy Finance, industry trends

Within the C&I and residential sector, the Indian rooftop market can be further divided based on two financing mechanisms: The CAPEX and the RESCO models.

The CAPEX model is the most common business model for rooftop solar deployment in India with a market share of approximately 75%. In this model, the off-taker is the owner of the rooftop solar system and bears the entire capital expenditure of the project. The gains from tariff savings also accrue to the off-taker.

The RESCO model is an alternative to the CAPEX model, and has around 22% market share. In this model, a rooftop solar project developer bears the capital expenditure of the project. The developer also oversees the installation, operation, and undertakes the maintenance of the rooftop solar system. Further, the developer and the roof owner enter into an agreement in which the latter may either consume the electricity generated or receive appropriate monthly rent from the developer for the duration of the project. The roof owner in exchange will allow the developer to access his roof.

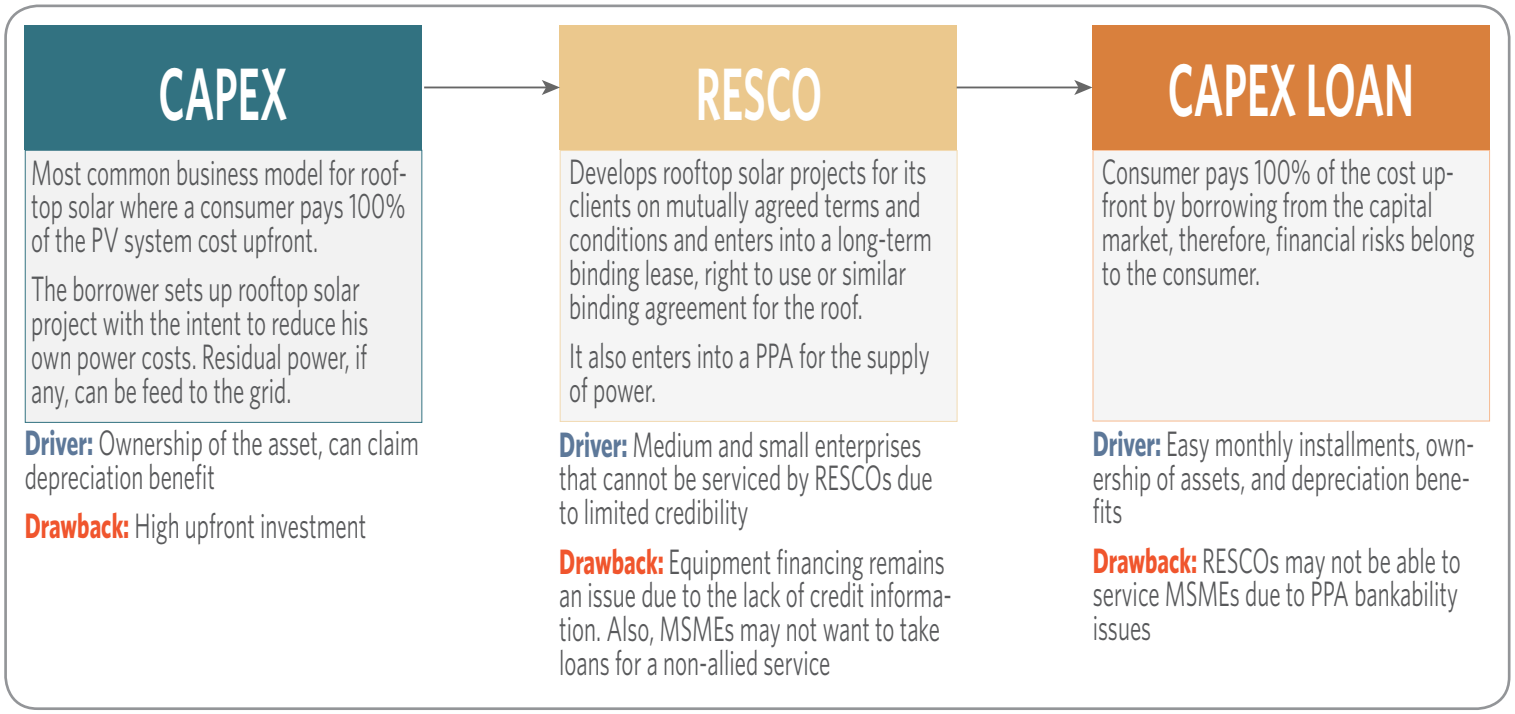
1.2 Challenges with existing models

The key challenges that restrict the attractiveness of the CAPEX model include high upfront capital requirement and the lack of historical performance data about the solar technologies used in the past. Moreover, the 80% accelerated depreciation benefit, which was one of the primary drivers for the CAPEX model, has been reduced to 40%, which further reduces the popularity of the model.

Over the years, the rooftop solar market in India has adopted the RESCO model in response to the barriers faced by the CAPEX cash model. However, the RESCO model also suffers from various limitations. These can potentially be overcome through the adoption of the CAPEX loan model.

Whereas, in case of the RESCO model, lack of financing for companies is a key barrier which needs to be addressed. This model also poses several challenges for the developer, as limited legal recourse is available in cases where contracts are dishonored under the extant Indian legal system. The recovery rates of seized rooftop solar systems are also low, resulting in substantial financial losses for the RESCO model in case of a breach in the PPA contracts.

Figure 2: Evolution of business models in India solar industry



Source: CPI Analysis

These barriers are more pressing for smaller C&I and residential customer segments as transaction sizes are low due to fragmented size of projects, lack of financial strength, and technical know-how. An unbridled growth of the residential and small C&I customers requires further intervention to catalyze uptake of the models. This will require us to look beyond the traditional sources of finance, e.g. cash, and start tapping into the commercial lending sector.

To explore the avenues for expanding the rooftop solar market, this report examines the viability of a new model of financing: A CAPEX model with a commercial loan component. We focus application of this model for micro, small and medium enterprises (MSMEs) within the C&I sector, an historically underserved market segment.

We conducted primary interviews with 10 stakeholders to identify and examine the strengths and barriers for the CAPEX loan model and recommend solutions that would allow this model to scale. The interviewees included project developers, financiers, and off-takers.

This report is divided into four parts:

- Section 2 introduces the structure of the CAPEX loan model and the potential drivers for expansion in rooftop solar;
- Section 3 identifies key barriers faced by the model
- Section 4 highlights suggested solutions and maps these solutions to the barriers.
- Section 5 is the conclusion and the way forward

CPI is currently conducting a similar analysis for the residential sector, which will feature in a separate report to be published at a later date.

2. The CAPEX loan model: A potential solution to scale-up rooftop solar for Micro, Small and Medium Enterprises (MSMEs) in India

The CAPEX loan model is a potential alternative to the existing business models in the rooftop solar market.

2.1 The CAPEX loan model

The CAPEX loan model is a variant of the existing CAPEX cash model, where the customer makes an upfront payment for the installation of the rooftop solar system. Unlike the existing model, in the CAPEX loan model, a part of the payment is made through customer's own equity while the remaining is financed through a direct commercial debt on the off-taker's books.

The proposed model is a promising alternative to the aforementioned popular models given that it can enable not only direct access to finance, but also provide cheaper power to MSMEs.

Though the CAPEX model with an upfront payment has become popular in India, the solar loan market is yet to pick up pace.

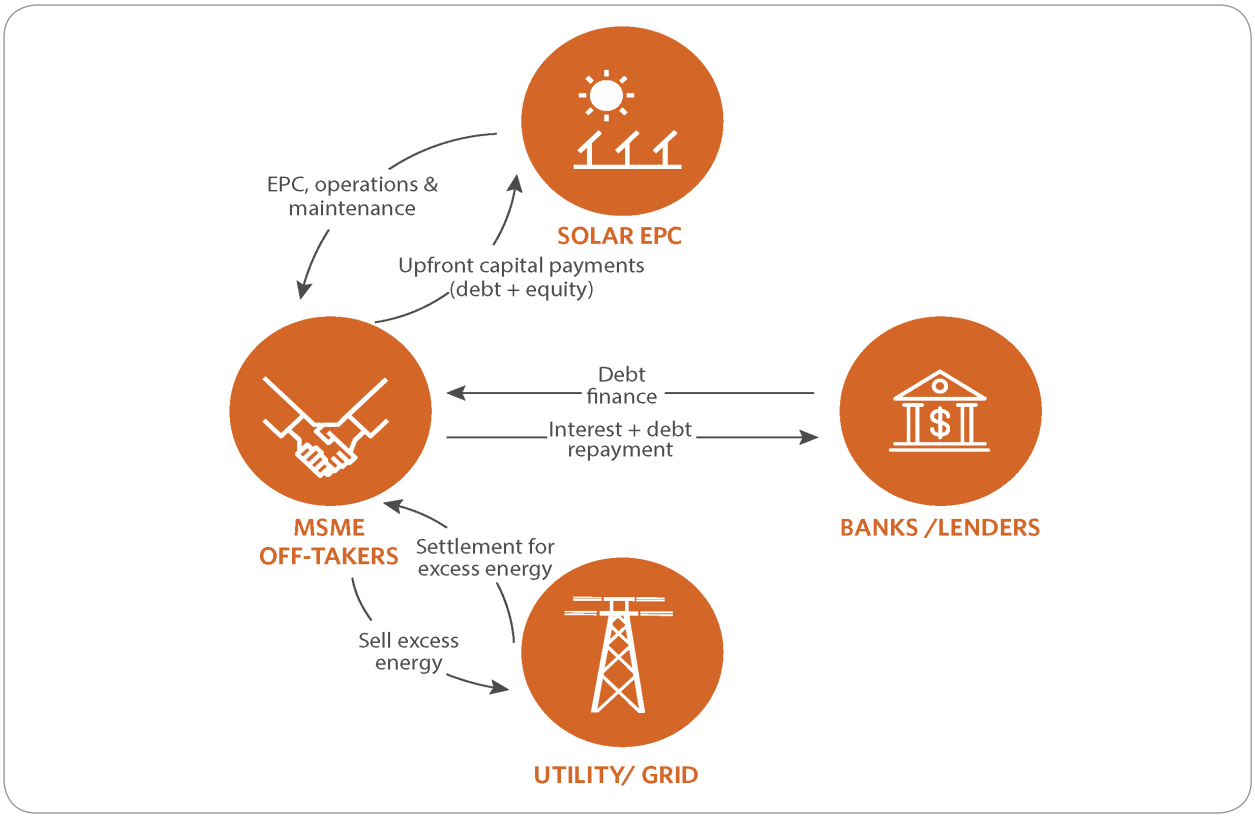
We believe that a large section of the market, currently serviced by upfront cash payments, can be converted in to a potential market for commercial solar loans. This will enable reduction in the overall cost of capital for the off-taker and open previously inaccessible markets to the lenders.

2.2 Advantages in comparison to the existing models

Our analysis shows that when compared to the existing CAPEX and RESCO models, the CAPEX loan model has certain drivers that makes the adoption of the model attractive to the MSME sector. For instance, **the cost of solar installations is significant for MSMEs, most of whom lack a cash surplus to provide the upfront payment required for a CAPEX cash model.** This reduces the attractiveness of the model to MSMEs.

We interviewed 10 relevant industry stakeholders, including developers, financers, consultants, and off-takers to identify the drivers that make the CAPEX loan model a more effective business model than the CAPEX cash and the RESCO model for the MSME sector.

Figure 3: The CAPEX loan model mechanics



Source: CPI Analysis

Expanding the use of the loan financing model for rooftop solar power in India is a promising solution to scale up adoption of rooftop solar power in the MSME sector and achieve the government's rooftop solar target. To facilitate greater use of commercial financing, it is important to understand the drivers that affect this model.

The interviewees rated each factor on a scale of 1 to 4, with 1 being the least significant and 4 being the most significant driver that attracted investment (unscored factors were given a 0). We averaged the stakeholder ratings for each driver to reach a final score. The ranks are shown in the table below.

Table 1: Drivers that make the CAPEX loan model more effective than the existing business models

DRIVERS	RANKS
Reduced cost of ownership	1
Existing relationship between the off-taker and the lender	2
Lack of debt finance under RESCO model	3
Accelerated depreciation benefits	4

2.2.1 REDUCED COST OF OWNERSHIP

To compare the financial attractiveness of the CAPEX loan and the RESCO model, we analyzed both the models based on the following assumptions:

1. The CAPEX loan model, with commercial debt at 70:30 debt-to-equity (DE) ratio for a 10-year tenor

2. The RESCO model, with a 10-year PPA and project handover at the end of tenor

In both the models, we projected the total cash outflows for the off-taker during the project life. This included the actual cost that the off-taker must pay combined with the opportunity costs/benefits of the solar project. The assumptions used in the model are listed below:

The CAPEX Model: Equity deployed, debt service, and operations and maintenance (O&M) costs were the primary cash outflow. The opportunity cost of the equity invested (at 15% return) was considered the provisional outflow. An accelerated depreciation benefit, at 40% of the written-down-value, was also considered in the model.

The RESCO Model: The PPA tariff was determined with the assumption that the developer would set a tariff targeting a 15% equity return. Using the same equity returns, we projected tariffs at Rs. 7 and calculated annual electricity payments as the cash outflow during PPA tenor. Post PPA tenor, O&M costs were considered the outflow for the remaining project life.

The cash outflows from both the models were then discounted at the customer's opportunity cost (the expected return from business operations) to arrive at the net-present value (NPV) of the cash flows which would represent the actual cost of the solar plant for the off-taker.

Table 2: Comparative financial analysis of the CAPEX and the RESCO models

NPV OF TOTAL CASH OUTFLOW	AMOUNT (INR MILLION)
Under CAPEX model with commercial debt	48.40
Under RESCO model (tariff determination using WACC)	56.09

Our analysis shows that over the project's life the CAPEX loan model can be up to 14% cheaper over the RESCO model in terms of cost to off-taker. The results of the analysis are listed in Table 2.

Further analysis revealed that at the same cost of debt and equity for both, the off-taker and the developer, without accelerated depreciation benefit, both the models would have the same NPV for the off-taker. This suggests that **accelerated depreciation is the major reason for financial attractiveness of the CAPEX loan model over the RESCO model.**

In addition to the accelerated depreciation benefit, the financial attractiveness of the CAPEX model is also contingent on the cost of capital of the off-taker.

Our analysis considered a 15% opportunity cost on equity investments for the MSME off-taker. Thus, the attractiveness of the CAPEX model would increase for enterprises with low and stable returns on investment, due to low opportunity loss, compared to enterprises with higher growth rates.

In addition, the CAPEX loan model will be more attractive to enterprises that can secure debt at lower rates compared to the developers, due to low debt service costs.

(The detailed impact of accelerated depreciation and cost of capital along with list of inputs, key assumptions and methodology is in Appendix 3)

Our analysis yields two primary results:

- The CAPEX loan model with an accelerated depreciation benefit is up to 14% cheaper than the RESCO model over the life of the project.
- The attractiveness of the CAPEX loan model is further increased with the reduced cost of capital for the off-taker.

2.2.1 EXISTING RELATIONSHIP BETWEEN THE OFF-TAKER AND LENDER

Pre-existing relationships with banks is a major factor that can help MSMEs secure debt financing for rooftop solar installations, as financing is otherwise difficult to obtain in the RESCO model. Enterprises that have relationships with banks (from previously obtained finance for equipment or term loans) have an improved ability to borrow additional capital for solar projects. Such relationships may not typically exist for the RESCOs themselves.

2.2.2 LACK OF DEBT FINANCE UNDER THE RESCO MODEL

Raising debt for the MSME projects under the RESCO model has been a challenge for the developers. Both lenders and project developers, believe that funding the sector is difficult, expensive, and risky. These factors have resulted in low mobilization of debt finance for solar projects, servicing the MSME customers.

The challenge is further exacerbated by the characteristics of the project developers, as many of them are small companies that have existed for less than five years and have limited assets to offer as collateral. Additionally, these developers may not be able to raise enough equity to back the debt.

2.2.3 ACCELERATED DEPRECIATION BENEFITS

Accelerated depreciation is a major incentive that was introduced by the Government of India to increase the attractiveness of the solar project investments. It has also played a significant factor in driving the C&I off-takers to use the CAPEX model.

Under Section 32 of the Income-tax Act, accelerated depreciation (AD) accounts for a major relief in the upfront cost of solar by providing a tax break in the first few years of operations. The current policy allows investors, when setting up capacity for captive use, to take advantage of up to 40% of accelerated depreciation that could reduce the customer's tax liability in the initial years.

3. Barriers to scale-up the CAPEX loan model

In this section, we identify the key barriers in commercial borrowing to finance solar assets. This type of capital is frequently used by off-takers to finance solar assets.

The CAPEX loan model shows a lot of promise in terms of addressing challenges of the existing models, however, there are still barriers to scale-up. In order to indicate the significance of the various challenges limiting the growth of the model, we have prioritized the barriers according to their severity, using a ranking system of 1 to 5, with 1 being the most severe (Table 3). These rankings are based on the scores provided by the interviewees.

Table 3: Barriers to scale-up the CAPEX loan model for MSMEs

DRIVERS	AVERAGE SCORE	RANKS
Lack of interest by the lenders	4.29	1
Lack of awareness among the MSMEs	3.14	2
Inability of MSME to absorb additional debt	2.43	3
Opportunity cost of the investment	2.25	4

We have not included the policy barriers in our analysis, as these barriers are generic to the rooftop solar sector and are not specific to any business model (policy barriers are separately included as Appendix 1).

3.1 Lack of interest by the lenders

Lack of interest in lenders is the most significant barrier to commercial borrowing, with a score of 4.29 out of 5.

Information is key for the credit decisions made by banks. One of the major challenges include acquiring information about the credit risk of the borrower, as borrowers generally have more information than the lenders about projects. This problem is known as information asymmetry and is a key concern that needs to be addressed. As the absence of a mechanism to bridge the asymmetry between the borrowers and the lenders would lead to a failure of efficient loan allocations.

This barrier becomes more pronounced for loans to the MSME sector because it is more opaque, especially in the regional bank branches where MSME clusters are located. In these branches, lenders to MSMEs may not be adequately aware of the feasibility of the solar project, which exacerbates the effect of the problem.

The lack of interest from lenders is due to three sub-barriers:

1. Concerns regarding a company's ability to pay without delays/defaults. This may arise from inadequate data on payment track record and credit ratings for the companies. Lenders may become concerned by the risks of long-term project finance (Myers, 1985).

2. Perceived performance risks of solar projects coupled with limited awareness at the lender's level, leading to unwillingness to fund the CAPEX solar rooftop projects. This performance risk may arise due to multiple factors along the value chain. These are:

Sub-par quality of the equipment by the EPC
In recent years, India has been adding thousands of megawatts of solar power capacity which has led to record-low tariffs. But this boom is riding on an uncomfortable truth: poor quality. According to a study by PI Berlin, a German technical advisory firm, the solar modules or panels that form the industry's backbone are sub-par, and besides being poorly maintained, many plants mushrooming across India are flawed in their construction. Quality will be an important ingredient to build healthy plants with operation lives of 25 years economically, safely, and reliably. However, owing to short project timeframes, performing quality checks can be challenging. Since there are no alternatives for quality assurance in solar installations, quaility checks need to be effectively implemented. This is not only to avoid relative impacts on cost and time, but also the impacts on the O&M activities and committed plant guarantees at later stage.

Sub-optimal performance of the system due to inadequate operation and maintenance activities
Proper maintenance of a PV plant is essential to maximise both energy yield and the plant's functional life. Optimal operations must strike a balance between maximising production and minimising cost. Hence, in order to arrive at an accurate ROI figure, one needs to address the operations and maintenance issues by assigning accountability to agencies specializing in O&M services.

Box 1: Sub-par quality of the equipment inflates its risk profile

PI Berlin, a German technical advisory firm, analyzed six projects in collaboration with the Ministry of New and Renewable Energy (MNRE) and the two state-run organizations; the National Institute of Solar Energy (NISE) and the Solar Energy Corporation of India (SECI). They found that the Indian market is one of the most profitable markets, yet it is risky for project developers and investors in photovoltaics (PV or silicon-based solar panels). While large-scale projects of over 100 megawatts (MW) are now common, the investment risks caused by climate, poor installation, and lack of proper maintenance is on the rise. Take module quality for starters. PI Berlin observed that no specific certificates beyond the basic IEC (International Electrotechnical Commission, a global standards body for solar panels) certification were requested by the owners to the module manufacturers. Neither does SECI insist on many certifications for the companies to apply for projects (Quartz India, 2018).

Resource risk/generation risks
A tropical country like India usually receives about 300 days of sunshine a year. However, weather, characteristically, is extremely erratic. This risk arises due to insufficient amount of sunshine or the unpredictability of the weather.

3. High transaction costs involved in low ticket transactions is yet another reason for the disinterest from lenders. Rooftop solar transactions are usually small in size. This barrier is more significant for the CAPEX model where projects cannot be aggregated, unlike the RESCO model.

3.2 Lack of awareness among the MSMEs

Lack of awareness of alternative models among the off-takers is a major factor behind the low uptake of rooftop solar projects in India.

This barrier is particularly significant for MSMEs, where lack of knowledge on the technical and economic viability of solar, and capability issues at the enterprise level has resulted in relatively fewer rooftop installations.

These enterprises have limited knowledge of the different kinds of business models available for rooftop solar projects, and the terms of funding available from the lenders. The lack of access to this information makes it significantly more difficult for these enterprises to evaluate the benefits of adopting a rooftop solar project.

The barrier is exacerbated by lack of educational input from the rooftop solar industry or the government. Educating enterprises and MSME clusters on the financial and technical details of rooftop solar adoption will help correct this issue.

3.3 Inability of MSME to absorb additional debt

Highly leveraged existing borrowing structures of MSMEs often limit the enterprise's ability to absorb additional debt for rooftop solar projects.

Most MSMEs in the country have low fixed assets to long-term liability ratios, which limits the lender's ability to provide additional financing for solar installations. This is a major reason for lack of financing in the MSME sector which curtails the uptake of solar projects.

3.4 Opportunity cost of the investment

The opportunity cost of the investment is a significant barrier to adopting a CAPEX model for MSMEs.

Most MSMEs, particularly high growth enterprises, are unwilling to dedicate capital or block their borrowing limit to invest in a solar plant installation because they don't consider it a core activity. There is a preference to use these features to fund core business operations that could increase sales/boost profits and can in turn generate more returns. The impact of this barrier is already discussed in the financial analysis section above.

4. Solutions and policy recommendations

In this section, we will map potential solutions to the barriers identified in Section 3. This is, again, performed based on the feedback received from stakeholder consultations. We have used a combination of primary and secondary research to prioritize the solutions by estimating the overall impact and feasibility of these solutions. The solutions are listed in Table 5, below.

Table 4: Proposed solutions to overcome the barriers faced by the CAPEX loan model

SOLUTIONS	RANKS
Mandatory O&M Contract	1
EPC Player's Guarantee	2
Partial Risk Guarantee Fund	3
Awareness Creation for MSMEs	4
Standardized Solar Loan Product	5
Standalone Solar Insurance	6

These solutions are designed to be accessible to developers, lenders, and off-takers in the rooftop solar sector and range from operational and process changes to exploring new financing mechanisms and better use of public funds.

To measure the impact and feasibility of each recommendation, we categorized them as low, medium, and high on each metric and combined them to create a measure of overall attractiveness.

For the impact metric, we considered the ability of the proposed recommendation to address the challenge, and the overall potential it can unlock. For the feasibility metric, we considered the likelihood of implementation of the proposed recommendation. If all recommendations are implemented together, their impact would be much higher than implementation of individual recommendations.

We have presented a one on one barrier-to-solution mapping in Table 6. While the two major challenges seem to have direct and implementable solutions, the last two barriers relating to the inability of MSMEs to absorb additional debt and its opportunity cost remain to be further examined. Although most of these measures can be used to mitigate the risks, further research is warranted to assess its feasibility and impact.

4.1 Challenge 1: Lack of interest by the lenders

4.1.1 CHALLENGE 1A: DELAY/DEFAULT ON PAYMENTS AND RISK OF EXISTENCE

Recommendation: Partial risk guarantee fund

In general, lenders are averse to lending to developers targeting MSMEs and unrated C&I players due to the high degree of credit risk associated with funding their projects.

Our discussion with lenders allude that a partial risk guarantee fund, using public funds, can be a potential solution to address the credit risks in MSME projects. It would also cover the private lenders against the risk of delay/default in payment, and cover any business operation risks.

Box 2: Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)

PRGFEE is a risk-sharing mechanism that provides commercial banks with a partial coverage of risks involved in extending loans for energy efficiency projects. The Government of India has approved around Rs. 312 crore for PRGFEE.

The fund encourages lending in the energy efficiency space by covering up to 300 lakhs or 50% of the loan amount for an initial period of 5 years. It has attracted special interest from leading banks and financial institutions across the country.

A risk guarantee fund can improve the overall risk profile of solar projects, which in turn can reduce the interest rates for rooftop solar loans in the MSME sector. This improves the attractiveness of the sector and increases solar uptake.

Table 5: Key policy recommendations to overcome challenges faced by the CAPEX loan model

BARRIER	SOLUTION	KEY PARTICIPANTS	IMPACT	FEASIBILITY	RATIONALE
1. Lack of interest from the lenders					
1.1 Payment delays and defaults and risk of existence	Partial risk guarantee fund	Central and State Govts.	Medium	High	MSMEs are in the high risk category due to their limited credit history and information available, resulting in a high possibility of payment default. Since the loan tenures for solar projects are high, lenders are apprehensive of the operational existence of these enterprises. These factors make it difficult for the lenders to fund the MSME sector. A risk guarantee fund would mitigate these barriers by shielding lenders in case of payment delays/defaults. In case an enterprise is losing business, this fund can partially cover the losses for the lender.
1.2 Perceived performance risk leading to unwillingness to fund					
1.2.1 Quality of the equipment	EPC player's minimum generation guarantee	EPC players	Medium	High	A minimum guarantee by the EPC assures the off-taker of an adequate quality of the solar panels.
1.2.2 Sub-optimal performance due to inadequate maintenance	Mandatory O&M contract	O&M Agencies	High	High	A mandatory O&M contract ensures a timely, efficient, and professional maintenance of the equipment. An optimized O&M is an important factor for the sustained capacity utilization of a solar power plant.
1.2.3 Resource risk/ Generation risk	Standalone solar insurance	Third party insurance companies	Low	Medium	A standalone insurance product could cover the unpredictability in the weather leading to fluctuations in the number of sunny days/ amount of sunlight.
1.3 High transaction costs/time involved in low ticket transactions	Standardized solar loan product	Banks/Other lenders	Medium	Medium	The small size of rooftop projects (specific to the CAPEX projects due to lack of aggregation) leads to high transaction costs/time/efforts and is not attractive to lend. The lenders suggested that if a standardized solar loan can be made which includes all processes, information templates, and project risk metrics it could significantly reduce the overall costs. It would also clarify the process and information requirements for the borrower.
2. Lack of awareness among the MSMEs	Awareness creation for MSMEs	Developers, Third party	Medium	Medium	Lack of awareness amongst the MSMEs about the technical and commercial viability of solar has led to fewer rooftop solar installations in the sector. Focused campaigns for MSMEs, specifically MSME clusters, can create awareness and demonstrate economic benefits of solar power to increase the sector demand.

This solution has a medium impact, as per the conversations with our stakeholders. This is because such instruments exist in the market in various capacities, such as Micro Units Development & Refinance Agency Ltd. (MUDRA) scheme by Small Industries Development Bank of India (SIDBI). Unfortunately, these schemes have had limited impact so far.

Another example of a partial risk guarantee fund is the credit guarantee fund by SIDBI. As a major policy overhaul, the corpus of the credit guarantee fund was raised substantially from Rs. 2,500 crore, at the request of the Indian Government. The government also raised its guarantee level to 75% of such loans, which is an increase of 50%. More information on the credit guarantee scheme for MSMEs is included in Section 7.2 (Appendix 2).

4.1.2 CHALLENGE 1B: PERCEIVED PERFORMANCE RISK LEADING TO UNWILLINGNESS TO FUND

Sub-optimal performance of the system

Recommendation: Mandatory O&M contract

Operation & maintenance ("O&M") activities play an important role in determining the performance of the solar generation asset.

Subsequently, an optimized O&M contract is important for the success of a solar power plant.

Currently, O&M contracts are either outsourced or managed by Engineering, Procurement and Construction contractors (EPCs), who can further outsource to local vendors. In some cases, activities like cleaning and monitoring are performed by the off-takers themselves. Some of the lenders and developers we interviewed stressed that the service-level agreements and contractual frameworks for O&M are not well-defined. When combined with capability issues at the local vendor level, this results in inadequate operation and management of a plant. The up-shot of this is that solar plants often perform at sub-optimal levels.

An O&M contract can include the following contractor services and obligations (Medium.com):

- Plant monitoring requirements,
- Scheduled maintenance requirements,
- Unscheduled maintenance requirements,
- Agreed targets and/or guarantees (for example, response time or system availability figure),
- Contractual obligation for the contractor to optimize plant performance,
- And, all maintenance tasks could be performed in such a way that it minimizes their impact on the productivity of the system.

These contracts can have other key provisions such as performance ratios and yield guarantees, uptime guarantees, and performance incentives that could establish clear accountability for the O&M contractor.

Having a strong and well-defined contract with the EPCs or a specialized O&M vendor can ensure adequate O&M practices. This ensures that the warranties are maintained, plant reliability remains optimum, and the overall plant performance is sustained.

Box 3: Dedicated O&M leading for improved project performance

Rockford Solar installed a solar plant in one of India's highly industrialized zone Mandi Govindgarh in the state of Punjab. The area had consistent high temperatures and significant quantities of dust pollutants (fly ash, acid sludge, tar sludge, coke breeze) that would get deposited on the panels every day.

Rockford Solar undertook a pro-active approach by performing daily O&M functions like cleaning and were therefore able to achieve a high capacity utilization factor for the project.

Quality of the equipment/ Technological risks

Recommendation: EPC players' guarantee

A 'performance guarantee' by the EPC player is another potential solution that can cover the technological risks of a rooftop solar plant.
In such a guarantee, the EPC contractor based on certain pre-set conditions, will provide a minimum generation guarantee for a defined period in the PPA. Such a guarantee can give both the lender and the off-taker an assurance on the project's performance and superior quality of the equipment for the off-takers.This measure, as mentioned in Table 6, ranks medium on impact as it would partially reduce performance risk, and ranks high on feasibility. This is because the EPC contractors are better placed to absorb the performance risks compared to the off-takers.

Resource/ Generation risk due to inadequate sunshine

Recommendation: Standalone solar insurance

A standalone solar insurance product is a mechanism that could cover the risks associated with the unpredictability of the weather, like in case of storms or hurricanes, and the loss of power generation when the sun is not shining.

An insurance product can cover the resource risks of a solar project.
Existing insurance companies can provide insurance that shields both the off-taker and the EPC contractor against such risks, making the transaction more secure.

Such an arrangement can provide the lenders with an additional layer of security that lowers the chance of default due to performance issues. ICICI Lombard and HDFC Ergo General Insurance companies have brought similar insurance products to market, although their effectiveness and uptake is yet to be ascertained.

Box 4: HDFC ERGO solar insurance

HDFC ERGO General Insurance Company has announced the launch of the Solar Energy Shortfall Insurance Policy, designed to account for the non-traditional and non-physical damage-related risks that solar projects regularly face. The policy will cover anything from utility-scale solar farms and green fields across India, to portfolios of rooftop installations for commercial and residential buildings.

Under the policy, the company will cover risks related to non-physical damage, such as insufficient hours of sunshine and the related impact on the performance of the project. It also protects against the incorrect installation of a system and the subsequent impact that would have on the revenue models. Additionally, the policy covers errors in the calculations of projected yields.

4.1.3 CHALLENGE 1 (C): THE HIGH TRANSACTION COST/TIME INVOLVED IN LOW TICKET TRANSACTIONS

Recommendation: Standardized solar loan product

A standardized solar loan product, created by banks/ lenders, can help address the high transaction costs and time linked to funding the CAPEX loan rooftop projects.

A solar loan – like a home loan – can have clearly defined assessment processes, standard templates for information, and well-defined risk categories for different types of projects. This would standardize the entire process of lending and would provide clarity for the borrower.

A common and well-defined assessment process can improve the ability of the lenders to assess a project and reduce the turnaround time. This reduces the associated transaction costs for individual solar projects.

4.2 Challenge 2: Lack of awareness among the MSMEs

Recommendation: Awareness creation for MSMEs

A significant barrier to the uptake of the CAPEX loan model is lack of awareness in the MSME sector.

These enterprises lack knowledge of the technical and economic viability of solar, the available business models, and the types of funding available. There have been limited efforts from the rooftop solar industry or the government to address this issue.

Box 5: Solar Energy Awareness Campaign: CaptureMySun

To spread awareness of the potential of solar energy in India, MYSUN organized the fourth photo-walk under the #CaptureMySun campaign. A nationwide initiative, #CaptureMySun plans to cover more than 20 cities across India and winners from each city would compete against each other for a grand prize of Rs. 50,000. The first three photo-walks were organized in Mumbai, Bengaluru, and Hyderabad, and were met with a great response.

To attract customers, it is important to consider pre-existing awareness and coordinate marketing efforts. Above-the-line marketing[1] efforts such as roadshows and events that specifically target MSME clusters can help these enterprises understand and evaluate the viability of solar energy.

Encouraging the positive perception of solar and retail solar loans are essential to ensure adequate demand for the CAPEX loan model.

4.3 Challenge 3 and 4: Inability to absorb additional debt and opportunity cost of the investment

Our analysis shows that the following barriers **- opportunity cost of the investment and inability of MSMEs to absorb additional debt due to over leveraged balance sheets of the company -** apply specifically to the financial heath and decisions of an enterprise.

Both these barriers are pressing, though neither have complete solutions at present. In our current scope of study, we have been able to identify certain fixes that can partially address these issues; debt restructuring at the MSME level can solve over-leveraged balance sheets by increasing capacity for additional borrowing.

To address the opportunity cost of investment, our analysis shows that with accelerated depreciation benefit, the CAPEX model is attractive even for organizations with higher growth. Any further improvements in the competitiveness of solar projects can make investments in solar more attractive for these enterprises.

However, these solutions would have limited impact. Additional research and discourse is required to create more concrete solutions.

4.4 Other Recommendations

In addition to the suggested solutions, several other factors can catalyze the involvement of lending institutions.

These factors include the education of loan disbursement agencies, establishing norms for quality control of products, pilot studies to measure the technical and commercial impact of the high penetration of rooftop solar on host power distribution companies, creating intermediation platforms to raise awareness, and time-bound clearance of subsidy applications.

Secondary solar modules and equipment markets encourage the re-use and re-deployment of stranded project assets for the remainder of their life. These assets could be assessed, and assurance could be provided to off-takers by attaching limited period warranties.

Smart grids are an advanced type of infrastructure that allow the two-way flow of power. Along with upgraded transformers that can take the added rooftop capacity, they could create a conducive environment for rooftop solar uptake.

1 'Above the Line' advertising consist of advertising activities that are largely non-targeted and have a wide reach. ATL communication is done to inform the customers about the product. Conversions are given less importance in above the line advertising.

5. Conclusion and way forward

Currently, the CAPEX loan model is in a nascent stage in India, with only a limited share of the rooftop solar industry.

A large part of the industry is still driven by upfront payments. However, due to the liquidity constraints of the MSME sector, cash payments may not be feasible. This opens an opportunity for the proposed CAPEX loan model.

Our analysis demonstrates that the CAPEX loan model is financially viable for the commercial, industrial, and the MSME sectors with an additional support from the government's fiscal incentives.

The CAPEX loan financing model in India is largely constrained by lack of lender and MSME awareness, issues related to credit worthiness of the borrower, and the over-leveraged position of the enterprises.

We have developed recommendations for policy changes and financial instruments that could address these challenges. Government entities, industry players, financing agencies and other stakeholders will need to work together to implement these recommendations.

The key solutions that we recommend are:

1. **Mandatory O&M contract:** A strong and well-defined contract with the EPC, or a specialized O&M vendor, can ensure adequate O&M practices and that the warranties are maintained, plant reliability remains optimum, and the overall plant performance is sustained.
2. **EPC players' guarantee:** A mandatory 'performance guarantee' by the EPC player, based on certain pre-set conditions, can give a minimum generation guarantee for a defined period. Such a guarantee can give the off-taker assurance of the equipment's quality.
3. **Partial risk guarantee fund:** This fund would cover private lenders against the risk of default and can potentially lower interest rates for MSMEs, improving the attractiveness of the rooftop solar sector.
4. **Standardized solar loan product:** Such a product can standardize the information collection and assessment procedures, thus bringing down both the transaction costs and time.
5. **Standalone insurance product:** A standalone insurance product by insurance companies could cover resource risks arising due to insufficient sunny days.
6. **Raising awareness among lenders and borrowers:** To increase access to debt financing for rooftop solar, the Ministry of New and Renewable Energy (MNRE) can train bankers to assess loan applications for rooftop solar power more thoroughly. The devlopers could adopt above-the-line marketing solutions like events and roadshows, and the government can work to create awareness among the potential off-takers.

As part of the next steps to this report, it would be valuable to study the role of various institutions and public bodies in the implementation of these solutions to understand their responsibilities and ownership. This would enable the creation of policies and frameworks for execution.

Having identified the impact and feasibility of these solutions and the corresponding risks, **additional work must be conducted to determine the efficacy of the various policy and market risk mechanisms that have been formulated,** and their impact on costs, resources, and the availability of capital. Further studies are required to measure the technical and commercial impact of the high penetration of rooftop solar on host power distribution companies.

If the accelerated deprecation benefits are further reduced by the government, as the trends suggest, the attractiveness of the CAPEX loan model may deteriorate compared to the RESCO model. This needs to be further investigated as the policies shift.

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7. Appendices

7.1 Appendix 1: Policy barriers

7.1.1 SIZE RESTRICTION ON THE ROOF

Locations with spacious roofs – automobile manufacturing plants, for instance - may have enough area for a plant with a 20 MW capacity, but the government policies allow only 1 MW of installed capacity for grid-connected rooftop plants. If these restrictions are lifted, the additional capacities would create a significant cost benefit for those who have already adopted rooftop solar.

7.1.2 UNCERTAIN TIMELINES

Another issue with most state-level policies is that they don't have set timelines for any of the benefits or subsidies they offer solar plants.

Once a customer installs a solar plant and begins receiving the subsidies or benefits associated with the plant, the timeline that outlines the provision of these benefits is often unclear. The uncertainty surrounding the timeline can potentially reduce the confidence a given customer has when entering a long-term contract. Improving the transparency of contracts would greatly improve the confidence of potential consumers, which would subsequently increase the attractiveness of installing a solar plant.

Appendix Box 1: Stable policies and timelines

In 2015, the state of Karnataka issued a policy specifying that the benefits associated with government subsidies must continue for 10 years after the commission of the solar plant. The state of Maharashtra enforces a net-metering policy when solar plant owners sign a 20 year contract with the distribution company. This freezes contractual obligations for the duration of the signed period.

The states of Karnataka and Maharashtra have both successfully implemented timelines for the various policies they have introduced. These have significantly helped in accelerating the adoption of rooftop solar plants.

7.2 Appendix 2: Credit Guarantee Mechanism

CGM- Enhancement in Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) corpus from Rs. 2,500 cr to Rs. 8,000 cr:

The government has majorly overhauled its credit guarantee scheme to increase the number of adequate loans available to MSMEs. Mainly by tripling its corpus to Rs. 8,000 crore and by allowing non-banking financial companies (NBFCs) and banks to take advantage of the official guarantees and extend credit to solar developers at greater units.

The corpus of the credit guarantee fund has been raised substantially from Rs. 2,500 crore at the behest of Prime Minister Narendra Modi. The government has also decided to raise its guarantee level to 75% of such loans, which was 50% earlier, as it intends to enable smoother credit flow at greater units, keeping in mind their financial constraints and massive employment generation potential.

NBFCs that seek guarantees to offer loans to MSMEs must lower their interest rates to a level that meets the criteria set for government-backed loans. Meeting these interest rate levels are incentivized by the increased security recieved from government-backed loans. While in the past these loans were collateral-free, the government has now asserted that it will allow banks to seek collateral from the borrowers, provided they prove it necessary for the security of the loan. However, since 85% of these loans are already secured by a government guarantee and margin money (75% and 10% respectively), the need for such collateral is minimal.

Further, the government has decided to make structural changes to this crucial guarantee fund. Earlier, guarantee for credit flow of around Rs. 19,000-Rs. 20,000 crore a year was given under it. Now that the guarantee corpus is raised substantially, the credit flow may go beyond Rs.40,000-50,000 crore.The Credit Guarantee Fund Trust for Micro and Small Enterprises will operationalize this scheme. The total loans extended under such guarantees so far have touched Rs. 1,40,000 crore, of which the outstanding amount is around Rs. 72,000-Rs. 75,000 crore.[2]

2 https://www.financialexpress.com/ec5onomy/credit-guarantee-government-triples-corpus-to-rs-8000-crore-for-msme-companies/1195082/

7.3 Appendix 3: Financial analysis

Appendix Table 1: Key inputs for financial analysis

KEY INPUTS	UNITS	VALUES
Operating Inputs		
Installed capacity	MW	1
Capacity Factor	%	17.0%
PPA Tariff	INR/kWh	7.00
PPA Tenor	Years	10.00
Increase in PPA Tariff	%	2.0%
Annual Degradation	%	0.5%
Investment Inputs		
Installed capacity	MW	1
Investment costs	INR /MW	50.0
Other Inputs		
O&M costs	INR mn/MW/p.a.	0.50
Annual increase in O&M costs		3.00%
Project Life	Years	25
Hours of energy generation per annum		8,760
Financial Inputs		
Depreciation period	Period (Years)	25
Book Depreciation	WDV	4.00%
Accelerated Depreciation	WDV	40.00%
Capital Structure		
Debt	%	70.0%
Equity	%	30.0%
Debt term	Years	10.00
Cost of debt	%	12%
Cost of equity	%	15%
Tax Rate		
Income Tax Rate		34.61%
MAT rate		21.34%

Financial model approach and assumptions:

The following models were compared:

- CAPEX Model: At 70:30 debt/equity ratio with a 10-year loan tenor
- RESCO Model: With a 10-year PPA (and project handover to the off-taker at the end of PPA tenor)

Approach:

For both the models, our analysis projects the total cash outflows from the off-taker for its project life. These cash outflows include the actual cost that the off-taker must incur/pay along with the opportunity costs/

benefits. The assumptions used in the model are as below:

CAPEX Model: For the base model assumptions we considered a debt/equity ratio of 70:30 for a tenor of 10 years. Rate of debt and equity are considered 12% and 15% respectively.

Equity deployed, debt service and O&M costs were considered as primary cash outflows. The opportunity cost of the equity invested (at 15%) was considered as the provisional outflow while an accelerated depreciation benefit (at 40% WDV) was also considered in the model.

RESCO Model: For RESCO model we determined the PPA tariff for a tenor of 10 years. The basic assumption for identifying the tariff was that the developer would set a tariff to target at least 15% return on equity. Using the same equity internal rate-of-return, we estimated the tariff at Rs. 7 and projected the annual electricity payments as the cash outflow for the PPA tenor. For the post-PPA tenor, we considered O&M costs as the outflow for the remainder of the project life.

The projected cash outflows from both the models were then discounted at the customer's opportunity cost (expectation of return from business operations) to arrive at the NPV of the cash flows which would represent the actual cost of the solar plant for the off-taker.

Our analysis, as shown above, has revealed that the RESCO model could be up to 14% more expensive than CAPEX model for its project life.

Appendix Table 2: Comparative financial analysis of CAPEX and RESCO model.

NPV OF TOTAL CASH OUTFLOW	AMOUNT (INR MILLION)
Under CAPEX model (including AD benefit and discounting the opportunity cost)	48.40
Under RESCO model (for 10 year PPA)	56.09

Why is the CAPEX model better than the RESCO model? Since we used a similar rate of debt and equity for both the off-taker and the developer (12% and 15% respectively) and to determine the tariff, the entire 14% cost difference between the models is due to the **accelerated depreciation (AD)**. The NPV without AD benefit (as shown below) demonstrates that both the models are equally attractive for the off-taker.

Appendix Table 3: Comparative financial analysis of the CAPEX and the RESCO model.

NPV OF TOTAL CASH OUTFLOW	AMOUNT (INR MILLION)
Under CAPEX model (discounting the opportunity cost and without AD benefit)	55.46
Under RESCO model (for 10 year PPA)	56.09

However, there are factors other than AD that can impact the attractiveness of an AD model.

Opportunity cost of an off-taker:
For our analysis we considered a 15% return from business for the MSME sector. **The CAPEX model is more financially attractive for enterprises which have lower but stable returns on investment than it would be for organizations with higher growth trajectory.** The table below compares the different models by opportunity cost:

Appendix Table 4: Impact of opportunity cost on attractiveness of the CAPEX and the RESCO model

OPPORTUNITY COST FOR DEVELOPER	NPV UNDER CAPEX MODEL (INR MN)	NPV UNDER RESCO MODEL (INR MN)	CAPEX MODEL IS CHEAPER BY
12%	53.33	63.75	16.34%
14%	49.93	58.46	14.59%
15%	48.40	56.09	13.71%
16%	46.97	53.87	12.80%
18%	44.38	49.85	10.97%

Cost of debt:

Cost of debt is another factor that could impact the attractiveness of the CAPEX model for the enterprises. As shown in Table 5, the CAPEX model is more attractive for enterprises that can secure debt at levels lower than the developer, and vice versa. Table 5 displays the NPV for CAPEX model at different rates of debt:

Appendix Table 5: Impact of cost of debt on attractiveness of the CAPEX model

COST OF DEBT	NPV UNDER CAPEX MODEL
10%	46.53
11%	47.47
12%	48.4
13%	49.34
14%	50.27

Based on the above analysis, we can conclude that when the cost of debt and equity for the developer and the off-taker is identical, the CAPEX loan model is financially more attractive, due to accelerated depreciation benefit. The model is even better suited for adoption by organizations which have stable (lower than 15%) return on investments or can secure debt at lower interest rates compared to the developer.