CLIMATE POLICY INITIATIVE

The Drivers and Challenges of Third Party Financing for Rooftop Solar Power in India

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Descriptors

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Keywords	Rooftop solar power, renewable energy finance, third party finance
Related CPI Reports	Reaching India's Renewable Energy Targets Cost-Effectively
	Solving India's Renewable Energy Financing Challenge: Which Federal Policies can be Most Effective?
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Our work helps nations grow while addressing increasingly scarce resources and climate risk. This is a complex challenge in which policy plays a crucial role.

Executive Summary

In order to meet rapidly growing electricity demand, the Government of India has set an ambitious target of installing 40 GW of rooftop solar power by 2022. This is a significant increase from the 0.7 GW of installed capacity at the end of March 2016. The Indian rooftop solar power industry has grown steadily in recent years, due to the declining cost of installation and favorable government policies. However, the growth rate remains slower than what will be required to achieve India's 40 GW rooftop solar target.

There are three key barriers to the growth of rooftop solar power in India: the high upfront costs of installation, low access to debt finance, and perceived performance risk. Commercial and industrial consumers are reluctant to invest the high upfront amount required to install rooftop solar capacity – for instance, the size of a typical rooftop solar installation for commercial and industrial customers is around 150-200 KW, costing more than INR 10 million – especially given that it is a non-core business activity. In addition, banks are reluctant to lend to rooftop solar projects because there are high perceived risks and limited information on the performance and track records of rooftop solar investments. And finally, because rooftop solar power is a relatively new technology in India, many potential customers are concerned with performance risk, a perception that the technology may not perform as expected over its lifetime.

In order to expand the rooftop solar industry in India, there is a need to develop policy solutions, business models, and financing instruments which can address these barriers. **One promising solution to manage these barriers is the third party financing model.** Globally, the third party financing model for rooftop solar power has been a significant driver of growth in the rooftop solar industry.

Under the third party financing model, consumers buy electricity from a developer, who installs, owns, and operates a rooftop solar plant on the consumer's property. The developer then sells the power to the consumer under a long-term power purchase agreement at a specified price during the contract term, typically for 15 to 25 years. The success of the third party financing model hinges on the fact that developers are in a better position to manage the financing challenges and performance risk of rooftop solar power – and the model shifts these responsibilities from the consumer to the developer.

Currently in India, the third party financing model supports around 102 MW, or 13%, of total rooftop solar installations. The industry believes that there is potential to increase the total installed capacity under the third party financing model to more than 20 GW by 2022, meaning that this model has the potential to achieve more than half of the government's 40 GW target.

Third party financing for rooftop solar power could help achieve more than half the government's target of 40 GW by 2022.

However, the third party financing model would first need to overcome certain challenges. In order to expand the use of third party financing and support more rooftop solar installations, it is important to understand the driving factors for adoption of the third party financing model and the challenges to its adoption. **This paper explores the driving factors and challenges to the third party financing model, and proposes a series of recommendations for policy changes and financial instruments which could address these challenges.**

Consumers of rooftop solar power are divided into three segments: industrial, commercial, and residential. Rooftop solar power has not expanded much into the residential segment, due to its low profitability and high transaction costs. It will be more feasible for the residential segment by around 2020, when the segment is expected to achieve grid parity, which is when the cost of rooftop solar power becomes equal to grid electricity. Because of this, our analysis of the third party financing model primarily focuses on the industrial and commercial segments, which are more viable in the next three to four years.

Our analysis demonstrates that the third party financing model is financially viable in most states, in presence of current government fiscal incentives, for the commercial and industrial segments. In fact, it is

financially viable in the majority of states even without government fiscal incentives, because the majority of states have already achieved grid parity.

The key driver for the adoption of the third party financing model is its ability to remove the high upfront installation costs and perceived performance risk for consumers. In addition, savings in the cost of electricity is another major driver for the third party financing model. However, in order for the model to expand, several challenges to the third party financing model need to be addressed.

Limited access to debt finance remains the most significant challenge to the third party financing model. Since the rooftop solar sector is new and transaction costs are high (due to smaller projects), banks don't yet feel comfortable in lending to projects. Due to limited access to debt finance, the third party financing model has been mostly driven by equity finance in India, which has limited potential for scale in the way it is currently used.

Consumer credit risk is the second biggest challenge to the third party financing model. This is caused by several factors, including low availability of credit assessment procedures, low enforceability of agreements, and lengthy and costly legal processes in the case of a dispute or payment default.

Challenges in the implementation of net metering also pose a significant challenge. Net metering[1] policies across the different states are not consistent and vary in terms of process, technology, and assigned responsibilities. In addition, implementation of net metering policy suffers from issues related to the state-level public electricity distribution companies (DISCOMs) who are responsible for implementing net metering. These issues include a lack of appropriate training for DISCOM officials on rooftop solar installation approvals and implementation, delayed approvals from DISCOMs for net metering installations, and lack of proper monitoring of DISCOMs' implementation performance.

We have developed potential solutions for policy changes and financial instruments which could address these challenges. We focus on the top ten most promising policy solutions (Table ES1), as well as three promising financial instruments. Government entities, industry players, financing agencies and other stakeholders will need to work together to implement these recommendations.

The right policy changes and financial instruments can address challenges and drive growth of the third party financing model.

The key policy changes that we recommend are:

- First, to increase access to debt finance for rooftop solar, the Ministry of New and Renewable Energy (MNRE) can enable a training system for bankers on how to better assess loan applications for rooftop solar power.
- Second, to reduce consumer credit risk, MNRE and state governments can include DISCOMs as a party to the power purchase agreement between the developer and the consumer. In case a consumer defaults on bill payment, DISCOMs may terminate the consumer's power supply from the grid, thereby ensuring that the consumer has a strong incentive to pay for the solar power on time. Also, the Ministry of Law and Justice can create local specialized courts to resolve consumer payment disputes, thereby ensuring that any default-related cases will be decided quickly.
- Third, to remove challenges in implementation of net metering, MNRE can offer rooftop solar power a higher Renewable Purchase Obligation (RPO) credit.[2] This would incentivize DISCOMs to fulfill more of their RPO requirement through rooftop solar power, rather than other sources of renewable energy, since they would be able to fulfill more of their requirement by sourcing the same amount of power from rooftop solar power.

1 Net metering is a storage mechanism for consumers who generate their own electricity from solar power to sell electricity they do not use to the grid.

2 Renewable Purchase Obligation (RPO) is a mandatory requirement for power-selling DISCOMs to have a certain minimum percentage of their power portfolio from the renewable power sources.

The key financial instruments that we recommend are:

- Loans4SME, under development with the India Innovation Lab for Green Finance, is a peer-to-peer lending platform that aims to catalyze debt investments by connecting debt investors directly with creditworthy small and medium enterprises (SMEs) in renewable energy.
- The Rooftop Solar Private Sector Financing Facility, another instrument under development with the India Innovation Lab, could increase the availability of debt finance for rooftop solar installations. It involves two phases: aggregation of creditworthy solar rooftop projects, which can be funded through a warehouse line of credit, and securitization of the these loans through issuance of green bonds. Through this solution, the aggregate deal size would be large enough and of sufficient credit quality to attract more debt finance, and at a lower cost.
- A Rooftop Solar Investment Trust (RSIT) could also help increase the availability of equity for rooftop solar power in India. The trust would group bundles of 1 to 5 MW in size, capitalized with a mix of equity and debt. It would then sell bundles of rooftop installations to investors looking for long-term cash flows from the underlying standardized leases.

Table ES1: Key policy recommendations to overcome challenges to the third party financing model

BARRIER ADDRESSED	RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
LIMITED ACCESS TO DEBT FINANCE	Train bank officials in processing rooftop solar loans	Ministry of New and Renewable Energy	MEDIUM	HIGH
	Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
	Create a first-loss fund to support rooftop solar project lending	Small Industries Development Bank of India / Ministry of Finance	MEDIUM	MEDIUM
	Create a standardised tool to assess risk of solar rooftop projects	Rating agencies	MEDIUM	MEDIUM
	Develop certification standards for solar projects	State nodal agencies	MEDIUM	MEDIUM
CONSUMER CREDIT RISK	Create local specialized courts to fast-track the resolution of disputes	Ministry of Law and Justice	HIGH	MEDIUM
	Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
CHALLENGES IN IMPLEMENTATION OF NET METERING	Incentivize DISCOMs by providing higher RPO credit for rooftop solar power	Ministry of New and Renewable Energy	MEDIUM	HIGH
	Create consistent net metering policies and processes across states	Ministry of New and Renewable Energy	MEDIUM	MEDIUM

Contents

1. Introduction

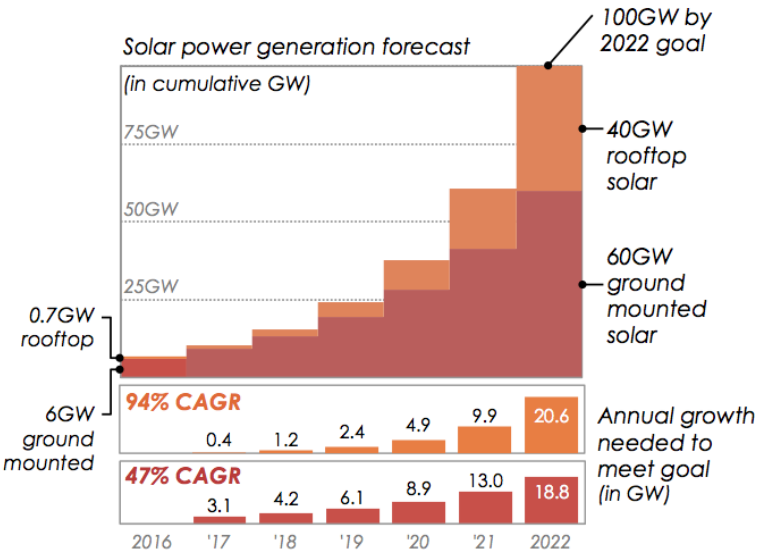
With 237 million people without electricity, and rising per capita electricity consumption, India's electricity demand and generation is expected to grow significantly over the next decade (IEA, 2015). The Government of India has identified solar power as a key tool in increasing electricity access, meeting the increasing demands of power for the fast growing economy, and reducing overdependence on fossil fuel-based power.

In 2015, the government significantly raised its solar power target from 20 GW by 2020, to 100 GW by 2022. This is a very ambitious target – to put it in perspective, the current leading country in solar power capacity, China, had a total installed solar capacity of around 43.5 GW at the end of 2015. India's target of 100 GW of solar capacity includes 60 GW of utility-scale solar power and 40 GW of rooftop solar power. By the end of March 2016, India had installed a total capacity of 6.7 GW (MNRE, 2016), with 6 GW of utility-scale projects and 0.7 GW of rooftop projects (Bridge to India, 2016).

India has set a target of 40 GW of rooftop solar power by March 2022 from 0.7 GW in March 2016, which will require an addition of 6.5 GW per year.

While utility-scale solar power seems to be growing in line with the target, rooftop solar power growth is still way behind the annual level of capacity addition required to meet the 40 GW target, and needs to accelerate quickly. In order for the rooftop solar industry to reach 40 GW from current levels, the industry must add around 6.5 GW of capacity every year, implying a compounded annual growth rate (CAGR) in current annual capacity addition of 94% (Figure 1). In order to achieve this target, the rooftop solar power industry will require favorable policies, innovative financing instruments, and better business models.

Figure 1: Annual rooftop solar capacity addition needs to increase significantly in order to meet the 40 GW target



The Indian rooftop solar market has three key consumer segments: industrial, commercial, and residential.[3] 74% of current rooftop solar installation is in the industrial and commercial segments, with only 26% in the residential segment. Industrial and commercial consumers pay higher rates for grid electricity than the residential segment. Due to greater potential savings in the cost of electricity, the industrial and commercial segments have adopted rooftop solar power more quickly than the residential segment. Rooftop solar power for the residential segment will be more financially viable by around 2020. Because of this, our analysis focuses primarily on the industrial and commercial segments, which are more viable over the next three to four years.

In order to make rooftop solar power viable for consumers in all segments, the government has primarily used fiscal incentives, including capital subsidies and accelerated depreciation. Capital subsidy is a one-time grant based on the cost of installation, whereas accelerated depreciation allows faster depreciation in the earlier years of an asset to minimize taxable income. However, despite these policies, deployment of rooftop solar power has not accelerated

3 For details on the global rooftop solar industry and its parallel to the Indian rooftop solar industry, please see Appendix 6.1 and Appendix 6.2. For more details on Indian government fiscal/policy incentives for rooftop solar power, see Appendix 6.3.

to the pace required for reaching India's targets. This motivates an examination of business models that can enable deployment of rooftop solar power at scale.

One business model that has played a key role in rooftop solar growth globally, and shows potential in India, is the third party financing model. In the third party financing model, an installer/developer builds a solar energy system on a customer's property for no (or little) upfront charge. The generation from the solar energy system offsets the customer's electric utility bill, and the developer sells the power generated to the customer at a fixed rate, typically lower than the local utility tariff. However, the success of this model in India will depend on several factors.

In this paper, we examine the challenges facing the third party financing model in India, in order to recommend policy changes as well as financing instruments. Section 2 examines the key drivers and challenges for the rooftop solar power sector in India overall. Section 3 then examines the key drivers and challenges for the third party financing model specifically. Section 4 discusses the key recommendations for policy changes and financial instruments to address the challenges. Section 5 offers a conclusion and guidance for future work.

2. Rooftop Solar Power in India: Drivers and Barriers to Growth

Growth of the rooftop solar power industry in India will depend on how well we understand the driving factors and barriers to adoption within the industry. In this section, we have identified the key drivers and barriers to the rooftop solar industry in India. We interviewed more than 50 relevant stakeholders in the rooftop solar industry, including developers, financers, consultants, policymakers, and consumers.

After determining the most significant drivers and barriers, we then asked these stakeholders to rate each of them on a scale of 1 to 10, with 1 being the least significant and 10 being the most significant (unscored factors were given a 0). 20 of the 50 interviewees participated in this second round. We averaged the stakeholder ratings for each driver and barrier to reach a final score.

2.1 Drivers of the adoption of rooftop solar power in India

Based on our interviews, we identified four broad drivers for the adoption of rooftop solar power, in order of priority (Table 1).

Table 1: Drivers of the adoption of rooftop solar power

DRIVERS	SCORE (OUT OF 10)
SAVINGS IN THE COST OF ELECTRICITY FOR THE CONSUMER	8.0
THE NEED FOR AN ALTERNATIVE ELECTRICITY SOURCE DUE TO POWER SCARCITY	4.0
SOCIAL IMAGE OF BEING SEEN AS "GREEN" FOR THE CONSUMER	3.0
GOVERNMENT REQUIREMENT TO INSTALL SOLAR POWER	2.5

Savings in the cost of electricity for the consumer is the most significant driver for the adoption of rooftop solar power.

1) Savings in the cost of electricity for the consumer

Savings in the cost of electricity for the consumer is the most important driver for the adoption of rooftop solar power, with a score of 8 out of 10 for both the industrial and commercial segments. In our interviews, its importance was rated twice as high as the other drivers, which averaged around 3 to 4. For the commercial and industrial segments, average grid rates are INR 7.9/kWh and INR 6.7/kWh respectively. Using solar rooftop power, consumers in the commercial segment can save around INR 2.4/kWh, or 30% of their electricity costs, while consumers in the industrial segment can save around INR 1.2/kWh, or 18% of their electricity costs.

According to one Mumbai-based EPC developer: "Two years ago, one third of the consumers would [install solar rooftop] for a subsidy, one third because of green image, and the remaining because of power scarcity. However, now out of every ten consumers, five [install rooftop solar power] because of electricity bill savings, three because of tax savings, one because of green image, and one because of power scarcity."

2) The need for an alternative electricity source due to power scarcity

The second key driver for rooftop solar is power scarcity, with a score of 4 out of 10. Power scarcity is either no availability of grid power or an intermittent power supply. This results in consumers using diesel-based generating sets to fulfill their power requirements. However, diesel power is not only costly but also is at the mercy of volatile oil prices. Increasingly, consumers are shifting towards rooftop solar power as an alternative electricity source that is not only more reliable than grid power but also is much cheaper than diesel-based electricity.[4]

3) Social image of being seen as "green" for the consumer

The third key driver for the adoption of rooftop solar power is consumers' desire to have an image of being environment-friendly, with a score of 3 out of 10. Consumers who are driven by this factor are even willing to pay higher prices than grid power for power from renewable sources.

4 Solar power typically costs less than INR 10/kWh, compared to diesel power which typically costs more than INR 15/kWh

However, this driver is not very strong on its own. According to a Bangalore-based EPC player, "many residential consumers enquire about rooftop solar. Their main motivation is to use environment friendly energy. However, many don't end up installing the plant due to its high initial capital and low access to finance."

4) Government requirement to install solar power

The fourth key driver for the adoption of rooftop solar power is a government requirement to install solar power, called the Renewable Purchase Obligations (RPO), with a score of around 2.5 out of 10. This requirement only applies to the commercial and industrial segments, not residential.

The RPO obligation requires entities which produce power either for sale or for their own consumption (1 MW and above) to buy a certain minimum amount of solar power as a percentage of their total power sold/ consumed. State Electricity Regulatory Commissions (SERC) in 24 states have declared solar RPO targets for 2016-2017, which vary from 0.2%to 2.5% percent. However, the efficacy of this driver depends on the effectiveness of policy implementation by state governments and, hence, can vary in significance.

In addition to RPOs, many states have recently created a policy of mandatory rooftop solar power installations for all new buildings. This is another government requirement that could potentially be a big driver for rooftop solar power in the future.

2.2 Barriers to the adoption of rooftop solar power in India

From our interviews, we identified eight key barriers that potential rooftop solar consumers might face. The following barriers are in the order of their significance (Table 2).

1) High upfront costs of installation

The most significant barrier to the adoption of rooftop solar power in India is the high upfront costs of installation, with a score of 8.5 out of 10. The size of a typical rooftop solar installation in the commercial and industrial segments is around 150-200 KW, costing more than INR10 million.[5] Commercial and industrial consumers are reluctant to invest such a high amount upfront, especially for a non-core business activity. On the other hand, the size of a typical rooftop solar installation in the residential segment is 4-5 KW, which costs around INR 400,000, but is still high for this segment.

Table 2: Barriers for the adoption of rooftop solar power

BARRIERS	SCORE (OUT OF 10)
HIGH UPFRONT COST OF INSTALLATION	8.5
LIMITED ACCESS TO DEBT FINANCE	8.0
CONSUMERS' PERCEPTION OF PERFORMANCE RISK	6.5
CHALLENGES IN THE IMPLEMENTATION OF NET METERING	5.5
LACK OF CONSUMER AWARENESS OF ROOFTOP SOLAR POWER AS AN ENERGY OPTION	5.0
DIFFICULTY IN ACQUIRING GOVERNMENT SUBSIDIES FOR ROOFTOP SOLAR POWER	4.5
LIMITED AVAILABLE ROOFTOP SPACE	4.5
THE ADDITIONAL RESPONSIBILITY OF OPERATIONS AND MAINTENANCE	3.5

2) Limited access to debt finance

The second most significant barrier facing potential rooftop solar consumers is limited access to debt finance, with a score of 8 out of 10. Banks are reluctant to lend to rooftop solar projects because there are high perceived risks and limited information on the performance and track records of rooftop solar investments. They prefer lending to large utility-scale projects. Even when banks lend to rooftop solar projects, the high risk perception has led to high costs of borrowing (up to 14.5%) for rooftop solar installations.

The high upfront cost of installation and low access to debt finance are the two most significant barriers facing potential consumers of rooftop solar power.

5 The exchange rate used is INR 1 = US $0.015

3) Consumer perception of performance risk

The third barrier impeding the adoption of rooftop solar power is consumers' perception of performance risk, with a score of 6.5 out of 10. This is the perceived risk that the technology won't perform as expected. Rooftop solar power is still a relatively new technology in India and, therefore, there is a perception that it may not perform as expected over its lifetime. Additionally, since there are a number of new entrepreneurs in the rooftop solar market, with no or little track record, it has been difficult for consumers to trust them.

4) Challenges in the implementation of net metering

The fourth barrier is challenges in the implementation of net metering, with a score of 6 out of 10. As solar power can be generated only during the day, it requires storage of power for consumption at night. However, the main power storage option – battery storage – is very costly, which limits the viability of a storage backed rooftop solar power system. The cost of the solar system without battery storage is around INR 60 million per MW, which would increase to INR 110 million per MW in case a battery is included. In addition to the initial cost, there would be an additional cost of battery replacement every 6-7 years. Due to these additional costs, net metering is necessary to make rooftop solar power viable at scale.[6]

Since the Central Electricity Regulatory Commission (CERC) issued its model net metering regulations in 2013, 27 states and union territories have issued net metering policies or regulations. However, only a few states have begun actual implementation of net metering: Andhra Pradesh, Telangana, Punjab, Delhi, Chandigarh and Karnataka. A few other states such as Haryana, Tamil Nadu and Rajasthan are aggressively pursuing net metering, but there is a lot of work that needs to be done to ensure effective implementation. Net metering policies vary across states in terms of process, technology, and assigned responsibilities. Though some states have detailed and clear policies, many states have not yet defined them well and there are ambiguities present. In addition, implementation of net metering policy suffers from several issues related to DISCOMs, the state-level public electricity distribution companies who are responsible for implementing net metering. These issues include a lack of appropriate training for DISCOM officials on rooftop solar installation approvals and implementation, delayed approvals from DISCOMs for net metering installations and lack of proper monitoring of DISCOMs' implementation performance.

5) Lack of consumer awareness of rooftop solar power as an energy option

The fifth barrier to adopting rooftop solar power is low awareness among consumers of rooftop solar power as an energy option, with a score of 5 out of 10. Lack of awareness of both the technology as well as potential financial benefits has made it difficult for developers to acquire consumers, which has also increased transaction costs and the overall cost of solar systems. The customer acquisition cost in India is currently as high as 10% of the total cost, whereas in a country like Germany, where awareness for rooftop solar is much higher, the customer acquisition cost is only around 5% of the total cost.

6) Difficulties in acquiring government subsidies for rooftop solar power

The sixth barrier is difficulties in acquiring government subsidies for rooftop solar power, applicable to residential consumers, with a score of 4.5 out of 10. The central government offers a provision of a 30% subsidy for rooftop solar power installation for residential consumers. However, the process of approval for the subsidy is lengthy and requires considerable effort from the consumer. Since rooftop solar power is still not viable for residential consumers due to subsidized grid rates, it's not possible to adopt rooftop solar power without the support of the subsidy.

7) Limited available rooftop space

The seventh challenge is a lack of rooftop space for installations, with a score of 4.5 out of 10. Industrial consumers generally have a large amount of rooftop space available, but residential and commercial consumers often don't have as much vacant rooftop space available. This has impeded adoption.

8) The additional responsibility of operations and maintenance (O&M)

The final challenge is the additional consumer responsibility of operations and maintenance (O&M) for the solar system, with a score of 3.5 out of 10. Many consumers don't want to take on the additional burden of O&M, as no such responsibility exists for grid power.

6 Under net metering, power flow direction changes on the basis of whether the rooftop solar system is in power surplus (when solar generation is higher than consumer demand) or deficit (when solar generation is lower than consumer demand). The flow of power is into and out of the grid, respectively. The power in is sold and bought at the same price as the grid rate for the consumer.

3. The Third Party Financing Model in India: Drivers and Challenges

Based on our stakeholder interviews and research, it is clear that the most significant barriers to adoption of rooftop solar power are the high upfront costs of installation, consumers' low access to debt finance for rooftop solar power, and perceived performance risk. Properly managing these barriers could significantly increase adoption of rooftop solar power, and thus bring India closer to its rooftop solar power target of 40 GW by 2022.

One promising solution to manage these barriers is the third party financing model. Under the third party financing model, a consumer buys electricity from a developer, who installs, owns, and operates a rooftop solar plant on the consumer's property. The developer then sells the power to the consumer under a long-term power purchase agreement at a specified price during the contract term, typically for 15 to 25 years. The success of the third party financing model hinges on the fact that developers are in a better position to manage the financing challenges and performance risk of rooftop solar power.

One promising solution to managing finance and performance challenges is the third party financing model. Under the third party financing model, a consumer buys electricity from a third party developer, who installs, owns, and operates a rooftop solar plant on the consumer's property.

The third party financing model has been a significant driver of growth in the rooftop solar industry globally, especially in the USA. Of the 1.2 GW of residential rooftop solar installed in the U.S. in 2014, 72% was third party-owned through leases and power purchase agreements. It has also started picking up recently in other countries, including China and Japan.

Currently in India, the third party financing model supports around 102 MW, or 13%, of rooftop solar installations. The industry believes that there is potential to increase the total installed capacity under the third party financing model to more than 20 GW by 2022, meaning that it could achieve more than half of the government's 40 GW target.

This potential for expansion of the third party financing model is primarily in the industrial and commercial segments in the immediate future. It has not expanded much into the residential segment, due to the residential segment's low profitability, stemming from lower grid prices and high transaction costs because of smaller plant capacity. It will be more feasible for the residential segment by around 2020, when the segment is expected to achieve grid parity. Because of this, our analysis of the third party financing model primarily focuses on the industrial and commercial segments, which are more viable in the next three to four years.

While the third party financing model is gaining popularity in India, its growth has been limited so far. Increasing its use could help drive adoption of rooftop solar power. In this section, we have analyzed the third party financing industry in India, focusing on the key challenges it faces and potential solutions to those challenges.

3.1 Types of third party financing models in India

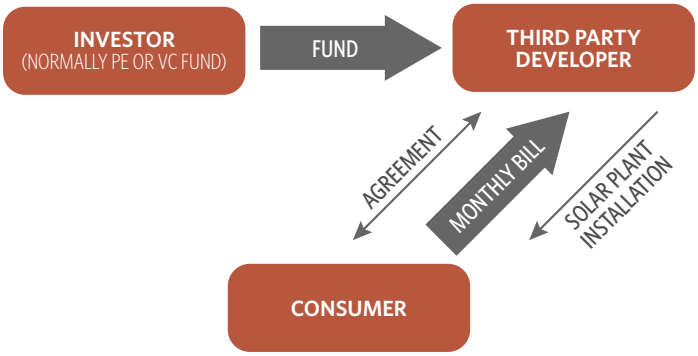
Third party finance is still in a nascent stage in India and many new third party financing players have entered the market in the last two years. These players can be categorized into two types, based on their financing arrangement. Both the types have their own advantages, and both at the same time can play a key role in expanding third party financing in India.

A key driver of third party financing in India is the government's policy of accelerated depreciation. Accelerated depreciation is a policy which allows greater depreciation in the earlier years of an asset and is used to minimize taxable income. However, it would be ineffective in case of the absence of or insufficient taxable income, as discussed below.

The two types of third party financing models are:

1) Companies that have raised equity or debt to install and own rooftop solar assets

Figure 2: Third party financing model where the solar company owns the assets

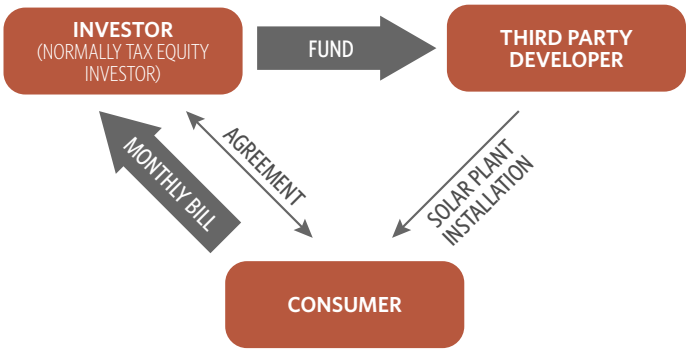


Under this model (Figure 2), the solar system is on the balance sheet of the company, making the company eligible for government fiscal incentives. However these companies are typically not able to utilize the tax benefits under accelerated depreciation because, given the absence of income from other sources, they don't have enough tax liabilities to offset. On the other hand, since the contract is directly between the company and the consumer, it is simple and the company has not only more control but also more at stake. Amplus Solar, Sun Terrace Energy, and Fourth Partner are the key companies that operate under this model.

2) Companies that connect a consumer with a tax equity investor

Under this model (Figure 3), facilitated by the company, third party investors enter into an agreement with the consumer and the solar assets are owned by investors on their balance sheet. Under this model, the investor – who typically has income from other business activities and therefore, tax liabilities to offset – is able to take advantage of the tax benefits from the government's policy of accelerated depreciation. Because of these tax benefits, this model has higher economic viability compared to the first type of model. However, this type is more complex and faces specific challenges, including that there are multiple participants and a need to exactly match the required investment to the investor's appetite. Cleanmax Energy is one of the key companies using this model.

Figure 3: Third party financing model where an investor entity owns the assets



The solar companies involved in the two models differ only in ownership of the assets, as the solar company owns the assets on its balance sheet in the first model and a separate investor entity owns the assets in the second model. Otherwise, under both models, solar companies have the same obligations – they manage consumer acquisition, credit assessment of the consumer, contract execution with the consumer, engineering, procurement, and construction (EPC) of the solar system on the consumer's rooftop, monthly bill collection from the consumer, and operation and maintenance of the solar system.

3.2 The role of government fiscal incentives in supporting third party financing

The success of the third party financing model will depend on its financial viability for the financer. One of the key estimates for financial viability is the expected internal rate of return (IRR)[7] for an investor. The IRR would be different in different states and different consumer segments because of variations in the cost structure of electricity. Also, the impact of the government's fiscal incentives plays an important part in deciding the final IRR for the third party financing model.

In this section, we analyze the impact of the fiscal incentives on the expected IRR under the third party financing model, across 21 major states and union territories in India, covering the majority (around 97%) of the population (Figure 4).

Based on our primary research, the minimum required cost of equity, or IRR, for rooftop solar investors is 14%. The Indian government offers fiscal incentives to support rooftop solar installation. For the commercial and industrial segments, there is an incentive of

7 Unless specified otherwise, internal rates of return (IRR) in this paper refer to the equity IRR.

Table 3: Key assumptions used to calculate the IRR

KEY ASSUMPTIONS	
COST OF INSTALLATION PER MW	INR 6 CRORE
DEBT AS % OF TOTAL CAPITAL	70.0%
INITIAL PANEL CAPACITY UTILIZATION FACTOR	17.0%
ANNUAL DECREASE IN PANEL CAPACITY UTILIZATION FACTOR	0.50%
COST OF DEBT	11.5%
COST OF EQUITY	14.0%
OPERATING EXPENSES AS % OF REVENUES	10.0%

40% accelerated depreciation and for the residential segment, there is a capital subsidy of 30%. The assumptions for calculating IRRs are provided in Table 3.

The third party financing model is viable in most states in presence of current government fiscal incentives.

In our 21 state sample, at current prices with existing fiscal incentives, the available IRR for the third party financing model is above the required rate of 14% for the residential segment in 15 states, the industrial segment in 15 states, and the commercial segment in 18 states (Figure 4a). The average IRRs for the residential, commercial and industrial segments for all states are 15.5%, 17.2%, and 22%, respectively.

In particular, the available IRR is more than 20% for all three segments in five states – Delhi, Haryana, Maharashtra, Odisha, and Uttar Pradesh – which makes them particularly attractive for the third party financing model. However, in three states the third party financing model is not yet viable in any of the segments: Chhattisgarh, Gujarat, and Uttarakhand. The variability in results is mainly driven by variation in grid tariffs.

Given current fiscal incentives, due to declining costs of rooftop solar installation and increasing grid rates, the third party financing model is expected to be viable in all states by 2020. This implies that the government may need to support the rooftop solar industry only until 2020, after which fiscal support can be gradually withdrawn. Alternatively, to further accelerate the adoption of rooftop solar, the government can introduce additional incentives in those states where rooftop solar has not yet become viable. However, a critical assumption behind this analysis is that consumers, investors, and solar companies are able to easily access all government incentives until 2020. As discussed earlier, historically there have been difficulties in acquiring government subsidies for rooftop solar power.

The third party financing model is expected to be viable in all 21 states under consideration by 2020.

The third party financing model is viable without fiscal incentives in states which have achieved grid parity in the industrial and commercial segments.

We also analyzed the expected IRR for the third party financing model for different states and consumer segments under a scenario of no fiscal incentives, in order to assess financial viability in case the solar company/investor is unable to utilize these fiscal incentives, or these incentives are withdrawn by the government (Figure 4b). Our analysis shows that third party financing without any fiscal incentives is viable only in states that have achieved grid parity. Fiscal incentives will be required to enable third party financing of rooftop solar power in states that have not yet achieved grid parity.

Out of our 21 state sample, in the industrial segment 11 states have achieved grid parity, and in the commercial segment, 14 states have achieved grid parity. This means the third party financing model is viable in these states without fiscal incentives. In addition, since five more states will achieve grid parity in the next three years in these segments, the number of viable states will increase significantly in the near future.

However, for the residential segment, the third party financing model is not yet viable in any of the states without fiscal incentives. Grid parity for the residential segment will take at least four more years for half of the states, at which point the model will be viable for the residential segment in those states. This implies that fiscal incentives for the residential segment should be formulated for the long-term.

The third party financing model will be more feasible for the residential segment by around 2020, when the segment will achieve grid parity. Because of this, our analysis of the third party financing model primarily focuses on the industrial and commercial segments, which are more viable in the next three to four years.

Figure 4: Internal rate of return by state and consumer segment for states (a) with the current fiscal incentives and (b) without any fiscal incentives. Cell shading shows states with IRRs above the investor-required 14% IRR for new projects, with darker shades reflecting a higher IRR. States with segments below the IRR threshold are not shaded.

	(a) IRR with fiscal incentives			(b) IRR without fiscal incentives		
	Residential	Industrial	Commercial	Residential	Industrial	Commercial
Andhra Pradesh	15.8%	18.2%	24.3%	8.9%	14.4%	19.4%
Assam	8.9%	10.1%	17.5%	4.2%	7.7%	13.9%
Bihar	9.3%	17.4%	17.4%	4.5%	13.8%	13.8%
Chhatisgarh	9.6%	11.4%	12.5%	4.7%	8.9%	9.8%
Delhi	14.9%	23.5%	37.7%	8.3%	18.7%	30.2%
Gujarat	11.3%	10.7%	10.7%	5.9%	8.3%	8.3%
Haryana	15.3%	24.3%	24.3%	8.6%	19.4%	19.4%
Himachal Pradesh	14.9%	14.4%	18.2%	8.3%	11.3%	14.4%
Jharkhand	18.2%	17.1%	17.4%	10.4%	13.5%	13.8%
Karnataka	17.2%	16.3%	26.5%	9.8%	12.8%	21.1%
Kerala	17.2%	13.7%	19.4%	9.8%	10.7%	15.4%
MP	13.5%	12.5%	14.4%	7.4%	9.8%	11.3%
Maharashtra	24.7%	23.9%	42.4%	14.4%	19.0%	34.0%
Odisha	14.0%	22.2%	23.1%	7.7%	17.7%	18.3%
Punjab	19.1%	20.2%	22.2%	11.0%	16.0%	17.7%
Rajasthan	16.7%	19.0%	20.2%	9.5%	15.1%	16.0%
Tamil Nadu	14.9%	18.6%	30.9%	8.3%	14.7%	24.7%
Telangana	18.6%	18.2%	24.3%	10.7%	14.4%	19.4%
Uttar Pradesh	24.1%	22.2%	23.1%	14.1%	17.7%	18.3%
Uttarakhand	7.0%	7.0%	13.3%	2.9%	5.3%	10.4%
West Bengal	19.6%	19.4%	22.2%	11.3%	15.4%	17.7%

3.3 Drivers for the third party financing model in India

Expanding the use of the third party financing model for rooftop solar power in India is a promising solution to scale up the adoption of rooftop solar power and achieve the government's target of 40 GW by 2022. In order to facilitate greater use of third party financing, it is important to understand the drivers and challenges that are affecting the model.

The key driver for the third party financing model is its ability to resolve many significant barriers to the adoption of rooftop solar power: the high upfront costs of installation, consumers' low access to debt finance, and perceived performance risk.

We identified drivers specific to the third party financing model in India by interviewing key stakeholders in the industry and asking them to score the significance of these drivers on a scale of 1 to 10, with 10 being the most significant. Most of the drivers relate to removing the challenges to rooftop solar power. Table 4 shows the identified drivers for the third party financing model in order of their significance.

Table 4: Drivers for the third party financing model

DRIVERS	SCORE (OUT OF 10)
NO UPFRONT INSTALLATION COSTS FOR THE CONSUMER	8.5
NO PERFORMANCE RISK FOR THE CONSUMER	7
CONSUMER SAVINGS IN THE COST OF ELECTRICITY	5.5
NO OPERATIONS AND MAINTENANCE RESPONSIBILITIES FOR THE CONSUMER	4.5

1) No upfront installation costs for the consumer

The most important driver for the third party financing model is that there are no upfront costs for consumers, with a score of 8.5 out of 10. The upfront cost is borne by the solar company or investor, and consumers need to pay them monthly, as per the electricity consumed from the rooftop solar system. This aspect is the most significant driver because the high upfront costs of rooftop solar power, coupled with consumers' limited access to debt finance for rooftop solar, are the two most significant barriers impeding the adoption of rooftop solar power in India.

2) No performance risk for the consumer

The second most significant driver for the third party financing model is that consumers do not need to be concerned about the performance risk of rooftop solar power, with a score of 7 out of 10. In the self-financing model, consumers have to bear the performance risk – i.e. how much electricity the system generates over time – since they own the solar assets. Under the third party financing model, since consumers pay only for the power consumed, they do not need to worry about performance risk. Hence, if the performance of the rooftop solar system degrades or if the solar system stops working, the consumer does not need to pay for unused electricity.

Under the third party financing model, consumers only pay for electricity consumed, eliminating the barriers of high upfront installation costs and performance risk.

3) Consumer savings in the cost of electricity

The third driver is potential savings for consumers on their electricity bills, with a score of 5.5 out of 10. Under the consumer-financed model, there is a significant upfront investment, after which consumers can start saving on electricity costs. By contrast, under the third party financing model, since there are no upfront costs for the consumer, they can lower their electricity costs from day one of the installation, depending on how the solar and grid tariffs compare.

4) No operations and maintenance responsibilities for the consumer

The fourth driver is that there is no added responsibility of operations and maintenance (O&M) for the consumer, with a score of 4.5 out of 10. This added responsibility was identified as one of the barriers impeding adoption of rooftop solar power. Under the

third party financing model, consumers do not need to worry about O&M because it is the responsibility of the third party financing developer.

3.4 Challenges to the third party financing model in India

We have also identified the key challenges to the third party financing model in India. Table 5 lists all the challenges to the third party financing model in order of their significance.

Table 5: Key challenges to the third party financing model

CHALLENGES	SCORE (OUT OF 10)
LIMITED ACCESS TO DEBT FINANCE	8.0
CREDIT RISK OF THE CONSUMER	8.0
CHALLENGES IN THE IMPLEMENTATION OF NET-METERING	5.5
LACK OF CONSUMER AWARENESS OF ROOFTOP SOLAR POWER AS AN ENERGY OPTION	5.0
CONSUMERS' RESISTANCE TO A LONG TERM CONTRACT	5.0
DIFFICULTY IN ACQUIRING GOVERNMENT SUBSIDIES FOR ROOFTOP SOLAR POWER	4.5
LIMITED AVAILABLE ROOFTOP SPACE	4.5

The third party financing model does not address all the challenges facing the rooftop solar industry in general (discussed in Section 2). We first discuss the key challenges shared with the rooftop solar industry as a whole, followed by a discussion of the key challenges that are specific to the third party financing model.

Limited access to debt finance and challenges in the implementation of net metering, two key challenges to the rooftop solar industry, remain unaddressed by the third party financing model.

The other major challenges facing the rooftop solar industry that the third party financing model does not address are: lack of awareness among consumers of rooftop solar power as an energy option, difficulties in acquiring government subsidies for rooftop solar power, and limited available rooftop space, all discussed in Section 2.

The availability of debt finance and proper implementation of net metering will directly affect the financial viability of the third party financing model. Hence, it is imperative to understand the importance of these two factors. We have analyzed the impact of these two factors on the viability of the third party financing model.

1) Limited access to debt finance

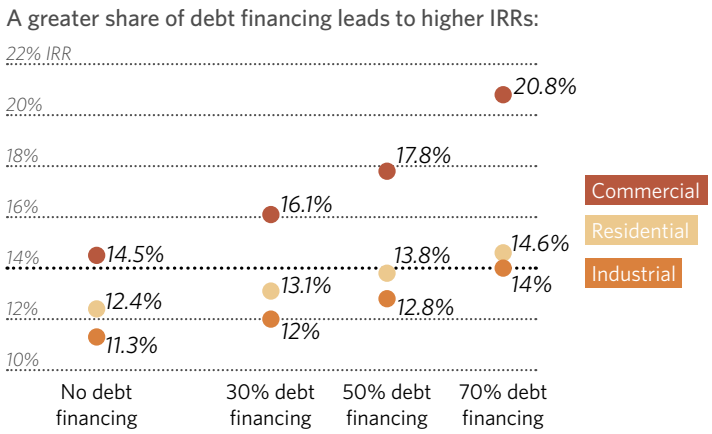
Limited access to debt finance received a score of 8 out of 10. The internal rate of return of a third party financing project will change with the ratio of debt to equity. To determine what proportion of debt would make the third party financing model viable, we calculated the IRR under different percentages of debt (Figure 5).

The right proportion of debt is key to the financial viability of the third party financing model.

As Figure 5 shows, under a ratio of 0% debt and 100% equity, the IRR for the industrial and commercial segments is 11.3% and 14.5% respectively. These IRRs increase with an increase in the proportion of debt. At 70% debt, the IRR changes to 14% and 20.8% respectively for the two segments. As discussed earlier, the third party financing model is financially viable only if the IRR is more than 14%. Hence, though it is financially viable for the commercial segment with no debt, for the industrial segment it is financially viable only with a proportion of 70% debt.

The cost of debt is another key factor that would affect the IRR. In the above analysis, we considered the cost of debt to be 11.5%. However, if debt is available at lower cost – for example, with the help of development banks – then the viability of the third party financing model

Figure 5: Effect of the proportion of debt on the IRR for the third party financing model



Note: We have used the state of Andhra Pradesh as an example for this analysis.

would improve accordingly. For example, if the cost of debt can be reduced by 5%, it can improve the IRR by 2% to 3%, depending on the grid tariffs.

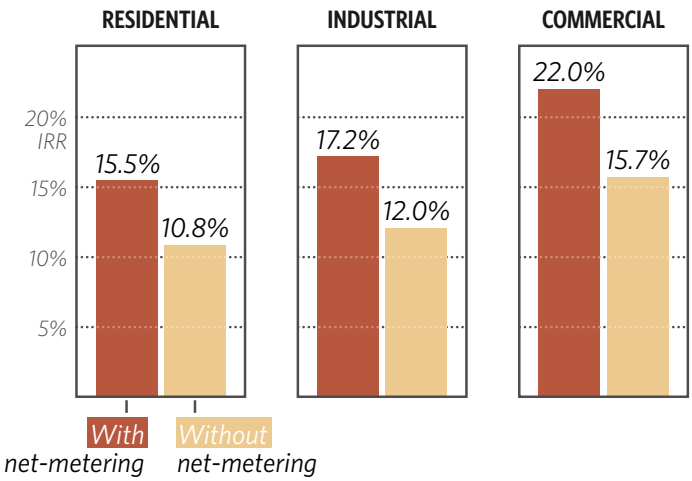
2) Challenges in the implementation of net metering

Challenges in the implementation of net metering received a score of 5.5 out of 10. The IRR of third party financing would improve with the availability of net metering because with net metering, all the power generated by the solar system is utilized even at times when the consumer is not consuming it. Excess power not utilized by the consumer would go to the grid and not be wasted. We have therefore analyzed the IRR for the third party financing model with and without net-metering, using the assumption that on an average around 20%[8] of the electricity generated from a rooftop solar system would not be consumed by the consumer, due to lower demand at the time of electricity generation. Thus 20% of the electricity could be supplied to the grid with net metering, and electricity could be withdrawn from the grid at times of excess demand.

Proper implementation of net metering is key to the financial viability of the third party financing model.

As Figure 6 shows, the average IRR in the absence of net metering would be 12% and 15.7% for the industrial and commercial segments, respectively. This increases with net-metering to 17.2%, and 22% respectively. Hence, the third party financing model in the industrial segment is not viable without net metering, highlighting the significance of net metering for the viability of the third party financing model.

Figure 6: Effect of net metering on the average IRR



The third party financing model requires improved net metering implementation and increased access to debt finance in order to expand.

In addition to the challenges shared with the rooftop solar industry in general, there are also two challenges specific to the third party financing model: consumer credit risk and consumers' resistance to a long-term contract.

1) Consumers' credit risk

The most significant challenge specific to the third party financing model is consumers' credit risk, with a score of 8 out of 10. Under the third party financing model, rooftop power purchase agreements have contract terms of 15-25 years, consistent with the period required for the third party financer to earn the expected IRR. The investor has to be certain of the credit worthiness of the consumer over the long-term contract, since any default by the consumer will significantly influence the IRR.

Further, the risk of disputes between the consumer and the third party financer over such a long period is high, particularly because as solar costs fall, the consumer may be tempted to renege on the contract and buy cheaper power from other sources. The risk of payment default by the consumer, or credit risk, thus increases over time.

In addition, the enforcement of contracts is generally difficult in India. The legal process is cumbersome and costly. The long dispute resolution and recovery process is frustrating for even large institutions like banks who fail to recover their loans, resulting in a high share of distressed portfolios. In the World Bank's Ease of Doing Business 2016 rankings, India was ranked 178 out of 189 countries on contract enforcement (World Bank Group, Economy Rankings, 2016).

8 20% is the average of electricity supplied to the grid estimated through market interactions.

2) Consumers' resistance to a long-term contract

The second challenge specific to the third party financing model is consumer resistance to a long-term contract, with a score of 5 out of 10. Typically, the contract for the third party financing model is for a period of 15-25 years, as short-term contracts are not viable for solar companies or investors. However, many consumers consider long-term contracts to be risky because they can't accurately estimate their consumption and utility prices over such a long period of time, and are thus reluctant to enter into a long-term contract.

In summary, the key challenges to the third party financing model are, in order of significance: limited access to debt finance, credit risk of the consumers, challenges in implementation of the net metering, lack of awareness among consumers of rooftop solar power as an energy option, consumers' resistance to a long-term contract, consumer difficulties in acquiring the government subsidies for rooftop solar power, and limited available rooftop space.

4. Recommendations for Addressing Challenges to the Third Party Financing Model

In order for the third party financing model for rooftop solar power to succeed in India, policymakers and industry players will need to address the most significant challenges. To this end, we have developed recommendations for policy changes and financial instruments which could address these challenges.

Similar to the methodology used to identify drivers and challenges, we identified these solutions through in-depth interviews with over 50 key stakeholders as well as secondary research. In order to measure the impact and feasibility of each recommendation, we categorized them as low, medium, and high. Impact is the ability of the proposed recommendation to address the challenge, and feasibility is the likelihood of implementation for the proposed recommendation.

In this section, we focus on the top recommendations, based on the significance of the challenges they address, as well as their potential impact and feasibility. Additional solutions which were identified but are not as significant are available in Appendix 4.

All the recommendations in the report are exhaustive and address various issues pertaining to the challenges. If all recommendations are implemented together, their impact would be much higher than implementation of individual recommendations.

4.1 Policy recommendations

We have selected the policy recommendations with high or medium impact to address three of the most significant challenges (Table 6). We have provided the top ten recommendations based on the top solutions to the top three challenges.[9]

CHALLENGE 1: LIMITED ACCESS TO DEBT FINANCE

Recommendation: Train bank officials in processing rooftop solar loans.

Table 6: Key policy recommendations to overcome challenges to the third party financing model

BARRIER ADDRESSED	RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
LIMITED ACCESS TO DEBT FINANCE	Train bank officials in processing rooftop solar loans	Ministry of New and Renewable Energy	MEDIUM	HIGH
	Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
	Create a first-loss fund to support rooftop solar project lending	Small Industries Development Bank of India / Ministry of Finance	MEDIUM	MEDIUM
	Create a standardised tool to assess risk of solar rooftop projects	Rating agencies	MEDIUM	MEDIUM
	Develop certification standards for solar projects	State nodal agencies	MEDIUM	MEDIUM
CONSUMER CREDIT RISK	Create local specialized courts to fast-track the resolution of disputes	Ministry of Law and Justice	HIGH	MEDIUM
	Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
CHALLENGES IN IMPLEMENTATION OF NET METERING	Incentivize DISCOMs by providing higher RPO credit for rooftop solar power	Ministry of New and Renewable Energy	MEDIUM	HIGH
	Create consistent net metering policies and processes across states	Ministry of New and Renewable Energy	MEDIUM	MEDIUM

9 There are many different ways to prioritize solutions. Table 18 at the end of the report (in Appendix 4) provides one such way. This table also provides some intuition to the top ten recommendations here. The restrictions used by us to provide the top ten recommendations – the top three challenges and at least medium impact – guarantee that our recommendations provide a balanced view.

The main reason banks are reluctant to lend to rooftop solar power projects is that bank officials are not well-trained in assessing the bankability of rooftop solar projects appropriately. Thus, an immediate step should be training bankers in how to process rooftop solar loans and the dynamics of the rooftop solar industry and associated risks. MNRE can work with development banks to provide this training. A dedicated team in each bank can be trained, in turn to provide support to its branches.

The feasibility of this recommendation is high as similar trainings on different products are already provided in banks, internally or externally. However, it has a medium potential impact since eventual execution would depend on factors such as the bank management's view of the rooftop solar power industry.

Recommendation: Involve DISCOMs in power purchase agreements between the consumer and third party financer.

DISCOMs can be made a party to power purchase agreements between the consumer and third party financer, with the responsibility of collecting monthly payments from the consumer. In case of default, DISCOMs can terminate power supply from the grid. As a last resort, power generated from the rooftop solar project could be purchased by DISCOMs at a predetermined rate. This would give comfort to banks as there would be a guaranteed purchaser. This recommendation would help address both limited access to debt and consumers' credit risk.

The potential impact is high as the credit risk of the consumer would be considerably reduced. However, the feasibility would be low as this not only requires the introduction of a new policy for DISCOMs but also increases revenue uncertainty for DISCOMs. In particular, DISCOMs would be averse to participation given that rooftop solar projects would result in loss of revenue from the high paying customers. Hence, to increase the feasibility of this measure, DISCOMs may need to be provided certain incentives.

Recommendation: Create a first-loss fund to support rooftop solar project lending.

The government could create a first-loss fund, a fund that would cover part of the risk of default by borrowers of rooftop solar loans. The fund can be used as a first-loss facility for the loans extended to solar rooftop projects. This would reduce the risk for lenders to rooftop solar projects, thereby encouraging them to lend more to rooftop solar projects. Small Industries Development Bank of India (SIDBI), banks, and non-banking financial companies (NBFCs) may extend loans to the extent of five to ten times of this fund, depending on their risk assessment of the consumer.

The potential impact of this solution is medium, as it would encourage banks and financial institutions to lend to rooftop solar projects. Also, feasibility is medium as setting up the fund by the government would take some time and effort.

Recommendation: Create a standardized tool to assess risk of solar rooftop projects.

There is a clear need for standardized risk scoring mechanisms and uniform practices for potential financers and lenders to evaluate rooftop solar power projects, particularly on the commercial side. The developer of the risk assessment tool should focus on collaborating with industry participants to develop screening, scoring, and selection methodologies to help non-participating banks or alternative funding sources understand key credit, project, and performance risks.

The potential impact is medium as mitigating risks would not only require standardized scoring mechanisms, but also appropriate instruments. Also, feasibility is medium as creating a standardized tool would require involvement of multiple stakeholders like DISCOMs, third party financers, EPC developers, banks and state nodal agencies.

Recommendation: Develop certification standards for solar projects.

State nodal agencies can certify the quality of equipment and construction of a rooftop solar plant on a chargeable basis. This would provide assurance around the quality and cost of the project to banks/financing agencies before lending to the consumer.

The potential impact is medium as it would ensure that the equipment and construction is fit for generation of electricity from the rooftop plant, but this recommendation is unable to address the risk of decrease in the long term demand of electricity. Also, feasibility is medium as it would require the state nodal agencies to set up a new certification agency in each state.

CHALLENGE 2: CONSUMERS' CREDIT RISK

In addition to involving DISCOMs in power purchase agreement between the consumer and third party financer, one other policy recommendations to address consumers' credit risk is:

Recommendation: Create local specialized courts to fast-track the resolution of disputes.

A key reason for the high credit risk of consumers is the high likelihood of disputes over the long period of the contract, and apprehensions of ensuing legal action, which can be time-consuming and costly. One solution is to form tribunal courts dedicated to resolving these disputes quickly. The courts could be available in every region with specialized judges. They could be given rights similar to civil courts, with funding and appointment under the jurisdiction of MNRE.

The potential impact is high as dispute resolution is one the most significant challenges, but feasibility is medium given the costs and resources involved in setting up these tribunal courts.

CHALLENGE 3: CHALLENGES IN THE IMPLEMENTATION OF NET METERING

Recommendation: Incentivize DISCOMs by providing higher RPO credit for rooftop solar power.

At present, there is little incentive for DISCOMs to prioritize net metering implementation. Incentivizing DISCOMs more would help drive better implementation of net metering. An effective solution would be to incentivize DISCOMs to fulfill their Renewable Purchase Obligation (RPO)[10] requirements – a government requirement to install solar power – via rooftop solar installations, by providing 20-30% more credit to rooftop solar power generation compared to utility-scale solar power.

The potential impact is medium as the RPO requirement would need strict enforcement by state governments. However, feasibility is high as MNRE can easily modify the RPO requirement policy.

10 RPO is a mandatory requirement for power selling DISCOMs to have a certain minimum percentage of their power portfolio from renewable energy sources.

Recommendation: Create consistent net metering policies and processes across states.

A key challenge around net metering is inconsistent and ambiguous policy implementation across states. One solution is to make net metering policies consistent across states in terms of process, metering technology and time allotted to approve net metering applications. This would require the agreement of MNRE and state governments on the policy.

The potential impact is medium because this will enable solar companies to have a consistent commercial and operational strategy. Feasibility is medium as centrally driven policies are not easy to implement in India, given the country's federal structure where states have autonomy in implementation.

Recommendation: Train DISCOM officials on the grid-approval process.

DISCOMs are responsible for providing the approvals for grid connection that are necessary to implementing net metering. However, DISCOM officials often do not have sufficient knowledge of the approval process. State nodal agencies could train DISCOM officials on the processes to be followed for timely approval of grid connection. This would help DISCOM officials provide faster grid approvals. Feedback from the training would also help policymakers understand the on-the-ground issues faced by DISCOM officials.

The potential impact of this recommendation is medium as it would enhance the implementation capability of DISCOMs. Feasibility is also medium due to the cost and effort involved in training a large number of DISCOM officials.

Table 7: Key financial instruments recommendations to overcome challenges to the third party financing model

BARRIER ADDRESSED	RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
LIMITED ACCESS TO DEBT FINANCE	Loans4SME: a peer-to-peer lending platform	Non-banking financial company	MEDIUM	HIGH
	Rooftop Solar Private Sector Financing Facility	Special Purpose Vehicle entity	HIGH	MEDIUM
	Create a Rooftop Solar Investment Trust	Special Purpose Vehicle entity	HIGH	MEDIUM

4.2 Financial instrument recommendations

Our recommendations for financial instruments to address challenges facing the third party financing model are as follows.

Recommendation: Loans4SME, a peer-to-peer lending platform

Loans4SME is an instrument under development with the India Innovation Lab for Green Finance. It is a peer-to-peer lending platform that could help improve access to debt financing for small and medium enterprises (SMEs) in the rooftop solar industry. It would create a marketplace to catalyze debt investments by connecting creditworthy SMEs with debt investors. The platform will first assess each company via a credit scoring model to ensure that the companies only take on liabilities they can comfortably repay. Once the company lists its credit requirements on the platform, platform coordinators will work with both the borrowers and the lenders to structure and close the transaction.

The platform will manage the loan portfolio for the investor and ensure timely payments over the lifetime of the debt, thus creating an environment of trust. The potential impact is medium, as such platforms are not conventional and have so far seen limited success in India. However, feasibility is high as a single entity by itself can set up the platform.

Recommendation: Rooftop Solar Private Sector Financing Facility

The Rooftop Solar Private Sector Financing Facility is also an instrument under development with the India Lab. It would help in increasing access to debt financing for the rooftop solar industry. The idea involves two phases. The first phase is the aggregation or loan book building phase, which involves building a warehouse line of credit to provide loans to creditworthy rooftop solar projects over a period not exceeding 24 months. The second phase is the securitization phase which involves securitizing of the loans through issuing green asset-backed security (ABS) bonds to domestic institutional investors and domestic lenders or international investors.

To push borrowers from the aggregation phase to refinancing their loans and securitizing the loan book, loan clauses may include an upward revision in pricing at the 18 month mark. Through this solution, the aggregate deal size would be large enough and of sufficient credit quality to allow institutional investors to lend to solar rooftop power.

The potential impact is high as the instrument seeks to tap into the large pool of debt institutional investor capital which has exhibited a strong interest in the green bond market. However, feasibility is medium since this instrument would also require credit enhancement instruments.

Recommendation: Create a Rooftop Solar Investment Trust

A Rooftop Solar Investment Trust could help increase the availability of equity for rooftop solar power in India, and by doing so, it would also decrease the amount of debt required.

India approved similar instruments, real estate investment trusts (REITs) in 2014 and infrastructure investment trusts (InvITs) in 2016. REITs allow individual investors to own an interest in the securitized real estate market, while InvITs allow them to invest in securities backed by infrastructure projects. The greatest benefit of these instruments is quick and easy liquidation of investments in the real estate market or infrastructure projects, unlike the traditional way of selling entire physical assets.

A Rooftop Solar Investment Trust (RSIT) can be set up for the rooftop solar industry, with solar assets from the third party financing model. RSITs can group rooftop projects, already installed using capital from initial investors called project sponsors, into bundles of 1 to 5 MW in size (or possibly larger, based on investor appetite), capitalized with a mix of equity and debt. It would sell these bundles of rooftop projects to investors looking for long-term cash flows from the underlying projects. This would allow investors to buy solar assets in the capital market after the tax equity participants have earned their desired returns. The theory behind it is that if sponsor equity can consistently and profitably exit the investment, sponsors will demand a lower return upfront, which ultimately will lead to lower prices for rooftop solar power for consumers.

The potential impact of this recommendation is high as it would give an exit option to sponsor equity and thus quickly bring in initial funding for rooftop projects. However, feasibility is medium since this would require regulatory approvals from Security and Exchange Board of India (SEBI).

5. Conclusion

The Indian rooftop solar power industry is steadily growing, but much faster growth is required to meet the government's ambitious target of 40 GW by 2022. A key part to accelerated growth will be better business models which can drive more access to finance.

The third party financing model for rooftop solar power has been a significant driver of growth in the rooftop solar industry globally, and it has significant potential in India. It can resolve two of the key challenges faced by potential consumers of rooftop solar power: limited access to debt finance and perceived performance risk.

Currently, the third party financing model is in a nascent stage in India, with only a 15% share of the rooftop solar industry. Understanding the challenges to the third party financing model in India is key to creating solutions to drive its growth.

Our analysis demonstrates that the third party financing model is financially viable in most states, with the support of current government fiscal incentives, for the commercial and industrial segments. Furthermore, it is financially viable in the majority of states even without government fiscal incentives, because the majority of states have already achieved grid parity. However, in order for the model to expand, first several challenges to the third party financing model need to be addressed.

The third party financing model in India is constrained primarily by limited access to debt finance, consumers' credit risk, and challenges in the implementation of net metering. If these challenges can be addressed, the third party financing model could grow from supporting 102 MW of rooftop solar power currently to more than 20 GW by 2022, which is more than half the government's target.

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

The key policy changes that we recommend are:

- First, to increase access to debt finance for rooftop solar, the Ministry of New and Renewable Energy (MNRE) can enable a training system for bankers on how to better assess loan applications for rooftop solar power.
- Second, to reduce consumer credit risk, MNRE and state governments can include DISCOMs as a party to the power purchase agreement between the developer and the consumer. In case a consumer defaults on bill payment, DISCOMs may terminate the consumer's power supply from the grid, thereby ensuring that the consumer has a strong incentive to pay for the solar power on time. Also, the Ministry of Law and Justice can create local specialized courts to resolve consumer payment disputes, thereby ensuring that any default-related cases will be decided quickly.
- Third, to remove challenges in implementation of net metering, MNRE can offer rooftop solar power a higher Renewable Purchase Obligation (RPO) credit.[11] This would incentivize DISCOMs to fulfill more of their RPO requirement through rooftop solar power, rather than other sources of renewable energy, since they would be able to fulfill more of their requirement by sourcing the same amount of power from rooftop solar power.

The key financial instruments that we recommend are:

- Loans4SME is an instrument under development with the India Innovation Lab for Green Finance. It is a peer-to-peer lending platform that aims to catalyze debt investments by connecting debt investors directly with creditworthy small and medium enterprises (SMEs) in renewable energy.
- The Rooftop Solar Private Sector Financing Facility, also an instrument being developed under the India Lab, could increase the availability of debt finance for rooftop solar installations. It involves two phases: aggregation of creditworthy solar rooftop projects which can be funded by a warehouse line of credit, and securitization, which involves securitizing the deals through issuance of green bonds. Using this solution, the aggregate deal size would be large enough and of sufficient credit quality to allow institutional investors to lend to solar rooftop power, thereby increasing the flow of capital into rooftop solar projects.

11 Renewable Purchase Obligation (RPO) is a mandatory requirement for power-selling DISCOMs to have a certain minimum percentage of their power portfolio from the renewable power sources.

- A Rooftop Solar Investment Trust could also help increase the availability of equity for rooftop solar power in India. The trust would group rooftop installations into bundles of 1 to 5 MW in size, capitalized with a mix of equity and debt. It would then sell bundles of rooftop installations to investors looking for long-term cash flows from the underlying standardized leases.

This report is one of the first examinations of the third party financing model in India and can be used as the platform for future research. Future work may include in-depth analysis of specific policy and financial instrument recommendations, specifically, in-depth analysis of an appropriate level of compensation to incentivize DISCOMs to implement net metering; development of a standardized tool to assess the risk of solar rooftop projects; formulating state-wise capital subsidy policies to replace the current common national capital subsidy mechanism, and further development of the recommended financial instruments.

6. Appendix

6.1 The global rooftop solar industry

Globally, rooftop solar power comprises around 42% of total solar power installed capacity, whereas in India it comprises only 11%.

Global solar photovoltaic (PV) installation reached more than 232 GW in 2015 (Table 8). The industry is concentrated in Australia, China, Germany, Italy, Japan, Spain and the US. Rooftop solar installations form about 42% of overall global solar power (IEA, 2016). By comparison, in March 2016, India had a rooftop solar capacity of around 740 MW, or around 11%, of total solar capacity of around 6.7 GW.

Table 8: Global solar power capacity and the share of rooftop solar power

CAPACITY IN GW (DEC' 2015)	SOLAR POWER CAPACITY	ROOFTOP SOLAR CAPACITY	ROOFTOP SOLAR SHARE IN %
GLOBAL	2,32,000	98,075	42%
CHINA	43,530	6,094	14%
GERMANY	39,700	22,232	56%
JAPAN	34,410	29,248	85%
UNITED STATES	25,620	7,430	29%
ITALY	18,920	6,243	33%
AUSTRALIA	5,070	4,791	94%
INDIA	**6,740**	**740**	**11%**

Source: International Energy Agency (IEA), Greentech Media (GTM) , CPI

Government fiscal incentives have been the primary driver of rooftop solar power.

Globally, growth in the rooftop solar industry has been driven by favorable government policies and financial incentives, high grid prices, declining cost of equipment,[12] availability of innovative investment vehicles and increasing awareness regarding rooftop solar power. Among all of these, government fiscal incentives have been the most important driving factor. For example, feed-in tariffs have played an important role in developing rooftop solar industries in countries like Germany, Italy and Australia. In the US, rooftop solar growth has been largely driven by tax benefits and capital subsidy incentives. Japan and China have used a mix of capital subsidies and feed-in tariffs.

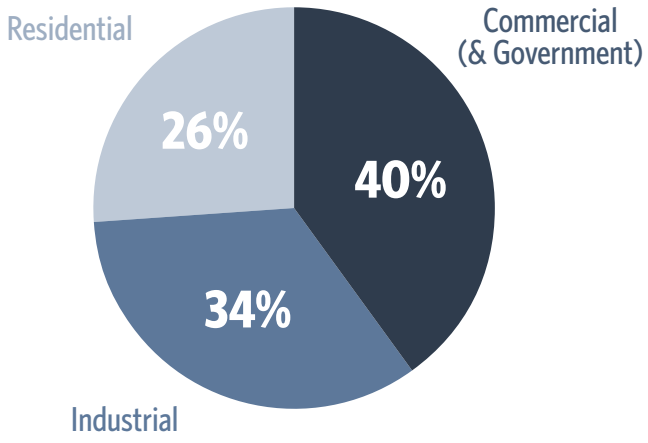
6.2 The Indian rooftop solar industry

The research firm Bridge to India estimated that the technical potential of rooftop solar in the residential, industrial, and commercial segments in 2014 is 64 GW, 40 GW and 8 GW respectively (Figure 7). However, most rooftop solar installations are in the industrial and commercial segments. The residential segment, despite its large potential, is lagging behind in solar power additions, mainly owing to the grid rate structure in India: the residential segment has lower grid rates as it is highly subsidized by the industrial and commercial segments. Consequently, the industrial and commercial segments have higher grid rates and hence larger bill savings from rooftop solar power installation. Residential segment consumers find less economic sense in shifting to solar rooftop due to relatively lower grid rates.

Rooftop solar has achieved grid parity in the industrial and commercial segments in many states.

Grid parity indicates whether investment in rooftop solar gives equal or better returns to investors than investments in conventional sources of electricity. Grid parity is associated with quick adoption of solar rooftop. However, it is not the only factor that determines the adoption of solar rooftop power;

Figure 7: Rooftop solar power in India by consumer segment



Source: Bridge to India, CPI

12 Total module costs of leading solar companies have decreased from around $1.31 a watt in 2011 to around $0.50/W in 2014 due to the reduction in processing costs, the fall in poly-silicon costs and improvement in conversion efficiencies.

other parameters like reliability of electricity supply, market dynamics, and availability of finance are also important.

We analyzed the grid parity status for 21 states in India, which comprise more than 97% of the population of India (Table 9). Our analysis shows that due to variation in grid rates, the year in which grid parity was or will be achieved varies by consumer segment and the state. Solar rooftop becomes attractive for the consumers in states where grid parity is achieved.

Table 9: Number of states which achieved grid parity by year (out of a total of 21 states)

CONSUMER SEGMENT	2015	2016	2017	2018	2019	2020
COMMERCIAL	14	17	17	18	19	20
INDUSTRIAL	11	13	14	15	16	17
RESIDENTIAL	2	2	2	3	7	10

In 2015, out of 21 states considered, 14 states (66% of the population) had grid parity in the commercial segment and 11 states (58% of the population) in the industrial segment. By the end of 2016, this will increase to 17 (80% of the population) and 13 (70% of the population), respectively. In contrast, in the residential segment, only 2 states (26% of the population) had grid parity in 2015, and it will take four years to reach grid parity in half of the states. Since grid parity has been achieved for a large portion of consumers in the commercial and industrial segments, solar power is already an attractive option for them.

The timeline for adoption of rooftop solar power is expected to vary by state and consumer segment (Table 10). We expect most of the adoption in the next three to four years to happen in the states of Andhra Pradesh, Delhi, Haryana, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh (mainly in the industrial and commercial segments) due to higher potential for savings in the cost of electricity.

To make rooftop solar power viable for consumers in all segments in all states, the government has allotted certain fiscal incentives for rooftop solar consumers – primarily capital subsidies and a policy of accelerated depreciation.

Accelerated depreciation is a policy which allows greater depreciation to be booked in the earlier years of an asset and is used to minimize taxable income. In India, the industrial and commercial segment consumers can avail of this policy. In March 2016, the allowed limit for depreciation in the first year of operation was reduced to 40% from an earlier limit of 80% set in 2010.

Capital subsidy is a direct subsidy granted to an investor in the rooftop solar installation by the government as a contribution in the initial cost of installation. From 2010 to 2015, the Indian government provided a capital subsidy of 30% for the installation cost of rooftop solar power, for all consumer segments (MNRE, 2015). However, due to procedural issues, few consumers were able to get the subsidy. In 2015, the government eliminated this subsidy for the industrial segment and most of the commercial segment; now it is available only for the residential segment and part of the commercial segment (institutional, government and social sectors).

Table 10: Year of grid parity achievement by state

STATES	INDUSTRIAL	COMMERCIAL
ANDHRA PRADESH	2015	2011
ASSAM	2022	2016
BIHAR	2016	2016
CHHATTISGARH	2021	2020
DELHI	2012	2005
GUJARAT	2022	2022
HARYANA	2011	2011
HIMACHAL PRADESH	2018	2015
JHARKHAND	2016	2016
KARNATAKA	2017	2010
KERALA	2019	2014
MADHYA PRADESH	2020	2018
MAHARASHTRA	2011	2003
ODISHA	2012	2012
PUNJAB	2014	2012
RAJASTHAN	2015	2014
TAMIL NADU	2015	2008
TELANGANA	2015	2011
UTTAR PRADESH	2012	2012
UTTARAKHAND	2027	2019
WEST BENGAL	2014	2012

6.3 Favorable policies for the rooftop solar industry in India

Besides accelerated depreciation and capital subsidy, the other policy incentives for rooftop solar power consumers in India are:

Priority sector lending: Under Indian banking regulations, banks must lend a certain percentage of their loan book to certain sectors, called priority sectors. In 2015,the Reserve Bank of India classified bank loans for solar power installation – up to INR 1 million (~US$ 15,000) for the residential segment, and up to INR 150 million (US$ ~2.2 million) for the industrial and commercial segments – as priority sector lending, thus increasing the motivation for banks to lend to rooftop solar plants.

Concessional lending: Development banks like the World Bank, Asian Development Bank (ADB) and KfW have committed to offer concessional loans through Indian banks to the rooftop solar sector. Once available, these loans would improve rooftop solar consumers' and developers' access to finance and reduce the capital cost, thereby providing a boost to the industry. Currently, the interest cost for solar rooftop installations is around 12%-13%, but it can be reduced to 9%-9.5% with concessional lending. Our analysis shows that an interest rate reduction by 4% can improve equity IRRs by 2%-3%.

Net metering: Net metering is the billing system where rooftop solar installation transmits the excess solar power generated to the grid and receives power from the grid when the rooftop solar power generation is not sufficient. The power in this case is sold and bought at the same price as per the grid rate for the consumer category. Net metering is now a part of solar policy in 25 states and union territories in India. However, implementation has begun in only a few states and is expected to begin soon in the remaining states. The barriers to implementation of the policy have been highlighted in Appendix 6.4.

6.4 Additional potential solutions to address challenges to the third party financing model

In addition to the recommendations listed in Section 4, which are the most significant and have the highest impact and feasibility, our research also identified other potential solutions which have lower impact and feasibility. The overall list of our recommendations and all potential solutions is highlighted in Table 18 at the end of the report.

6.4.1 LIMITED ACCESS TO DEBT FINANCE

From our primary research, it emerged that banks are reluctant to lend to rooftop solar power projects for a number of reasons, including lack of understanding of the rooftop solar technology and associated risks, limited ability to track the use of debt finance, lack of a standard risk assessment method for evaluating projects, and fear of accidental damage or theft of the equipment. To address these challenges, there are several potential solutions to increase the availability of bank debt finance for rooftop solar power (Table 11).

Table 11: Potential solutions to increase availability of bank debt finance

RECOMMENDATIONS	KEY PARTICIPANT	IMPACT	FEASIBILITY
Train bank officials in processing rooftop solar loans	Ministry of New and Renewable Energy/ Development banks	MEDIUM	HIGH
Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
Create a first-loss fund to support rooftop solar project lending	SIDBI / Ministry of finance	MEDIUM	MEDIUM
Create a standardised tool to assess risk of solar rooftop projects	Rating agencies	MEDIUM	MEDIUM
Develop certification standards for solar projects	State nodal agencies	MEDIUM	MEDIUM
Make general insurance for rooftop solar power equipment available at affordable rates	Government insurance companies	LOW	MEDIUM

In addition to the policy recommendations listed in Section 4, we have identified one other potential policy action, which can help address this challenge:

Make general insurance for rooftop solar power equipment available at affordable rates: There needs to be a mechanism to provide insurance for solar assets at affordable rates, maybe by government insurance companies. This would safeguard lenders against any safety risk for the equipment. The impact would be low as general insurance is a small consideration during evaluating a debt proposal. However the feasibility of this is high as insurance companies have similar products catering to other industries.

In addition to the policy solutions, there are also several finance instrument solutions to attract more finance not just from banks but other potential investors too. These were discussed in Section 4.

6.4.2 CONSUMERS' CREDIT RISK

Under the third party financing model, rooftop power purchase agreements typically have contract terms of 15-25 years. The risk of disputes between the consumer and the third party financer over such a long period is high, particularly because as solar power costs fall, there is a risk that the consumer can renege on the contract and buy cheaper power from other sources. This credit risk is one of the most significant challenges to the growth of the third party financing model currently.

In addition, contract enforcement is difficult in India - the legal process is time-consuming and very costly. In the World Bank's Ease of Doing Business 2016 rankings, India was ranked 178 out of 189 countries on contract enforcement (World Bank Group, 2016).

There are potential solutions, which, if implemented together, would have a high impact in overcoming this challenge of consumers' credit risk (Table 12).

In addition to the recommendations included in Section 4, other potential solutions with lower impact are:

Develop a standardized format for power purchase agreements: The power purchase agreements between the third party financers and consumers should be standardized along the lines of a format subscribed by MNRE. Every contract should be registered and there should be pre-defined set of decisions covering as many eventualities as possible. The impact would be low as it would enhance enforceability of the contract, but still would need other legal recourse to improve it further. However, the feasibility is high, as it is simple and inexpensive activity.

Provide third party financing investors access to consumers' credit information: The Ministry of Finance may allow third party financing investors to request the credit history of potential consumers, from the Credit Information Bureau Ltd (CIBIL)[13]. Using this information, investors will be able to better predict the expected behavior of potential consumers and predict the likelihood of their honoring the contract.

Currently, the potential impact of this recommendation is low, since CIBIL scores only record banking transactions of the consumers and do not cover utility bill payment. The impact can be increased if MNRE can include the history of utility bill payments within CIBIL scores and if DISCOMs can make consumers' records of power consumption and bill payments available to third party financing investors upon request. Feasibility is

Table 12: Potential solutions for managing consumers' credit risk

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Create local specialized courts to fast-track the resolution of consumer payment disputes	Ministry of Law and Justice	HIGH	MEDIUM
Involve DISCOMs in power purchase agreements between the consumer and third party financer	State governments/ DISCOMs	HIGH	LOW
Develop a standardized format for power purchase agreements	Ministry of New and Renewable Energy	LOW	HIGH
Provide third party financing investors access to consumers' credit information	Ministry of Finance	LOW	MEDIUM

13 Credit Information Bureau (India) Limited (CIBIL) is India's first Credit Information Company (CIC) which collects and maintains records of an individual's loans and credit cards payments. These records are submitted to CIBIL by member banks and credit institutions, on a monthly basis. This information is then used to create credit scores which are provided to credit institutions in order to help evaluate and approve loan applications.

Table 13: Potential solutions for improved implementation of net metering

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Incentivize DISCOMs by providing higher RPO credit for rooftop solar power	Ministry of New and Renewable Energy	MEDIUM	HIGH
Create consistent net metering policies and processes across states	Ministry of New and Renewable Energy	MEDIUM	MEDIUM
Train DISCOM officials on grid-approval process	State nodal agencies	MEDIUM	MEDIUM
Publish monthly performance data of DISCOMs	State nodal agencies	LOW	HIGH

medium since it would require the access to consumers' data to be extended to third party financing investors. Currently, CIBIL scores are only available to banks and NBFCs.

6.4.3 CHALLENGES IN THE IMPLEMENTATION OF NET METERING

A policy of net metering has been approved by all major states in India, but few have succeeded in proper implementation to date. The key challenges to implementation are that DISCOM officials are not sensitized to implement the policy, DISCOMs don't have an incentive to quickly approve consumers' applications to install rooftop solar on their roofs, the performance of DISCOMs is poorly monitored, net metering policy is not clear for some states and the net metering policy is inconsistent among states. As DISCOMs are the ones implementing net metering policy on the ground, the issues related to DISCOMs affect its implementation. Due to inconsistent policy across states, industrial and commercial consumers and solar companies operating in multiple states have to plan commercial and operational plans differently in different states. To overcome these issues relating to net metering, we propose certain recommendations, which if implemented together would have a high impact (Table 13).

In addition to the recommendations included in Section 4, there is another potential solution that would have a lower impact:

Publishing monthly performance data of DISCOMs: State nodal agencies should publish monthly data on the number of requests for rooftop solar, closures and rejection of requests with reasons for each DISCOM. The impact would be low as it would only help in monitoring the performance of the DISCOMs. To increase impact, some legal obligation on DISCOMs may be necessary. The feasibility is high as the Ministry of New and Renewable Energy by itself can make the required policy modifications.

There are also several challenges to the third party financing model that are not as significant as limited access to debt finance, consumers' credit risk, and challenges in the implementation of net metering. We discuss them here, along with potential solutions.

6.4.4 LACK OF AWARENESS AMONG CONSUMERS OF ROOFTOP SOLAR POWER AS AN ENERGY OPTION

Lack of awareness among consumers regarding rooftop solar power and its benefits, increases the sales effort and other transaction costs for the industry, owing to extra sales effort required to make the consumer informed and convinced. These factors in turn increase the cost of customer acquisition. There hasn't been much effort from the rooftop solar industry or the government to address this issue. To increase the awareness about solar rooftop, we propose certain recommendations, which if implemented together would have a high impact (Table 14).

Conduct awareness workshops on rooftop solar power: The Ministry of New and Renewable Energy can initiate solar workshops in different cities or places, specifically targeting municipality leaders, school/college directors, hospital/malls owner and industrialists, to spread

Table 14: Potential solutions to increase consumer awareness of rooftop solar power

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Conduct awareness workshops on rooftop solar power	Ministry of New and Renewable Energy/ State nodal agencies	HIGH	MEDIUM
Develop an educational mobile app	Ministry of New and Renewable Energy	MEDIUM	HIGH
Launch a showcase rooftop solar plant installation program	Ministry of New and Renewable Energy/ State nodal agencies	HIGH	LOW

awareness about power purchase agreements and rooftop solar power's value proposition. In addition, educational seminars, press conferences, and informational materials can be used to build the perception of solar products. The impact would be high as the message would reach out to influential people in the society. However, feasibility would be medium given the cost involved.

Develop an educational mobile app: A mobile app can be developed to spread awareness regarding solar rooftop and act as an exhaustive guide for consumers. It should provide technical assistance, as well as act as an online mapping tool to assess solar potential for any roof in the city. This will help identify the best solar energy options and provide information on subsidies, state policies, project planning, permitting and available financing options. The impact would be medium as it would be able to reach out to a much wider audience; the feasibility would be high, based on the government's success in launching other mobile apps.

Launch a showcase rooftop solar plant installation program: The Ministry of New and Renewable Energy can launch a program in the top 100 cities to set up rooftop solar plants on at least one consumer's rooftop in each zip code. These plants would become showcases for the feasibility of rooftop solar installations in the area. The cost of the solar plant can be recovered from the consumer's electricity bill over a period of 4-5 years. The respective DISCOMs should be given targets for selecting and implementing this. The impact would be high as it would raise awareness of rooftop solar power. However, feasibility would be low given the high costs involved.

6.4.5 CONSUMERS' RESISTANCE TO A LONG-TERM CONTRACT

Typically, the contract period for the third party financing model is 15-25 years, as short-term contracts are not viable for solar companies or investors. However, many consumers consider long-term contracts to be risky mainly because of a lack of trust on the agreement or uncertainty about the cost and quantum of long-term power consumption.

Develop a standardized format for power purchase agreements: This recommendation is also used to address consumers' credit risk. It would increase trust of the consumers in the agreement terms. The agreement format thus would be consistent and would safeguard the interests of the consumers.

Table 15: Recommendations to address resistance to long-term contracts

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Develop a standardized format for power purchase agreements	Ministry of New and Renewable Energy	MEDIUM	HIGH

6.4.6 DIFFICULTY IN ACQUIRING GOVERNMENT SUBSIDIES FOR ROOFTOP SOLAR POWER

The government provides a 30% capital subsidy for residential, government and institutional consumers. However, the general experience with the subsidy disbursement process has not been good. In the past, there were a number of delays in sanctioning and disbursement of the subsidy due to lack of funds, lack of process clarity, and involvement of multiple bodies.

However, in January 2016, the government allocated funds of USD $750 million for capital subsidies (Press Information Bureau, Government of India, 2016) and changed the disbursement mode from channel partners to state nodal agencies/financial institutions/Solar Energy Corporation of India Ltd. This should resolve some of the issues with the subsidy disbursement process, like fund availability, simpler process etc but only to an extent. We propose the following additional recommendations to tackle this issue (Table 16).

Provide income tax credits in place of subsidies to rooftop solar investors: The Ministry of New and Renewable Energy may give an option to consumers to avail income tax credits on the capital investment, to be set off against future income tax obligations, instead of subsidies. The impact of this recommendation would be high because it would not be uncertain like subsidy disbursement and would be easier for consumers as they need not follow up with an agency for getting the benefit; however, feasibility is low given that it requires regulatory change from the Ministry of Finance.

Table 16: Potential solutions to address difficulties in acquiring government subsidies

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Provide income-tax credits in place of subsidies to rooftop solar investors	Ministry of New and Renewable Energy, Ministry of Finance	HIGH	LOW
Allow each state to develop its own capital subsidy policy	Ministry of New and Renewable Energy	MEDIUM	MEDIUM

Allow each state to develop its own capital subsidy policy: As different states have different tariffs, the subsidy required to make rooftop solar power economically viable is different in each state. Hence, instead of having a uniform subsidy mechanism across all states, each state should be allocated a subsidy fund and allowed to make their own subsidy policy. As states would have better control over the disbursement of subsidies, the subsidy disbursement process would be faster and more efficient. However, this recommendation's impact would be medium because the differences in subsidy policies across states may create confusion for investors, especially if states do not define their policies clearly. Also, the feasibility would be medium because the policy implementation may be affected by competition between states to garner larger funds for the subsidy.

6.4.7 LIMITED AVAILABILITY OF ROOFTOP SPACE

There can be many reasons for a lack of available rooftop space. The key reasons are that the property may be rented or it may be located in a complex/ apartment, where the consumer doesn't have complete ownership of the roof, or the roof is already covered by other utilities or shadowed by some obstructions and the quality of the rooftop may not be appropriate to support a rooftop solar power plant.

Allow mounting structures for rooftop solar plants without prior approval: State governments should encourage municipal corporations and local urban bodies to make suitable amendments in the existing building bylaws to allow erecting a mounting structure for rooftop solar plants without any further approval. The height of the module structure carrying solar panels should not be counted towards the total height of the building as permitted by building bylaws, as this structure would be temporary. The impact would be medium as it would open up rooftop space. The feasibility is high as it only requires suitable amendments in the existing bylaws.

Provide for community-shared solar systems in rooftop solar policy framework: A community shared solar (CSS) project is a solar power system that provides benefits – such as electricity, net metering credits, and return on investment – to multiple participants. A CSS project is hosted by an entity with a suitable roof or parcel of land and is supported by multiple participants, who invest in the project or purchase the electricity or net metering credits generated. However, currently there is no explicit provision for CSS projects. Accordingly, the Ministry of New and Renewable Energy should provide for implementation of CSS projects. The impact is medium as it would require multiple consumers interested in buying power from a CSS project. Also, feasibility is medium as it would require the creation of state policies, and involvement of DISCOMs to implement.

Allow virtual net metering: Virtual net metering allows any customer with a net metered system to allocate credits associated with monthly excess generation from a system to other customers of the same distribution company. This would help the consumers who wish to generate or purchase rooftop solar power but don't have the rooftop space available for a rooftop solar plant. The impact is medium as it would require a vacant roof in the same area. Also, the feasibility is medium as it would require creation of state policies and the involvement of DISCOMs.

Table 17: Potential solutions to address limited availability of rooftop space

RECOMMENDATION	KEY PARTICIPANT	IMPACT	FEASIBILITY
Allow mounting structures for rooftop solar plants without prior approval	State governments	MEDIUM	HIGH
Provide for community-shared solar systems in rooftop solar policy framework	State governments	MEDIUM	MEDIUM
Allow virtual net-metering	State governments	MEDIUM	MEDIUM

6.4.8 COMPREHENSIVE SOLUTIONS TABLE

Table 18 provides the final scores for all potential solutions. Impact and feasibility were each scored on a scale of 1-3 (low-high), with the sum scored on a scale of 1-6. The significance of the challenge was scored on a scale of 1 to 10. The final score was the product of the sum of impact and feasibility and the challenge.

Table 18: Final scores for all potential solutions to address challenges for the third party financing model in India.

SOLUTION	CHALLENGE ADDRESSED (WITH SIGNIFICANCE SCORE [E])	KEY PARTICIPANT	IMPACT SCORE [B]	FEASIBILITY SCORE [C]	IMPACT + FEASIBILITY [D]	FINAL SCORE [E = A X D]
Train bank officials in processing rooftop solar loans	Limited access to debt finance (8)	Ministry of New and Renewable Energy	2	3	5	40
Create local specialized courts to fast-track the resolution of consumer payment disputes	Consumers' credit risk (8)	Ministry of Law and Justice	3	2	5	40
Involve DISCOMs in power purchase agreements between the consumer and third party financer	Limited access to debt finance (8)	State govts/ DISCOMs	3	1	4	32
Create a first-loss fund to support rooftop solar project lending	Limited access to debt finance (8)	Ministry of finance	2	2	4	32
Create a standardized tool to assess risk of solar rooftop projects	Limited access to debt finance (8)	Rating agency	2	2	4	32
Develop certification standards for solar projects	Limited access to debt finance (8)	State nodal agencies	2	2	4	32
Involve DISCOMs in power purchase agreements between the consumer and third party financer	Consumers' credit risk (8)	State govts/ DISCOMs	3	1	4	32
Develop a standardized format for power purchase agreements	Consumers' credit risk (8)	Ministry of New and Renewable Energy	1	3	4	32
Incentivize DISCOMs by providing higher RPO credit for rooftop solar power	Challenges in the implementation of net metering (5.5)	Ministry of New and Renewable Energy	2	3	5	27.5
Conduct awareness workshops on rooftop solar power	Lack of awareness among consumers of rooftop solar power as an energy option (5.5)	Ministry of New and Renewable Energy/ State nodal agencies	3	2	5	25
Develop an educational mobile app	Lack of awareness among consumers of rooftop solar power as an energy option (5.5)	Ministry of New and Renewable Energy	2	3	5	25
Make general insurance for rooftop solar power equipment available at affordable rates	Limited access to debt finance (8)	Govt insurance companies	1	2	3	24
Provide third party financing investors access to consumers' credit information	Consumers' credit risk (8)	Ministry of Finance	1	2	3	24
Create consistent net metering policies and processes across states	Challenges in the implementation of net metering (5.5)	Ministry of New and Renewable Energy	2	2	4	22
Train DISCOM officials on grid-approval process	Challenges in the implementation of net metering (5.5)	State nodal agencies	2	2	4	22
Publish monthly performance data of DISCOMs	Challenges in the implementation of net metering (5.5)	State nodal agencies	1	3	4	22
Develop a standardized format for power purchase agreements	Consumers' resistance to a long-term contract (5)	Ministry of New and Renewable Energy	1	3	4	20

Launch a showcase rooftop solar plant installation program	Lack of awareness among consumers of rooftop solar power as an energy option (5)	Ministry of New and Renewable Energy/ State nodal agencies	3	1	4	20
Allow mounting structures for rooftop solar plants without prior approval	Limited availability of rooftop space (4.5)	State govts	1	3	4	18
Provide income-tax credits in place of subsidies to rooftop solar investors	Difficulty in acquiring government subsidies for rooftop solar power (4.5)	Ministry of finance	3	1	4	18
Allow each state to develop its own capital subsidy policy	Difficulty in acquiring government subsidies for rooftop solar power (4.5)	Ministry of New and Renewable Energy	2	2	4	18
Provide for community-shared solar systems in rooftop solar policy framework	Limited availability of rooftop space (4.5)	State govts	2	2	4	18
Allow virtual net metering	Limited availability of rooftop space (4.5)	State govts	2	2	4	18

7. References

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