The Lab

India Innovation Lab for Green Finance

THE RESIDENTIAL ROOFTOP SOLAR ACCELERATOR

INSTRUMENT ANALYSIS
SEPTEMBER 2018

Rooftop Solar Accelerator

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DESCRIPTION & GOAL —
To accelerate mass adoption of residential rooftop solar to power 200 million households in India, through standardized product offering, easy financing, and efficient execution at scale

SECTOR —
Electricity/Power

PRIVATE FINANCE TARGET —
Commercial equity: private equity and venture capital, debt from banks and NBFCs (non-banking financial companies)

GEOGRAPHY—
India

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. It is comprised of three programs: the Global Innovation Lab for Climate Finance, the Brasil Innovation Lab for Climate Finance, and the India Innovation Lab for Green Finance.

AUTHORS AND ACKNOWLEDGEMENTS

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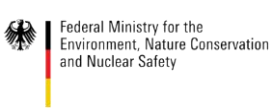


1. CONTEXT

Despite holding vast potential of up to 60 GW of power, the residential rooftop solar market in India hasn't realized its promise. Barriers include low consumer demand, limited access to commercial finance for developers, and high costs of customer acquisition for developers.

To date, India has only achieved 2.5 GW of rooftop solar installations, mostly on commercial and industrial roofs. In the residential rooftop solar market specifically, there is vast potential of over 60 GW, but less than 0.5 GW had been installed as of March 2018. (Bridge to India, 2018).

This is due to a number of barriers. On the demand side, there is low customer awareness, insignificant economic incentives, and perceived performance risks. On the developer side, there is difficulty in identifying the right customer segments, high customer acquisition costs, limited access to commercial finance, and long payback periods that often render the business model unsustainable.

However, a confluence of factors including a renewed push from government, rising grid tariffs, and declining PV prices are also working in favor of residential solar. The Rooftop Solar Accelerator (RSA)aims to tap the residential segment in the hitherto uncharted smaller-sized cities through using analytics to identify and market to the apt customer segments, offering a lease model to combat high upfront costs for customers, and by standardizing product offering to achieve operational efficiencies.

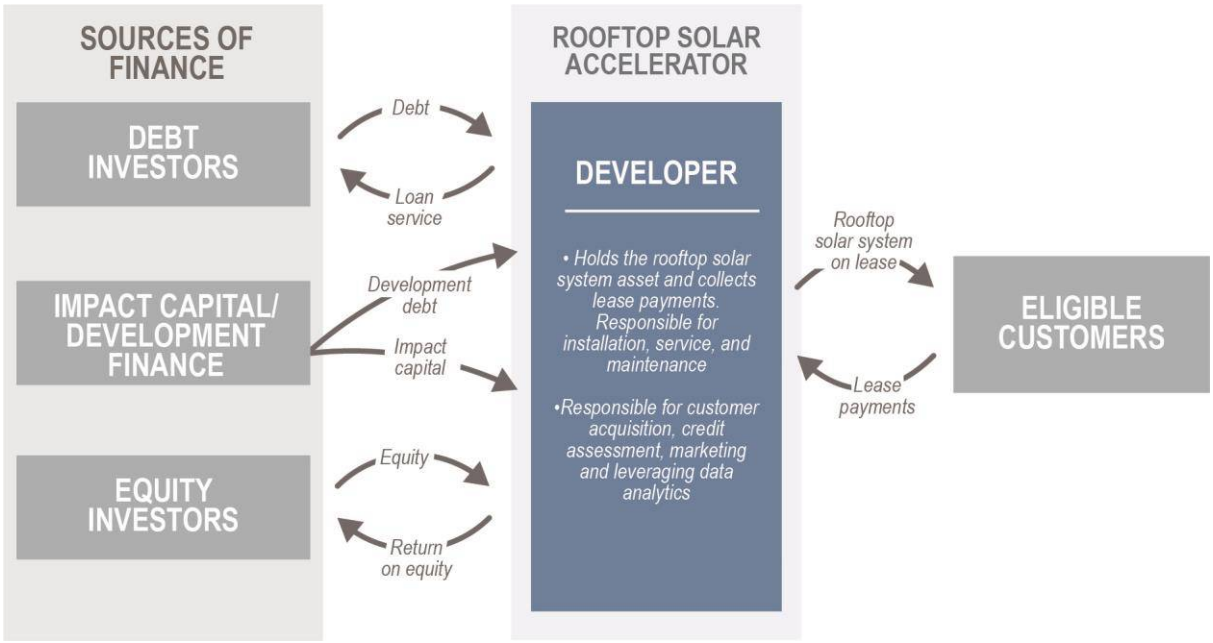
2. INSTRUMENT MECHANICS

The Rooftop Solar Accelerator will install solar panels on the rooftops of identified customer segments. The revenues generated through monthly payments made by its customers will be used to service loan repayments and meet operational expenses. The residual cashflows will be either reinvested or returned to equity holders.

The Rooftop Solar Accelerator (RSA) aims to accelerate mass adoption of residential rooftop solar in India, through standardized product offering, easy financing, and efficient execution at scale.

By scaling a standard solar leasing model into an untapped market in India, the proponent company, a project developer called Peacock Solar, will generate revenues through monthly payments made by its customers. These revenues will be used to service loan repayments as well as meet operational expenses. The residual cashflows will be either reinvested or given back to equity shareholders. The Rooftop Solar Accelerator's interaction with different stakeholders is depicted in the following graphic.

Figure 1: Rooftop Solar Accelerator instrument mechanics



In addition to the leasing model – which is still relatively new to India – this instrument differs from other attempts to unlock rooftop solar in several important ways:

- It introduces an analytic-driven framework for customer acquisition and credit evaluation. Data will be leveraged to segment customers on the basis of income levels, appliance ownership, education, awareness levels, profession etc. Advanced analytics will uncover early adopters, allow effective communication, raise the conversion ratios, and lower acquisition costs.
- It will apply a standardized product offering that brings in operational efficiencies to the leasing model, while making it easier for customers to decide - homeowners will be presented with only 1 or 2 configurations of system sizing and financing options.
- The entire sales cycle will be managed through a mobile app, which will further ease the training process and optimize the sales cycles.

3. INNOVATION

The instrument improves upon existing business models of rooftop solar in India through lease offerings, use of analytics and technology, product standardization and stringent lease agreements.

3.1 THE INSTRUMENT AIMS TO ADDRESS BARRIERS HINDERING THE ADOPTION OF ROOFTOP SOLAR IN THE RESIDENTIAL SEGMENT

There are several prominent barriers hindering scale up of rooftop solar for residential consumers in India that the Rooftop Solar Accelerator would address:

- **Low consumer awareness:** Grid electricity in the residential segment is subsidized in India (compared to commercial/industrial segment), and the economic case for adopting rooftop solar exists only for certain segment of consumers in specific states.

Thus the impetus to adopt rooftop solar remains largely missing from consumers' end. This instrument addresses this barrier by identifying and marketing to only those customer segments for which there is an economic case to adopt rooftop solar.

- **High upfront costs:** One of the biggest barriers to adoption of solar is the high upfront cost associated with equipment purchase. Consumers are reluctant to incur high upfront cost given their limited familiarity with the product and the lack of any urgency in adopting solar. Acquiring a bank loan to fund the purchase is a bureaucratic process with high interest rates and short tenure, thereby resulting in monthly payments greater than savings on the electricity bills. This instrument offers a monthly lease model characterized by easy, mutually agreed upon periodic payments, which will not require significant upfront payments.

- **Operational barriers:** Small and upcoming developers are often plagued by operational inefficiencies such as costly and time-consuming customer acquisition, slow sales cycles, and high training costs. These tend to drive up their costs multifold. The RSA model utilizes an analytically-driven customer acquisition framework, standardized product offering, and mobile sales to overcome these barriers.

- **Limited access to commercial finance for a small-scale developer:** Accessing private finance, especially debt, is a challenge for any young company in India. To provide comfort to debt financiers, the instrument reduces the loan payback period to 3-5 years (even if the tenure of the lease with customers is longer). In addition, third-party credit assessment of off-takers and stringent lease agreements, such as 24x7 access to terrace to ensure asset recovery in case of payment default, will further reduce default rates.

3.2 A COMPARISON WITH THE EXISTING BUSINESS MODELS

In India, the residential rooftop solar segment based on business operations can be divided into various business models:

- The Capital Expenditure (CAPEX) model, wherein the user of the rooftop owns the assets, consisting primarily of solar panels. The upfront cost may be paid via own capital or through bank borrowings.
- The Renewable Energy Service Company (RESCO) model, or the Operational Expenditure (OPEX) model, wherein the assets are owned by developers or third-party investors, and installed at the customers' premise. The customer typically pays a pre-determined price per unit generated as defined in the Power Purchasing Agreement (PPA) over a pre-specified period of time, normally 15 to 20 years.
- Hybrid models, whereby customers lease systems from developers for a certain period of time, after which they buy back the system at a pre-specified price. This reduces the risk for developers and financiers, and is an attractive option for users since they are able to own the assets but aren't required to pay the entire sum upfront. However, it hasn't yet taken off at scale in India, due to legal complications associated with ownership transfer and difficulty in risk assessment in such a business model.

The table below expounds on the value proposition offered by RSA with respect to other competitors in the market. We have compared the RSA model with that of a general CAPEX model, OPEX PPA model, and other hybrid models in the market.

Table 1: How RSA differentiates itself from existing business models

	ISSUES WITH EXISTING MODELS	RSA's DIFFERENTIATION
OPEX (PPA) MODEL	Developers have limited access to finance due to financiers' discomfort around risk of default and asset recovery.	➢ Stringent lease agreements, such as a clause on 24x7 access to terrace to recover asset in case of default, to provide comfort to debt funders. ➢ Third-party credit assessment of off-takers to lower default rates. ➢ Reduced payback period of 3-5 years for loan repayment even if lease tenure with customer is longer. ➢ Unlike traditional PPA model, RSA's offering has a fixed monthly payout, implying predictable cash outflows for homeowners.
CAPEX MODEL	High upfront cost of installing rooftop solar.	➢ Centralized monthly payouts instead of high one-time installation costs. There will be electricity bill savings from day 1. ➢ Centralized procurement to enable economies of scale for distributed systems.
ALL BUSINESS MODELS (CAPEX + OPEX)	Inefficient operations such as slow sales cycle, duplication in marketing efforts and training render the business unprofitable.	➢ Tech enabled operations and lease management for cost transparency and efficiency. ➢ Standardized agreements (in terms of system configuration and lease pricing) enable simpler training/sales.
	High cost of marketing and maintenance on a per unit basis	➢ Comprehensive data analysis aims at learning customer behavior and improve customer acquisition at every sales interaction. ➢ All distributed systems to be wifi monitored for remote performance management, proactive defect reduction, which will result in lower O&M costs.

3.3 CHALLENGES TO INSTRUMENT SUCCESS

The idea faces several challenges in terms of actionability and financial sustainability. The feasibility of this idea is yet to be tested as the planned test phase (pre-pilot phase) is not yet complete and the proponent is currently conducting on-ground market research through surveys and interviews to finalize on the strategy.

Further, even though the model per se is self-sustainable, revenue generation would depend on the success of the idea in terms of price realization and default rates. Additionally, scaling up can be impacted by the availability and timing of capital, which is usually difficult to come by for small/upcoming developers.

Lastly, while the use of data analytics and technological solutions may reduce costs and unlock new opportunities, it also poses threats in terms of data privacy and security. Over time, as copious amounts of data is gathered, there is a cost involved in ensuring its protection (Renewable Watch, 2018).

To ensure the proponent is able to successfully face these challenges, there is a continuous need to evolve the business model and tweak its strategy based on the level of success of its operations.

MARKET TEST AND BEYOND

4. IMPLEMENTATION PATHWAY AND REPLICATION

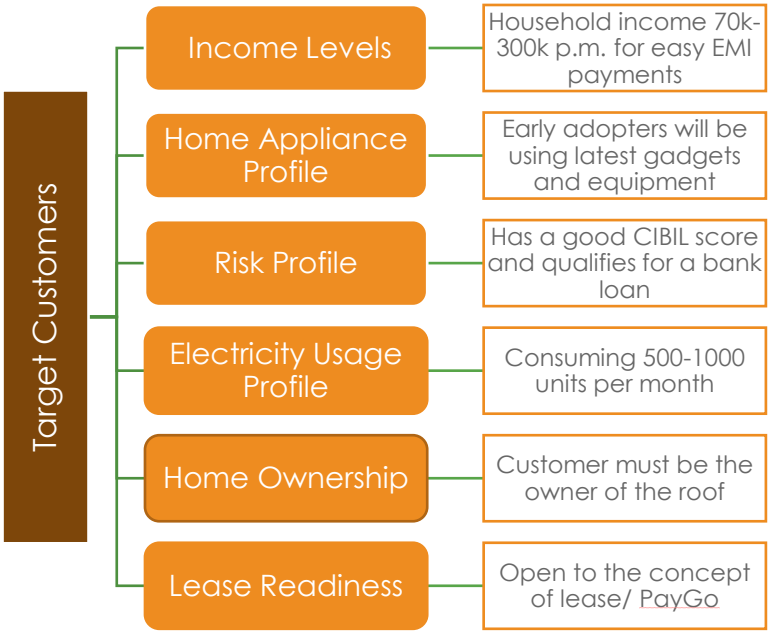
The proponent – Peacock Solar – will initially test this instrument by installing 20 projects by the end of 2018 in Kota, after which the company plans to perform a larger-scale pilot of ~250 projects, spread across multiple cities.

4.1 SCOPE AND GEOGRAPHY

The proponent has chosen to venture into hitherto untapped smaller cities in India due to higher availability of owned, independent houses with off-takers possessing terrace rights.

Criteria such as normalized electricity tariffs, state net metering policies, population density, digital penetration, among other factors, were used to screen states and cities for the pilot implementation. The cities that have been shortlisted are Kota, Nagpur, Jaipur, and Jodhpur. After further analysis, Kota (Rajasthan) has been chosen for pilot. Within the target geographies, potential customers will be evaluated on parameters such as income levels, home appliance profiles, electricity usage, home ownership, among others.

Figure 2: Key customer selection criteria



4.2 THE TEAM

The proponent of this idea is Peacock Solar, a developer with presence in Kota, Nagpur, Jodhpur, Maharashtra and Uttar Pradesh. Peacock's team consists of 7 staff, each holding responsibility for key business functions. Their team includes: i) Aniket Baheti – An IIT Madras and ISB, Hyderabad alumnus, Aniket has been engaged in India's solar sector since 2010 with the advent of Jawaharlal National Solar mission. He managed India's first private 100MW solar park in Jaisalmer and helped Govt. of Rajasthan frame its solar policy in 2011. ii) Hardik Jain – An IIT Kanpur & IIM Bangalore alumnus, Hardik brings in deep technology experience working multinational companies. He manages data analytics and technology development at Peacock Solar.

In addition, since Peacock Solar is incubated by Sangam Ventures, it is currently availing accounting & finance services from Sangam's finance team.

4.3 TEST AND PILOT

To test out its service and to collect/analyze consumer behavioral data, the proponent will first install around 20 projects of 5 KW each in Kota by the end of 2018. Learnings from the test of these 20 installations will be used to build data models, develop the prototype customer profile, and fine tune the strategy for future operations.

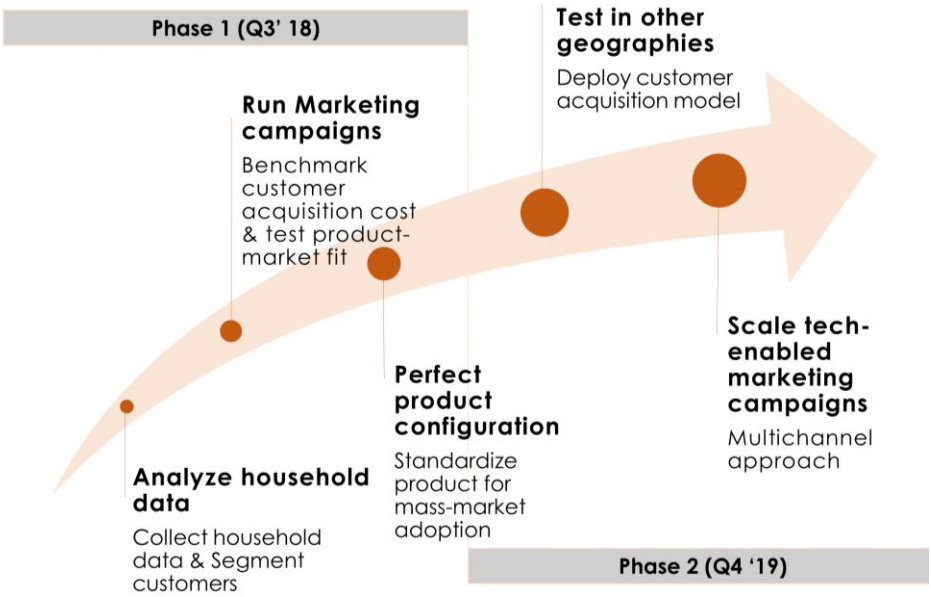
After the test phase is finished, the proponent aims to install close to 250 projects by the second quarter of 2019, as part of the pilot. To scale up rapidly, the proponent plans to standardize product offerings and configurations to ease the decision making for uptake. The total capital required for the pilot will be in excess of US$1 million, which will be a combination of debt and equity that the proponent plans to raise from VC (Venture Capital) firms, banks, and NBFCs (non-banking financial corporations).

In addition, the proponent seeks the support of philanthropic capital. Although the idea is predicated on self-sustenance, philanthropic support during the initial stages can be extremely useful in crowding-in commercial investment. Such capital can be in the form of junior equity to provide downside protection to commercial equity investors or a credit guarantee to partially cover for defaults and instill confidence in debt investors, or project preparation support to fund activities related to market research and credit assessment.

Table 2: Timeline for test and pilot. See Annex 8.2 for operations and strategy.

Key Metrics	Q3'2018	Q4'2018	Q1'2019	Q2'2019	Q3'2019	Q4'2019
Number of Customers Reached	1000	1150	1800	2100	2400	2800
Number of Installations	10	15	30	50	65	100
Cumulative Installations	10	25	55	105	170	270
Number of Cities	1	1	1	2	2	2

Figure 3: Timeline for operations and strategy



5. IMPACT

If successful, the idea can mobilize capital worth US$ 75 million by 2022. In case this business model sets a precedent for other companies to replicate, the total capital mobilized can be as high as US$ 380 million, while abating 640,000 tons of CO2, by 2022. This represents 500 MW of installed capacity.

5.1 QUANTITATIVE MODELLING

The Lab Secretariat has built a cash flow model based on a representative capital structure and the pricing Peacock Solar is likely to pursue in its pilot. For the following assumptions, the returns yielded come out to be 12.7% at the project level and 13.9% at the equity level.

Table 3: Internal rate return (IRR) model

Parameter	Details
Monthly Payment Amount	INR 3375 (or INR 675/kW)
Tenure of Lease	15 years
Typical Project Size	5 kW
Security Deposit	INR 25000 (or INR 5000/ kW)
Capital Structure	70% Equity, 30% Debt
Cost of Debt	12%
Loan Payback Period	5 Years
Project IRR (Internal Rate of Return)	**12.7%**
Equity IRR	**13.9%**

The Lab Secretariat is also of a view that there is a compelling case for utilization of philanthropic capital given the instrument's potential for high impact as it reaches pilot, and then scales up. Philanthropic capital could speed this process by crowding in commercial capital; allocating a small proportion of concessional capital (supported by a donor/philanthropic entity) to the overall pool of capital can boost the returns for common shareholders. This can have a strong catalytic effect, whereby a commercial investor who previously might not be sure of investing may now see this as a very attractive investment opportunity.

Table 4: Effect of concessional equity on common shareholder returns

Capital Structure	**70% Equity, 30% Debt**		
Proportion of Concessional Equity (in the overall capital structure)	0%	10%	15%
Equity IRR	13.9%	16.1%	17.8%
Incremental IRR	**-**	**2.2%**	**3.9%**
Capital Structure	**60% Equity, 40% Debt**		
Proportion of Concessional Equity (in the overall capital structure)	0%	10%	15%
Equity IRR	14.0%	16.6%	18.5%
Incremental IRR	**-**	**2.6%**	**4.5%**

For instance, our analyses show that a 10% contribution of concessional equity can raise the returns for common shareholders by 200 to 300 basis points. In case concessional equity's contribution rises to 15%, the incremental returns for common shareholders can jump by 350 to 450 basis points.

The concessional equity's returns are capped at 3% - that is, anything in excess of 3% are distributed to common shareholders, thereby raising their returns disproportionately. In case of negative cash flows in a particular year, the returns are shared between common equity and junior equity in the proportion of their contribution to the overall capital.

Since there is uncertainty regarding the capital structure at the time of pilot, we have computed the figures for multiple cases: the first one with equity constituting 70% of the total capital, while the second one with equity accounting for 60% of the capital. Given that Peacock Solar is still a startup and may not be able to access debt as easily as a mature company, we have generally assumed equity will play a more significant role than usual, at least till the pilot (compared to utility-scale projects, where equity's contribution may be as low as 25%).

5.2 ENVIRONMENTAL AND SOCIAL IMPACT

As highlighted in Section 4.2, the proponent plans to install 250 projects of 5 KW each during the pilot. This would mobilize US$ 1 million for clean energy and save up to 1600 tons of CO_2 per year.

The impact can be much higher in case the company becomes successful and is able to scale up. Table 5 summarizes these impacts. For the purposes of computation, we have assumed Peacock Solar will eventually be able to achieve 100 MW of installations at scale, if successful, which would abate 130,000 tons of CO_2. In case the proponent's business model sets a precedent for other companies to replicate, the impact can be even higher. We assume companies having business models similar to that of Peacock Solar would account for 500 MW of installed capacity by 2022, enough to power 100,000 homes, abating 640,000 tons of CO_2 which is roughly equivalent to the carbon footprint of a small town in India with a population of 350,000.

Achieving 20 GW of India's residential rooftop solar policy targets by 2022 is pivotal not just to meet the targets set in the Paris Agreement, but also for job creation. A report by Council On Energy, Environment and Water (CEEW) estimates that the rooftop solar segment generates seven times more jobs compared to the utility-scale segment, on a per MW basis. The proponent's business model, when replicated, can thus create as many as 12,500 jobs annually.

Table 5: Environmental impact of the project

	Pilot phase	At Scale	Replication
No. of households	250	20,000	100,000
Average project size (in KW)	5	5	5
Total Capacity (in MW)	1.25	100	500
Capital Mobilized (in USD Millions)	1	75	380
Jobs created (job-years)	31	2500	12500
CO_2 abated (tons per year)	1600	130,000	640,000

Assumptions: 1. Reduction of CO_2 emission per 1 kWh of solar power = 1 kg of CO_2. Please note that the above calculation considers only the reduction in CO_2 emissions for the electricity generated from a solar power plant vs. a coal plant and does not take into account CO_2 from other parts of the value chain. 2. Rooftop Solar generates 25 FTE per MW. 3. Capital mobilized per KW= INR 50,000. Source: Solar Mango, CEEW, MNRE

6. KEY TAKEAWAYS

As highlighted previously, barriers such as high upfront costs for customers, challenges in identifying the right customers, limited access to commercial finance for developers, etc. have limited the adoption of rooftop solar in the residential segment. This instrument improves upon current business models for rooftop solar to address some or all of these barriers.

- **Innovative:** The idea introduces a successful business model in other countries, solar leasing, to India and also improves upon it for the Indian context through standardization and leveraging data.
- **Financially Sustainable:** The business model is predicated on self-sustenance. Philanthropic support is only required during the test/pilot phase to cushion any unexpected losses and to incentivize commercial investment participation.
- **Catalytic:** If successful, the company can attract commercial capital that otherwise would not have flowed to the sector. Additionally, success of this idea can showcase demonstration and be replicated by other companies, which can further scale up the sector.
- **Actionable:** The proponent, Peacock Solar is a committed entity, and is backed by Sangam Ventures. The proponent has outlined a clear implementation pathway, as highlighted in the previous sections.

7. REFERENCES

Residential Rooftop Solar Potential
http://cdn.cseindia.org/attachments/0.07765900_1531131144_Going-Solar-Gurugram-solar-rooftop-action-plan.pdf

https://solarrooftop.gov.in/notification/Notification-08112016903.pdf

Mytrah Energy, Suzlon Energy, (2018, July). Digitizing Operations. Renewable Watch, 8(9), 28-28.
http://www.solarmango.com/in/tools/co2-emission-reduction-results/
https://www.ceew.in/focus-areas/renewables?page=1
https://www.downtoearth.org.in/news/rooftop-solar-power-s-massive-job-potential-untapped-60563

Bridge to India. (2018). India Solar rooftop map. Retrieved from:
http://www.bridgetoindia.com/wp-content/uploads/2018/08/india-solar-rooftop-map-_-March-2018-1.pdf

CPI Scaling-up-Rooftop-Solar-Power-in-India-The-Potential-of-Solar-Municipal-Bonds. Retrieved from
https://climatepolicyinitiative.org/wp-content/uploads/2018/02/Scaling-up-Rooftop-Solar-Power-in-India-The-Potential-of-Solar-Municipal-Bonds.pdf

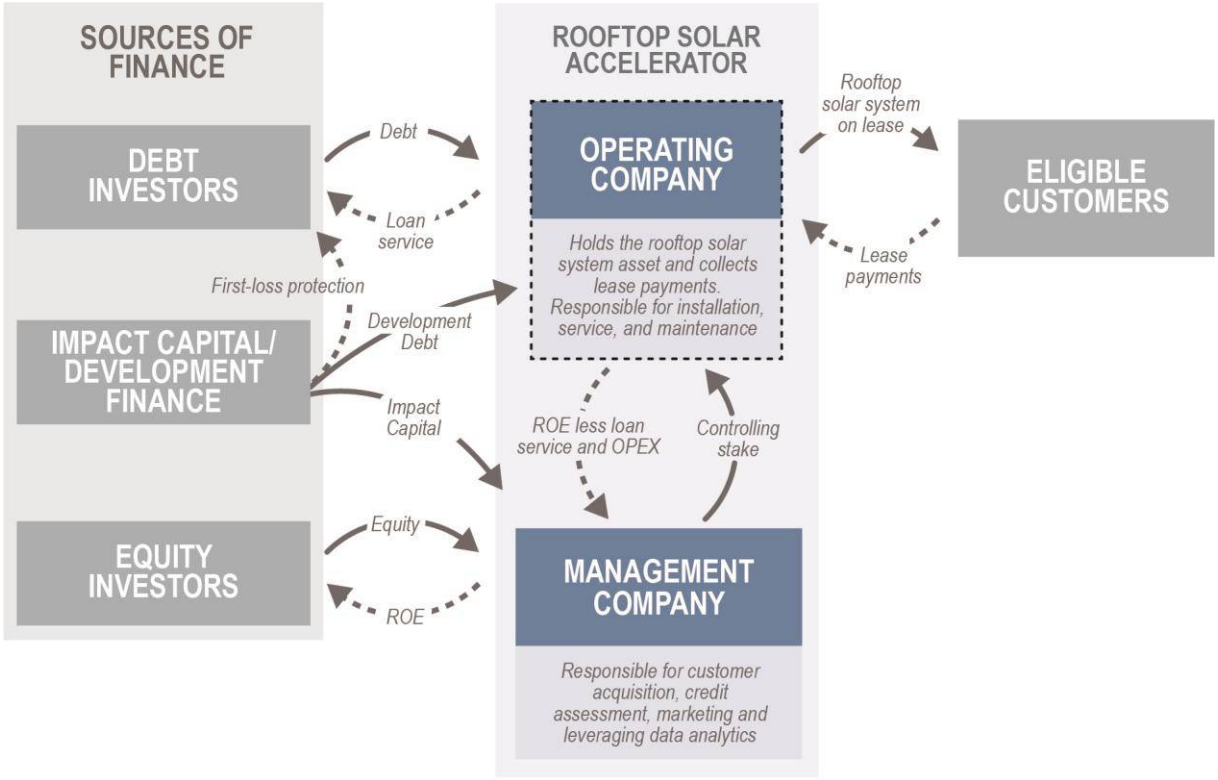
Carbon Brief: Guest post: Why India's CO2 emissions grew strongly in 2017
https://www.carbonbrief.org/guest-post-why-indias-co2-emissions-grew-strongly-in-2017

CEEW (2018) Scaling rooftop solar. Retrieved from
http://www.ceew.in/sites/default/files/CEEW-Scaling-rooftop-solar-Report-20Jul18.pdf

8. ANNEX

8.1 ALTERNATIVE COMPANY STRUCTURE

As Peacock Solar's scale grows, there is a possibility that the company might be split into 2 distinct entities: a Management Company (Mgmt Co) and an Operating Company (OpCo), with the former being the holding company of the latter.



The rationale for such a move is to ensure that lease payments collected by the OpCo first go towards servicing the loans provided by debt financiers. Such a hierarchy of cash flows would instill confidence in debt financiers, and encourages debt funding. Accessing commercial debt is a challenge for any young company in India, irrespective of the sector.

The residual cash flows will be paid back to the Mgmt Co via dividends, given that Mgmt Co is the holding company. The equity infusions in Peacock Solar will channeled through the Mgmt Co.

Such a structure is not suitable for initial stages of company's operations given that equity is likely to play a more significant role. Moreover, such a structure may invite double taxation, first at the OpCo level and then at the Mgmt Co level, and therefore Peacock Solar will assess the viability of this structure at a later stage.

8.2 OPERATIONS AND STRATEGY

Annex Table 1: Timeline for key activities

Activities	Q3'2018	Q4'2018	Q1'2019	Q2'2019	Q3'2019	Q4'2019
Data Analytics	Collect household level data (surveys, customer interactions)	-Analyze household level data. -Test credit evaluation model	-Improvise credit evaluation model. -Test marketing campaigns in new city.	Improvise Credit evaluation model	Analyze generation data and optimize system configuration	Analyze marketing campaign success in 2 cities
Marketing	Identify & deploy marketing campaigns	Test efficiency of marketing campaigns	Test efficacy of communication channels (online, offline). -Deploy marketing campaigns in new city	Optimize marketing campaigns in both cities	Optimize marketing campaigns in both cities	Optimize marketing campaigns in both cities
Funding	Seed equity funding	Begin equity fund-raise for 250 installations	Secure equity funding for 250 installations		Refinance debt once 100+ customers are achieved	Begin equity fund-raise for 2500 installations
Growth	Begin operations in 1 city	Achieve rapid growth in customers reached and installations per quarter	Maintain growth for the 1st city and begin soft launch in 2nd city	Achieve consistent growth rate in key metrics	Maintain growth rate of key metrics	