# How to make rooftop solar attractive to DISCOMs?

cSTEP Center for Study of Science, Technology and Policy
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India has deployed roughly 300 MW of rooftop solar (RTS) capacity in the first quarter of 2020, taking the overall RTS capacity to 5.74 GW. Yet, the installed capacity falls abysmally short (14%) of the ambitious RTS target of 40 GW by 2022. To make matters worse, the COVID-19 pandemic and the ensuing lockdown brought the RTS sector to a halt — creating a lot of uncertainty. Thus, a strategic and robust plan is essential to revive this segment, as the nation returns to normalcy.

The fundamental reasons behind the tepid growth of RTS in India are unfavourable policy regimes, high capital cost, and lack of awareness amongst consumers. Moreover, the fear of revenue loss dissuades distribution companies (DISCOMs) from promoting RTS. They anticipate substantial revenue loss by losing their profitable commercial and industrial (C&I) consumers, who currently hold as much as 73% of the RTS installation. The relatively low penetration of RTS across the Indian landscape has not harmed DISCOM finances, till now. However, when the respective states will start
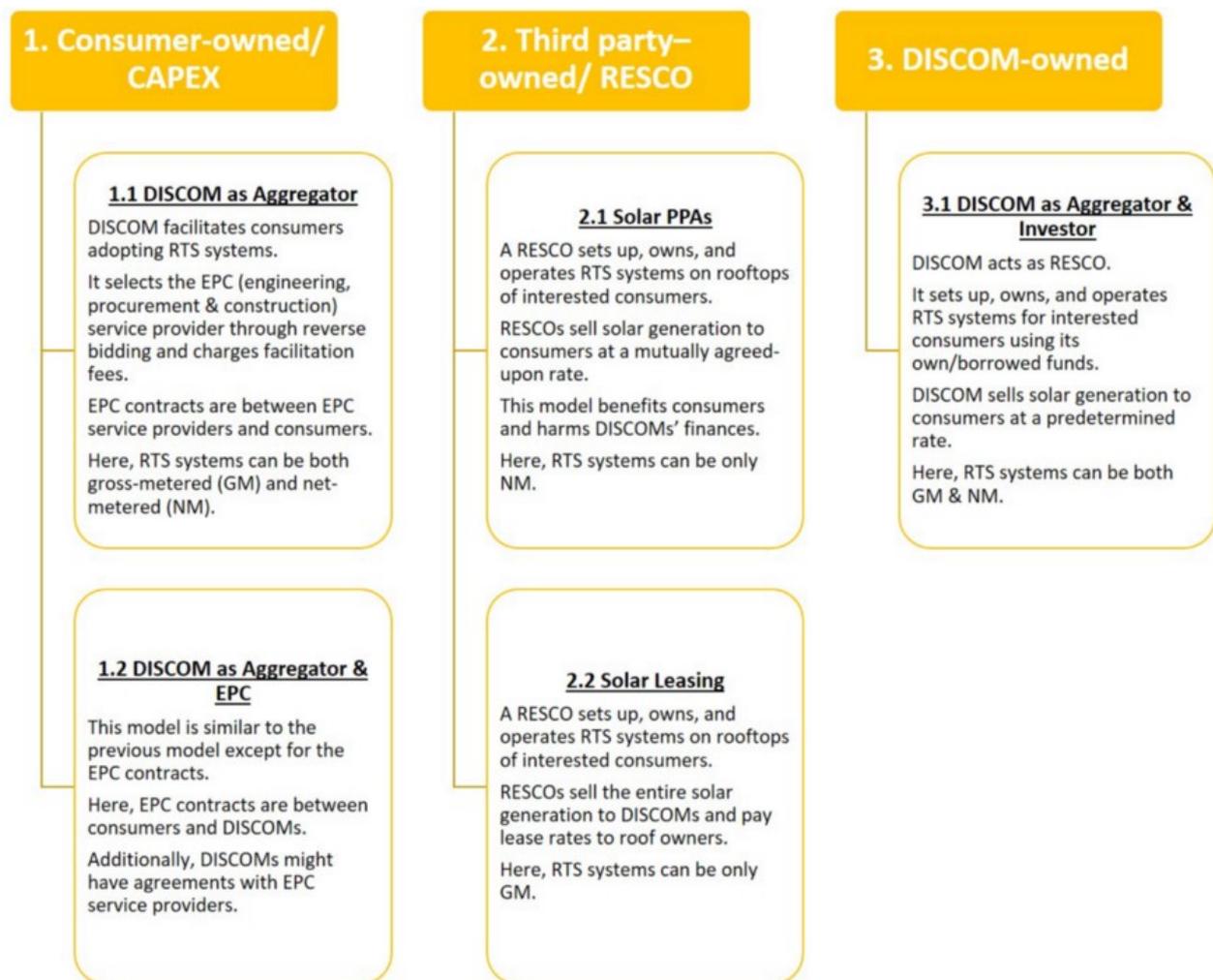
achieving their targets, DISCOMs will definitely feel the pinch. Considering the evident roadblocks and the impact of lockdown, this article highlights the optimal strategy, particularly for DISCOMs, to scale up RTS implementation.

For large-scale RTS implementation, India needs innovative mechanisms that primarily support DISCOMs. We need DISCOMs to lead the change by playing a key role for rapid RTS deployment. They should aggregate the demand in their jurisdictional areas, which would lead to economies of scale and reduce capital costs. Afterwards, DISCOMs can implement RTS with emerging aggregator business models. Currently, there are three basic aggregator models — consumer-owned/CAPEX (Capital Expenditure), third-party owned/RESCO (Renewable Energy Service Company) and DISCOM-owned, as Figure 1 shows.

**1. CAPEX**
The upfront investment is made by rooftop owners/consumers who set up, own, and operate RTS systems.

**2. RESCO**
The upfront investment is made by the RESCO, which sets up, owns, and operates RTS systems. RESCO sells solar generation to consumers at predetermined rates.

**3. DISCOM-Owned**
DISCOM itself becomes RESCO and sets up, owns, and operates RTS systems.

Basic classification of aggregator business models.

In India, CAPEX is the most common model, with a market share of almost 70%. Meanwhile, RESCO is also catching up, with its annual market share rising remarkably from just 4% in 2013 to 34% in 2019. These models have innovative sub-models, as explained in Figure 2.

**1. Consumer-owned/ CAPEX**

**1.1 DISCOM as Aggregator**

DISCOM facilitates consumers adopting RTS systems.

It selects the EPC (engineering, procurement & construction) service provider through reverse bidding and charges facilitation fees.

EPC contracts are between EPC service providers and consumers.

Here, RTS systems can be both gross-metered (GM) and net-metered (NM).

**1.2 DISCOM as Aggregator & EPC**

This model is similar to the previous model except for the EPC contracts.

Here, EPC contracts are between consumers and DISCOMs.

Additionally, DISCOMs might have agreements with EPC service providers.

**2. Third party– owned/ RESCO**

**2.1 Solar PPAs**

A RESCO sets up, owns, and operates RTS systems on rooftops of interested consumers.

RESCOs sell solar generation to consumers at a mutually agreed-upon rate.

This model benefits consumers and harms DISCOMs' finances.

Here, RTS systems can be only NM.

**2.2 Solar Leasing**

A RESCO sets up, owns, and operates RTS systems on rooftops of interested consumers.

RESCOs sell the entire solar generation to DISCOMs and pay lease rates to roof owners.

Here, RTS systems can be only GM.

**3. DISCOM-owned**

**3.1 DISCOM as Aggregator & Investor**

DISCOM acts as RESCO.

It sets up, owns, and operates RTS systems for interested consumers using its own/borrowed funds.

DISCOM sells solar generation to consumers at a predetermined rate.

Here, RTS systems can be both GM & NM.

Functioning of sub-aggregator models to promote RTS systems (Source: CSTEP analysis)

**Optimal Strategy**

To build a strategic RTS implementation plan, CSTEP proposes a framework called 'Policy Optimiser for Rooftop Solar', for which DISCOMs need to follow two simple steps:

1. Determine the financial implications of attaining RTS targets (under each aggregator model)

2. Choose and then amalgamate the favourable models

To start with, DISCOMs will have to assess the impact of RTS on their finances, particularly on projected average cost of supply (ACoS) values under each aggregator model. To be precise, RTS penetration affects DISCOMs' projected energy sales, power purchase costs, average revenue requirements (ARR), and thereby ACoS.

For this impact assessment, DISCOMs need to estimate annual RTS capacity additions in the preferred time frame (to meet the target). Additionally, they have to consider other assumptions, such as:

· **Shares of residential, C&I, and institutional consumer segments in RTS adoption:** DISCOMs can project these shares as per the historical trend and also customise as per their preferences. These shares vary under each model.

· **Division of the energy generation:** The solar generation can be segregated into captive consumed and exported energy as per existing net-metering (NM) and gross-

metering (GM) schemes.

In line with the aforementioned RTS assumptions, DISCOMs need to calculate relevant profit and loss parameters. The ensuing profit and loss parameters, due to RTS penetration, are mentioned in Figure 3. These parameters vary under each model. Next, DISCOMs just need to overlay these parameters with their 'conventional ACoS calculation model' to examine the impact on ACoS.

**Profit Parameters**

- Facilitation Fee (DISCOMs charge it from RESCOs and EPCs for facilitating the RTS implementation)

- Trading Fee (DISCOMs charge it from RESCOs for facilitating the RTS implementation)

- EPC margin through EPC projects (DISCOMs would have some profit margin while they act as EPC)

**Loss Parameters**

- Revenue loss (due to captive consumed energy)

- Extra power-purchase cost (due to exported energy)

- Distribution transformer (DT) augmentation cost (DTs would need to be upgraded for deployment of greater RTS capacities)

Required parameters from DISCOMs to determine revised ACoS

Ultimately, by deciding the RTS-assumption parameters, DISCOMs can determine revised ACoS values and compare those with actual ACoS without RTS. Thus, they can identify the favourable and detrimental models.
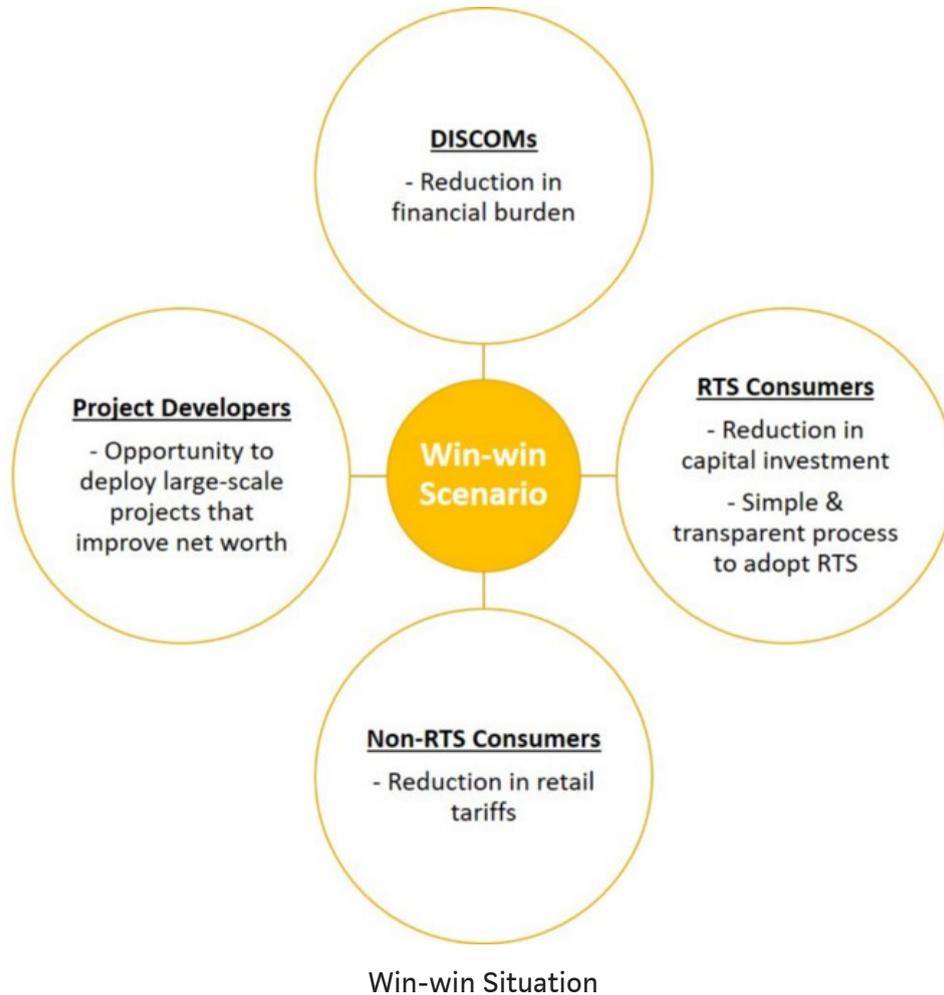
**The Optimal Amalgamation Strategy**

We would not suggest implementing RTS under a single favourable aggregator model as we cannot focus on all consumer segments and both metering schemes. **In fact, we recommend DISCOMs to select the top two–three models, divide annual targets amongst the chosen models, and then analyse the impact on ACoS projections.** Most importantly, DISCOMs should keep varying the shares of aggregator models in the planning stage until they attain the least ACoS values. By doing so, DISCOMs will have the most profitable business case along with balanced shares of consumer segments and metering schemes.

Eventually, DISCOMs' desired combination will highlight the optimal shares of selected aggregator models including:

· Ideal RTS adoption shares from each consumer category (to avoid disparities)

· Optimal NM and GM shares of appropriate consumer categories (to improve financial gains)

CSTEP's recommended strategy not just improves the profitability of DISCOMs for large-scale RTS deployment, but supports RTS consumers, non-RTS consumers, and project developers at the same time (as explained below).
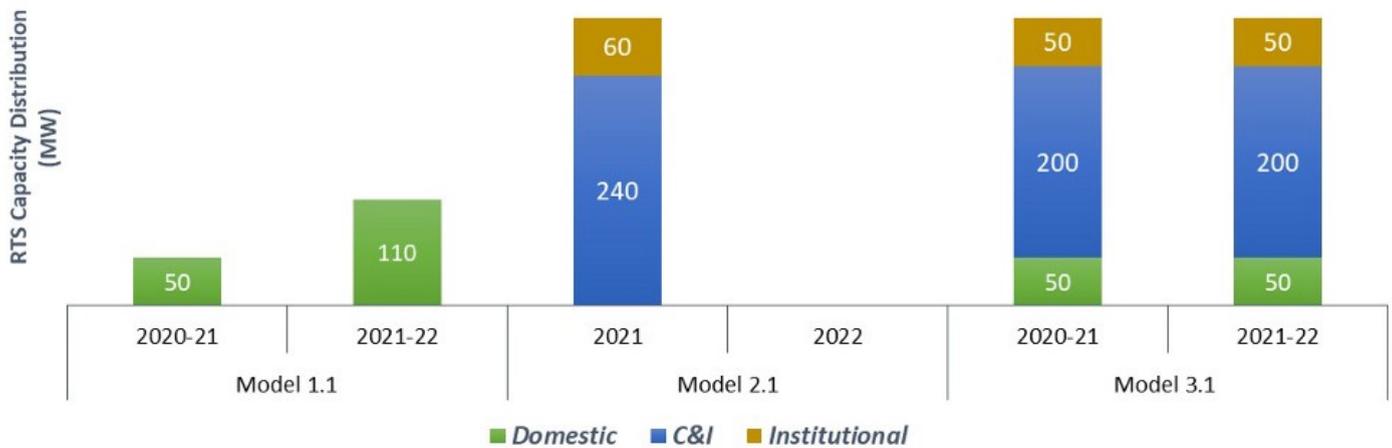
Win-win Situation

**Case Study of Bengaluru's DISCOM**

CSTEP has developed a Web-based tool, **CSTEP's 'Rooftop Evaluation for Solar' Tool (CREST)**, for Bangalore Electricity Supply Company (BESCOM). Airborne Light Detection & Ranging (LiDAR) was used for the first time in India to assess RTS

potential across 1,179 sq. km. in and around Bengaluru. With CREST results, we aggregated the overall RTS demand and proposed an amalgamation strategy to BESCOM for 1,060 MW RTS implementation by 2022. Here, CSTEP consulted with Karnataka Electricity Regulatory Commission (KERC) officials to understand their viewpoint on the aggregator models.

We suggested RTS capacity additions of 650 MW in 2020–21 and 410 MW in 2021–22. For this, it was proposed to amalgamate three aggregator models — Model 1.1, Model 2.1, and Model 3.1 — with shares of 15%, 28% and 57%, respectively. BESCOM wanted to implement most of the capacity through model 3.1, so this model holds the largest share. The consumer category-wise distribution is presented in Figure 5.



RTS capacity distribution amongst consumer segments (MW)

The metering schemes considered under each model are stated below:

1. Model 1.1: NM scheme with 70% captive consumption and 30% energy export

2. Model 2.1: NM scheme with 100% captive consumption

3. Model 3.1: GM scheme with 100% energy export

In the proposed strategy, the ACoS is likely to reduce by ₹ 0.00–0.01/ kWh in 2020–21 and ₹ 0.01–0.04/ kWh in 2021–22. Such an ACoS reduction signifies the positive impact on BESCOM's finances and the overall retail tariff structure.

In a nutshell, we would opine that Indian DISCOMs and respective regulatory commissions should use this simpler and scalable amalgamation method to boost the growth of RTS and meet the RTS ambitions in a timely manner.

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*Join us at the launch of CSTEP's 'Rooftop Evaluation for Solar' Tool (CREST) on Sep 2, 2020. To attend the online launch, register on this link.*

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