

'Utility driven Solar Roof Top ("SRT") programme' for Domestic Households in Andhra Pradesh

An innovative programme for the last mile common man

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Abstract— 'Utility driven Solar Rooftop ("SRT") programme' is a work package devised under the Technical Assistance of DFID focusing on supporting Andhra Pradesh Eastern Power Distribution Company Ltd. (APEPDCL) for devising Discom driven solar rooftop development in the State. In the proposed programme, Utility shall provide a helping hand to low-end domestic consumers by playing an overall facilitator's role and it is first of its kind in the country to encourage solar roof top installation by domestic consumers with no net financial burden on the Utility.

Key words – Solar Roof Top (SRT), Andhra Pradesh Eastern Power Distribution Company Ltd. (APEPDCL/Discom/Utility), Equated Monthly Installments (EMI).

I. INTRODUCTION

Government of India has set a Solar Roof Top (SRT) capacity target of 40 GW by 2022. While SRT installations in the industrial and commercial segments have gained momentum, traction for these installations in the residential segment remain low. In the case of industrial & commercial consumers, SRT installations offer a win-win proposition to the stakeholders by lowering cost of electricity to consumers and offering an attractive investment for developers/financiers. However, uptake for SRT systems have been sluggish among residential consumers due to a variety of reasons including weak business models, consumer aggregation challenges, multiple stakeholder involvement in obtaining consents and clearances, higher perceived default risk, lack of innovative financing mechanisms etc. In order to resolve these issues, it is imperative for the utilities to support SRT installations for the residential segment. Further, in the case of low-end residential consumers¹, SRT solution would aid in creating consumer empowerment through enabling energy security, greater energy affordability (by sheltering against future tariff increases) and improving electricity reliability for this segment.

'Utility driven solar rooftop pilot' is one of the work packages under the larger 'Power Sector Reform (PSR)' technical assistance programme approved by the Government of UK and Government of India. This work package aims to develop innovative business model options which aim to resolve issues such as consumer aggregation challenges, high perceived default risk, delays in approvals and availability of

financing at reasonable terms and therefore develop a model framework for a Utility driven solar rooftop model.

As part of the work package, a pilot scheme is being implemented in Vizag at two locations (Muralinagar and Madhurawada) with in Andhra Pradesh ("AP") to demonstrate the concept and the model.

The work package is designed to achieve the following objectives;

1. Elicit wider Utility participation in SRT roll-out by demonstrating a unique Utility driven solar rooftop business model
2. Demonstrate an innovative demand aggregation model where in Utility carries awareness program for consumers and assists in aggregating demand
3. Create access to the SRT solution for low end, subsidized residential consumer base to phase out government subsidy support
4. Demonstrate a model for access to financing at reasonable terms for low end subsidized residential consumer base

Once the model is deployed, it will be a first of its kind model in India, in a public utility context, demonstrating an implementable business model for utilities in SRT space, focused on the largely unaddressed low-end residential consumers, thereby adding net value to the sector.

II. OVERVIEW OF UTILITY/ DISCOM SUPPORTED SRT PROGRAM

The work package devised under the Technical Assistance of DFID will focus on supporting Andhra Pradesh Eastern Power Distribution Company Ltd. (APEPDCL) for Discom driven solar rooftop development in the State.

The key to successful implementation of the program is identification of appropriate business models which can incentivize stakeholders such as consumers and Discoms to achieve the desired program objectives.

The pros and cons of following SRT models were assessed in detail from each stakeholder perspective;

¹ Low-end residential customers are those whose average billing is lower than the utilities' average cost of supply

1. Discom owned
2. Capex jointly borne by consumer and Discom
3. Capex borne by consumer, but EMI on loan jointly shared by consumer and Discom
4. 3rd party owned
5. Consumer owned

Discom Owned/ Capex jointly borne by consumer and Discom/ EMI jointly shared by Discom and consumer:

The deteriorating financial health of State Discoms are a major hurdle for implementing business models 1,2 and 3 (mentioned above) as the Discom is exposed to bearing the financial burden in either full or part.

Third Party/Developer Owned:

Resistance of consumers to share their rooftop space with a private developer on a long term contract and lack of willingness of developers to install SRT under an opex route for a distributed consumer base, especially in the residential category, are major deterrents in implementing 3rd party owned business models.

Consumer Owned:

The alternative option available to Utility is to encourage consumer owned SRT where in consumer avails loans from financial institutions.

Critical success factors would be:

- Willingness of financial institution to lend to the target consumer (in the instant case, low power consuming residential consumers) at reasonable costs
- To ensure that the consumer outgo on account of EMI on loan amount² is not higher than the regular monthly Utility bill
- To minimize upfront payment by consumer
- To ensure timely loan repayment to financial institution

While this model has been selected for the AP pilot, to ensure its success, it is envisaged that Discom will play a critical role by collecting EMI and remitting to the bank, to provide necessary comfort to financial institution on default risks. In case the consumer defaults on EMI repayment, his/her electricity connection would be cut off. This is designed to provide adequate comfort to financial institution as Discom is taking direct burden of collecting EMI and repayment.

On this basis, Andhra Bank has been on boarded by APEPDCL to fund the debt portion of consumer at competitive terms. In case, EMI is higher than Utility bill, then such differential amount will be borne by the Discom in the form of a soft advance to the consumer from the subsidy saved which shall be recovered once loan tenure is over.

An important milestone for the programme was achieved after the APERC accorded approval for the scheme on 18th May, 2019. The two important features of this Order are:

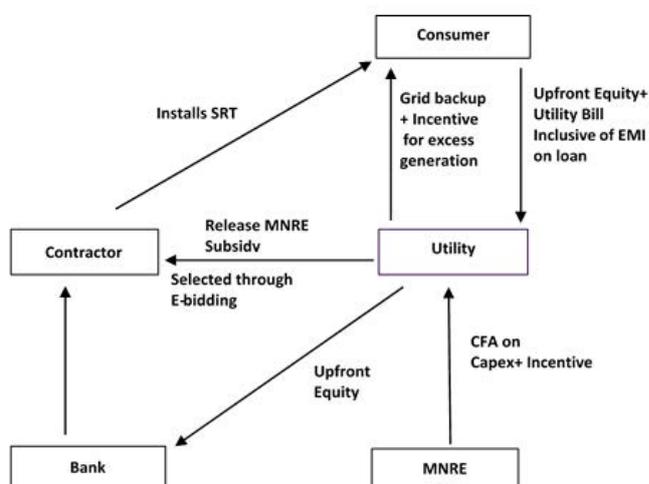
- It allows Discom to collect EMI through electricity bill, and there is a provision to disconnect in case of non-payment of EMI (as per consumer consent obtained at time of signing up).
- It allows Discom to top up the EMI payment to the bank through its own funds (for EMI in excess of the electricity bill) and recover it from the consumer after the loan has been repaid on an NPV neutral basis.

The model details are provided in the next section.

III. PROPOSED ROLL-OUT OF THE 'DISCOM DRIVEN SRT PILOT' IN ANDHRA PRADESH

Proposed model:

The business model for 'Utility Driven SRT systems' for Domestic Category B Consumers having monthly consumption of 140 to 200 Units (SRT system size: 1-1.5 kWac) is as shown below;



Schematic of the Model

Model overview:

Installation of SRT systems targeting residential household segment on voluntary basis. The SRT system will be financed through a combination of the following: - (a) 'Capital Financial Assistance' extended by MNRE, (b) loan to be taken by consumer at preferential terms and (c) upfront equity contribution from consumer.

The benefit for the consumer includes (a) EMI not exceeding the current power bills during the loan tenure period (plus the period of payback of the advance to the Discom) and (b) free power for the remaining duration of asset life. The Discom benefits due to reduction in subsidy amount.

Roles and Responsibilities of stakeholders:

a) Discom

- Discom shall be performing central role in performing following activities;

² Loan amount availed will be after Capital financial assistance (CFA) from MNRE and a minimal equity contribution from customer

- Conduct consumer awareness workshops and acting as an aggregator of consumer demand
- Driving the vendor selection and empaneling Contractors
- Assisting in arranging financing for consumers
- Collection of EMI from Consumer along with monthly Utility Bill and remit to Bank
- In case EMI is higher than Utility bill if any, shall be shared by Discom
- Facilitate in availing applicable subsidy from MNRE

b) Bank

- Bank, on boarded by APEPDCL shall fund the debt portion of Consumer
- Acknowledge receipt of down payment from consumer and link the loan account of consumer to the Contractor
- Complete disbursal of last tranche of loan upon commissioning of the system

c) Consumer

- Consumer shall submit the consent form for participation in the scheme and pay upfront equity
- Consumer to pay Utility bill towards EMI during loan tenure
- In case Discom shares part of EMI (subject to regulatory approval), Consumer shall continue to pay his/her share of EMI beyond loan tenure for few more years beyond loan tenure so that EMI shared by APEPDCL during loan tenure is neutralized by amount paid by Consumer on NPV basis
- Consumer thereafter completely owns the SRT system and meets his entire electricity needs free of cost

d) Contractor

- Sizing of the solar rooftop system for consumer based on historic consumption
- Visit the consumer house to execute tripartite agreement (Utility, Bank and consumer) stipulating the Terms & Conditions of loan
- Obtain all approvals for synchronizing the SRT with Grid
- Undertake all activities to obtain CFA from MNRE
- Testing and commissioning of Solar Roof Top System
- To set up Authorized Service Centre

Status of the pilot project:

A tender has been invited by APEPDCL on 15th October 2018 for implementing consumer Owned, Utility driven Solar Rooftop PV Scheme (5 MW) under net metering. Contractors would be empaneled for design, supply,

installation, commissioning of SRT systems with free O&M for 5 years for consumers aggregated on voluntary basis. APEPDCL received 5 bids for implementing the proposed pilot project. Financial bids were opened on 29th May 2019 and L1 Price is discovered as INR 51,500/kWp.

Other key milestones achieved are;

- MNRE has sanctioned Central Financial Assistance (CFA @30% of project cost) for implementation of 5 MW pilot project on 07th Feb 2019 including upfront disbursement of 30% of CFA. Proposal for revising the CFA to 40% has been accepted by MNRE and is under consideration.
- Andhra Bank has approved the preferential terms for the proposed pilot project and has issued circular on 13th March 2019

Estimated savings³:

It is proposed that financing shall be met as follows;

- Central Financial Assistance (CFA) from MNRE: 40% of project cost.
- Consumer share of Capex: 60% (50% Debt and 10% Equity) of total project cost

In the current scheme, Andhra Bank is on-boarded by APEPDCL for funding consumer up to a loan limit of INR 65,000 for a tenure of 7.5 years. Interest rate shall be MCLR + Term Premium of 0.25% - 0.50%.

Assuming 1 kWp SRT system supplies 140 units per month (average monthly consumption for consumer = 140 units) on net metering basis, estimated savings for consumers and Discom are as follows;

Estimated savings to consumer;

- Total EMI on loan: INR 397
- EMI borne by Consumer: ~ INR 397⁴
- EMI payment to Bank for a period of 7.5 Years (Loan Tenure)
- Additional period beyond loan tenure, consumer to pay his/her share of EMI: Nil (Being EMI on loan amount is lesser than avoided bill of consumer)
- Levelised annual savings per consumer (1-25 years): INR 2,353

Estimated savings to Discom;

- EMI out go during loan tenure: Nil (Being EMI on loan amount is lesser than avoided bill of consumer)
- Of the levelised annual cross subsidy out go of INR 5,878 /Consumer⁵ (BAU scenario), Utility could potentially save INR 2,278/Consumer⁶

³ Assumptions: CUF:19%, Project cost: INR 51,500/kWp, CFA:40% of Project cost, Consumer Contribution: INR 5150 /kWp, Net loan amount: INR 25,750/kWp, Loan tenure: 7.5 years, Interest rate:9.2%

⁴ EMI on loan amount (INR 397/Month based on the project cost discovered through bidding) is less than avoided bill of consumer (which is estimated to be INR 404/Month based on the historic annual consumption and the

prevailing tariff rates). Hence no top up is required from Discom for consumer's EMI repayment.

⁵ Average Cost of Supply – Average Billing Rate

⁶ Levelised annual savings in Marginal Power Purchase Cost (Variable Cost) (1-25 years)

Key benefits of the proposed model:

Active Discom participation can lead to rapid penetration in the residential segment and make the solar program more inclusive and widespread. Following are the key reasons why active Discom support can be a win-win for all stakeholders under the proposed model:

a) Benefits for the consumers

- Consumer self generates entire consumption after loan period (plus pay back to the Discom against any advances) without depending on Discom
- Addressing implementation challenges (interconnection delays, delay in obtaining NoCs) by eliminating role of multiple stakeholders (eg. SNAs)
- Lower price discovery of solar rooftop systems as involvement of multiple stakeholder's would be eliminated. L1 Price discovered in the recently concluded bid process issued by APEPDCL is INR 51,500/kWp against a benchmark price of INR 60,000/kWp set by MNRE (~14% drop).
- Access to finance at reasonable terms owing to lesser perceived risks
- Ensure quality of power supply
- Opportunity to consumers to earn incentives for the net energy injected into grid minimizing self-consumption

b) Benefits for the Discom

- Reduced subsidy burden for low end domestic category of consumers
- Meeting Discom's Renewable Energy purchase obligation (RPO) for net energy injected into grid
- Better energy management i.e., peak demand shaving and ease of distribution and transmission constraints
- Improved consumer satisfaction

c) Benefits to the SRT sector

- Demonstrates a model for low end residential segment which has gained limited traction with developer and financiers community
- Enables faster scale up with Discoms participating in aggregation and connections
- Demonstrates an effective financing model for residential consumer base

Potential of Consumer owned Utility driven SRT Program in Andhra Pradesh:

Total domestic consumer base served by both the Discoms (APEPDCL and APSPDCL) in Andhra Pradesh is 1.38 Crs. The estimated SRT opportunity is ~ 1400 MW, assuming 10% of total domestic consumer base i.e. ~ 14 lakhs subscribe under this program (Average consumption of 140 units per month requires an SRT capacity of 1kWp).

Thereby, Utilities could potentially save ~INR 319 Crs annually (levelized) for 25 years on variable cost alone.

IV. PROGRAMMATIC POTENTIAL IN ECONOMICALLY BACKWARD STATES

The estimated potential of SRT program if implemented targeting low end residential consumers in states like Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand and Rajasthan which are socially and economically backward with low per capita income is 7,500 MW (assuming only 10 % of the domestic households⁷ [1] install SRT systems of capacity 1kW under the proposed model). This estimated potential can contribute in meeting ~ 20 % of 40 GW capacity target set by MNRE. The total investment requirement is estimated as INR 38,625 Crs, of which CFA support from MNRE shall be INR 15,450 Crs⁸ and funding opportunity for financial institutions including DFID shall be INR 19,312 Crs.

Though Utility driven model address most of the issues from Discom perspective in implementing SRT however we foresee other challenges that would need to be addressed for achieving higher scale of SRT capacity additions. Based on our extensive stakeholder consultations with utility, contractors, financial institutions, electricity regulator, consumers and sector experts, some of the critical issues which needs to be addressed for enabling rapid scale up of SRT capacity are addressed in the next session.

V. KEY ISSUES TO BE ADDRESSED FOR ENABLING RAPID SCALE UP OF SRT CAPACITY TO MEET THE NATIONAL TARGET OF 40 GW BY 2022

1. **Creating awareness and Capacity building** - Awareness levels among domestic households on benefits accrued from SRT implementation is low. Similarly, Utilities to a large extent, undermine the fact that encouraging solar rooftop for low-end domestic households help reduce the subsidy burden for Utilities. Hence there is a huge need for awareness creation through dedicated initiatives to bridge knowledge gap among the various stakeholders. Capacity building of Discom is also critical so that Utility can promote Solar Rooftop by organizing awareness program, workshops, sharing of best practices with entrepreneurs, developers, contractors, banks etc.
2. **Need for Utility to play O&M role beyond 5 years (Free O&M Period)** - Empaneled contractor provides free O&M of SRT system for a period of 5 years whereas the performance of modules is guaranteed for 25 years. In such Utility led schemes, Utility should ideally designate separate teams responsible for carrying out O&M beyond 5 Yrs. The same team should also be responsible for facilitating contractors in availing CFA/subsidy from MNRE or any other government agencies. Asst. Divisional Engineer and Divisional Engineer (Operations) could be identified section wise and

⁷ The total number of electrified domestic households in these states stand at ~INR 7.5 Crs based on Saubhagya Portal, Gol as on 22nd March 2019

⁸ At capex of INR 5.15 Cr/MW and CFA at 40%, share of financial institutions at 50% and that of customer is 10%

authorized as nodal officers in case of LT and HT services respectively.

3. Financing challenges -

a) Debt funding for rooftop solar projects through domestic sources is available at a very high interest rate, which makes the projects financially unviable. Though renewable sector is identified as one of the priority categories, however, banks are reluctant to fund low end domestic/retail consumers as they perceive high default risk even though Utility assures collection of EMI as part of Utility bill and remittance to the Bank. Hence concessional financing and less-risky funds need to be provisioned for funding SRT schemes targeting subsidized consumers. In addition, multi-lateral funds and state subsidies need to target low end consumers without any intermediaries.

b) **Guidelines under priority sector lending at preferential terms (treating renewables as a separate category)** - This is vital for ensuring the success of the proposed model. Priority Sector Lending (PSL) should be aimed at providing institutional credit targeting domestic consumers as it is difficult for such small retail consumers to obtain credit.

4. **Policy related challenges** - Disbursement of Central Financial Assistance (CFA) offered by MNRE often gets delayed resulting in higher working capital commitments by contractors. Therefore contractors create certain buffers on the project cost anticipating this delay in receipt of CFA, resulting in escalation of cost of SRT system. It is imperative, that the applications are processed by MNRE in a timely manner which would bring down the costs of SRT systems.

5. **Gap in vendor eco system** - Presently, focus of vendors/integrators is primarily on large scale (> 5 kW) SRT systems. Solar integrators are not actively present in the space for unit capacity < 3 kW owing to meagre demand resulting in lack of standardization of equipment's (primarily inverter) and materials as well. Separate demand creation efforts by the Government for lower capacity SRT systems (< 3 kW) can help develop the vendor ecosystem resulting in standardization of products

6. **Quality of installations** - Certification of installation agencies along with specialized training and certification of technicians for installation of roof top solar systems would infuse confidence in consumers and would also enhance the quality of installations. Vendors/installation agencies should invest in strengthening their channel partner network with specialized teams taking care of installations and after sale support during free O&M period.

7. **Need to adopt new technologies for centralized monitoring & predictive maintenance** - Latest technologies such as mechanized solar panel cleaners that are fueled remotely and supported with artificial intelligence (AI) can be a boon to tackle the issue of high cost O&M especially cleaning of the solar panels. SRT plants are more susceptible to dust and responds adversely in a quick manner to abrupt weather. AI can be used for predictive maintenance to spot inconsistencies, determine when a panel or an inverter is about to fail and optimize maintenance schedule. MNRE shall progressively consider upgrading the benchmark costs for SRT systems to accommodate such technological advancements that will further enable installation agencies offering such solutions.

We believe that active involvement of Utilities and support from MNRE could bring an opportunity to address some of the issues highlighted above through measures such as the following:

- Empanel vendors through competitive bidding by aggregating demand and discovering project cost. Creation of awareness and centralized demand aggregation by Utility will help in bringing down the project cost due to economies of scale.
- Utility should take care of O&M activities for the rest of period by creating a dedicated O&M wing for distributed solar rooftop plants
- Facilitate in arranging financing for consumers at preferential rates such that no capital contribution is required from Utility.
- Utility to focus on creating demand for lower capacity SRT systems (< 3 kW) so that vendor ecosystem is developed resulting in standardization of products
- Extend financial support in the form of part EMI repayment or additional capex support of up to 10 - 20% of project cost to make the model more viable for consumers.
- Time bound release of CFA by MNRE and revision of benchmark costs to accommodate any technological advancements

“Views, thoughts and opinions expressed in this publication are of author(s) and may not necessarily reflect the views, thoughts and opinions of KPMG”

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BIOGRAPHICAL INFORMATION



Phani Bhushan is working as Associate Director with Strategy and Operations team of Infrastructure, Government and Healthcare (IGH) division of KPMG India. He has a post qualification experience of 11 years in the areas of thermal sector (Coal and Gas), renewable energy (especially Cogeneration, Solar thermal, Wind, Solar PV, Waste to Energy and Biomass), transmission and distribution sectors,

CDM project development in various sectors, Quantification & Reporting of Green House Gas (GHG) emissions, bid advisory support for IPPs in renewable sector and thermal sector (Coal and Gas) and Commercial due diligence of thermal and renewable projects.

His professional consulting experience includes regulatory support to Transmission and Distribution Utilities, energy efficiency in electricity distribution sector, commercial buildings, market entry strategy, renewable energy, bid advisory, bid process management and project management