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PACE-D TECHNICAL ASSISTANCE PROGRAM

User Manual for Solar Rooftop Evaluation Tool (SRET)

December 2015

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PARTNERSHIP TO ADVANCE CLEAN ENERGY DEPLOYMENT (PACE-D)

Technical Assistance Program

User Manual for Solar Rooftop Evaluation Tool (SRET)

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ACRONYMS

Acronyms	Definition
COD	Commercial Operation Date
CUF	Capacity Utilization Factor
DC	Direct Current
DSCR	Debt-Service Coverage Ratio
DISCOMs	Distribution companies
EPC	Engineering, Procurement and Construction
FI/FIs	Financial Institutions
GW	Gigawatt
HT	High Tension
IEC	International Electrotechnical Construction
IRR	Internal Rate of Return
kWp	Kilo Watt Peak
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
MS Excel	Microsoft Excel
O & M	Operations and maintenance
PACE-D	Partnership to Advance Clean Energy – Deployment
PPA	Power Purchase Agreement
PV	Photovoltaics
RECs	Renewable Energy Credits
RESCO	Renewable Energy Services Company
RPO	Renewable Purchase Obligation
SRET	Solar Rooftop Evaluation Tool
TA	Technical Assistance

ABOUT THE MANUAL

The Government of India has provided a significant policy push to solar rooftops by setting a target of 40 GW by 2022. This presents a huge opportunity for banks and financial institutions to expand their consumer base and diversify loan portfolios in the area of clean energy, including solar rooftops. However, the Indian financing community's exposure to solar rooftop financing has been almost non-existent due to limited understanding of how to evaluate the solar rooftop projects and determine their credit worthiness. To address this gap, the Partnership to Advance Clean Energy – Deployment Technical Assistance (PACE-D TA) Program1 has developed a Solar Rooftop Evaluation Tool (SRET). The SRET aims to help banks and financial institutions (FIs) to identify the key parameters that drive the viability and sustainability of rooftop commercial and industrial solar rooftop projects.

The purpose of this manual is to provide an easy-to-follow, step-by-step, comprehensive guide to assist banks and FIs to use the SRET for evaluating solar rooftop project proposals. The SRET has been developed in Microsoft Office Excel spreadsheet format with different forms for data entry, backend calculations and summary reports. This will enable users to customize the tool as per requirement. The detailed working of the SRET Forms is also included along with the screenshot of the forms for data field entry.

[1] The PACE-D TA Program is a five-year bilateral program which is led by the U.S. Agency for International Development (USAID) and the U.S. Department of State and implemented in partnership with the Ministry of Power and the Ministry of New and Renewable Energy.

SOLAR ROOFTOP EVALUATION TOOL

Objective

The SRET aims to address challenges faced by banks and FIs in evaluating solar rooftop projects. It uses a structured framework for evaluating the financial viability of the proposed project and assesses the level of risks encountered by the project and the risk mitigation measures adopted by the developer in addressing these risks. The SRET works as a decision support system for banks and FIs by:

- Providing a techno-commercial framework to evaluate viability of solar rooftop projects.
- Mapping the key risks and establish whether appropriate risk mitigation methodologies have been followed.
- Assisting the lender to arrive at an informed decision on financing commercial and industrial rooftop projects.

Who can use SRET?

The SRET is designed to support lenders to evaluate the solar rooftop proposals received for debt financing. It will be put into best use if these proposals have progressed up to the stage of identifying vendors with indicative quotes for procuring the solar rooftop power plant and its installation. Any proposal without this preliminary work might not have sufficient information for the banker or the FI to make an informed decision on debt financing and using the SRET may not yield appropriate results. The SRET can be used by developers, lender engineers and credit rating agencies, who assess the credit rating for solar rooftop projects. It can also be reviewed by a wide range of stakeholders including project developers and rooftop owners as it can help them understand the risks and returns associated with commercial rooftop projects.

Main Features of SRET

- Focuses on commercial and industrial solar rooftop projects especially design and structure of these projects.
- Can be customized for evaluation of any solar rooftop project—residential, clusters, portfolio, third party or self-owned self-consumption projects.
- Outlines a risk matrix plus with a focus on specific mitigation strategies.
- Incorporates existing and applicable policies, regulations and business models.
- Flexible and allows for changes in regulations, policies, business models and financial guidelines.

HOW SRET WORKS ?

The SRET work flow uses three stages to evaluate project proposals (Figure 1).

1. **Stage 1**: Screens the eligibility of the solar rooftop project based on a qualitative checklist of acute risks.
2. **Stage 2:** Captures and evaluates the technical and commercial parameters of the project and evaluates its technical and commercial viability.
3. **Stage 3:** Assesses the risks and risk mitigation strategies identified for the proposed project.

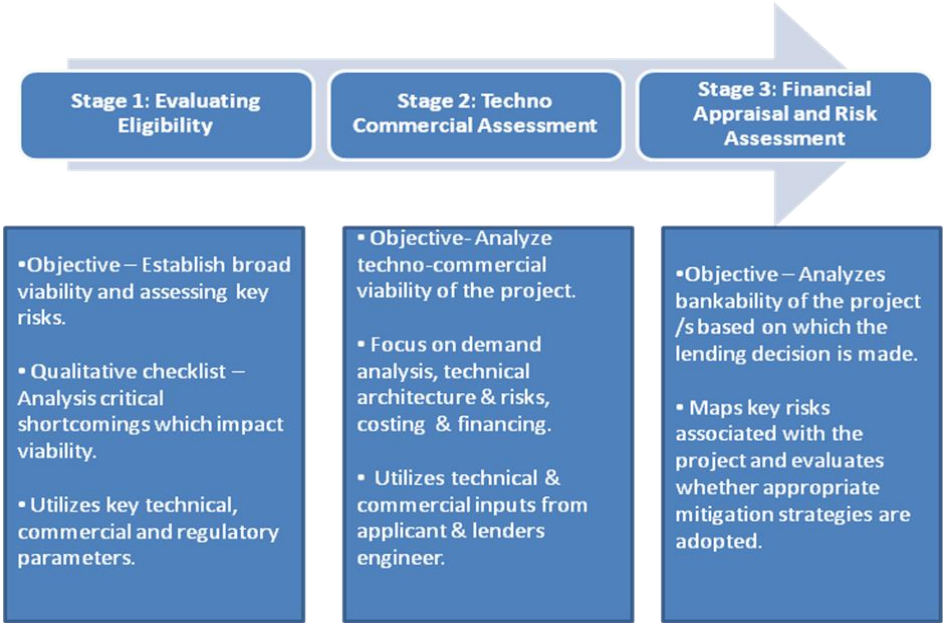


Figure - Work Flow of the SRET – How does it work?

The SRET is developed on Microsoft Office Excel 2007 using inbuilt formulae and formats. It comprises forms to capture data at different stages at the front end and the calculations at the back end. The data entered in the front end forms are fed into the back end calculation to generate the summary for each of the three stages. The back end part is manually hidden and can be unhidden using a command by the user in MS Excel as shown in Figure 2.

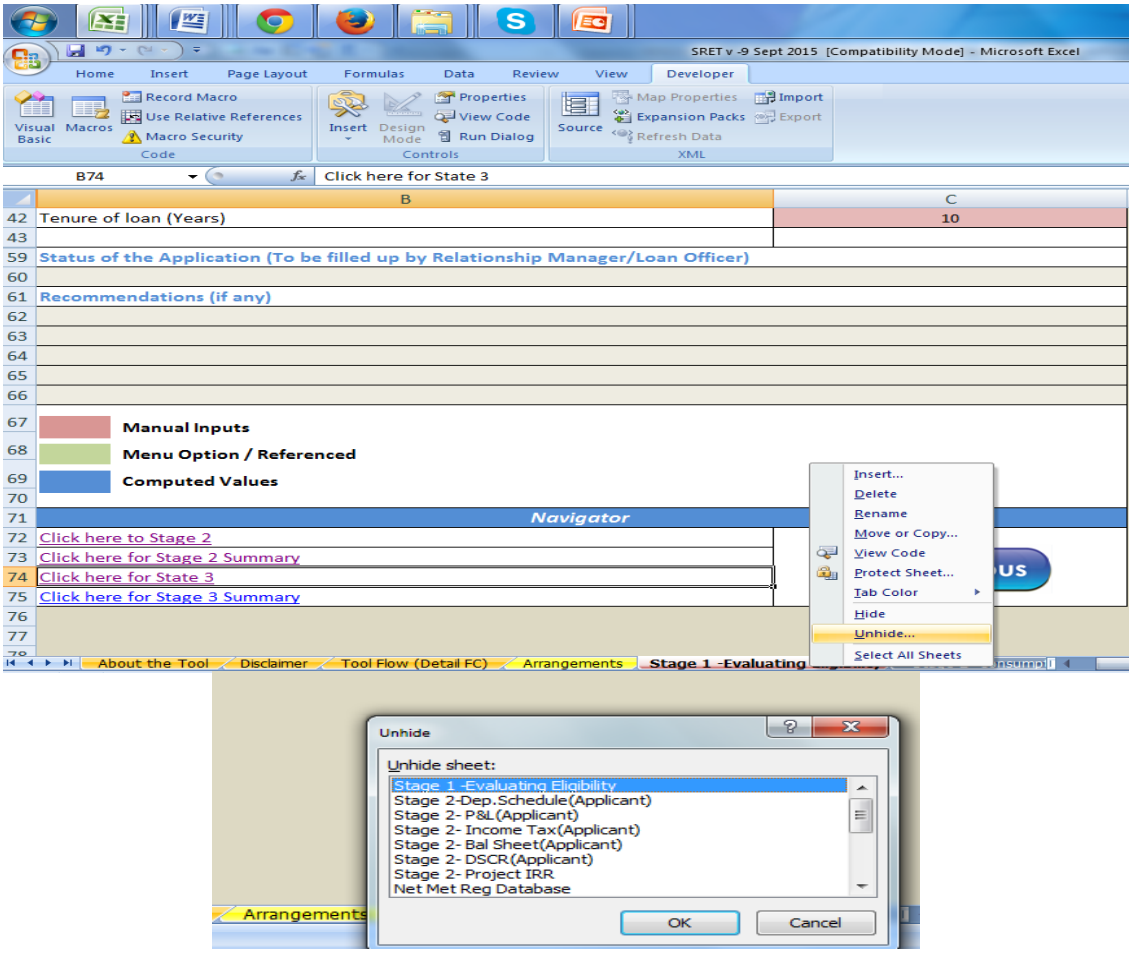


Figure - How to unhide the calculation tabs in excel?

SRET Flow

Figure 3 outlines the SRET structure which has also been highlighted in the tab called “Tool Flow” in the spreadsheet.

- ***Inputs:*** The tool requires different sets of data and different stages. For example:
  - In Stage 1, the form is filled by the Relationship Manager of the financing institution/bank by sourcing data from the applicant.
  - In Stage 2, the form is filled and validated by the applicant and lender’s engineer respectively.
  - In Stage 3, the lender, with the support from the lenders engineer undertakes a risk assessment, appraises the proposal from the applicant and sets the lending conditions.
- ***Flow:*** The SRET supports stage wise evaluation of the proposal starting from a preliminary qualitative checklist which establishes the eligibility of the project, to the detailed assessment of technical and commercial viability followed by a detailed risk assessment.
- **Components/ Forms:** Forms at various stages need to be filled by the applicant to allow evaluation of the solar rooftop proposal.

The idea of breaking down the evaluation into three different stages is to ensure optimum allocation of effort and resources for the evaluation, once the proposal moves from lower stage to a higher stage (Stage 1 -> Stage 3). For example, in Stage 1, a brief checklist of relevant parameters is used to evaluate the eligibility of the proposal. This approach avoids the rejection of the proposal at Stage 3 where a significant amount of effort and resources would already have been allocated for evaluating the subject proposal.

Note: The user can go to different stages or Components/Forms by clicking on the respective stage numbers and Components/Forms name as shown in Figure 3.

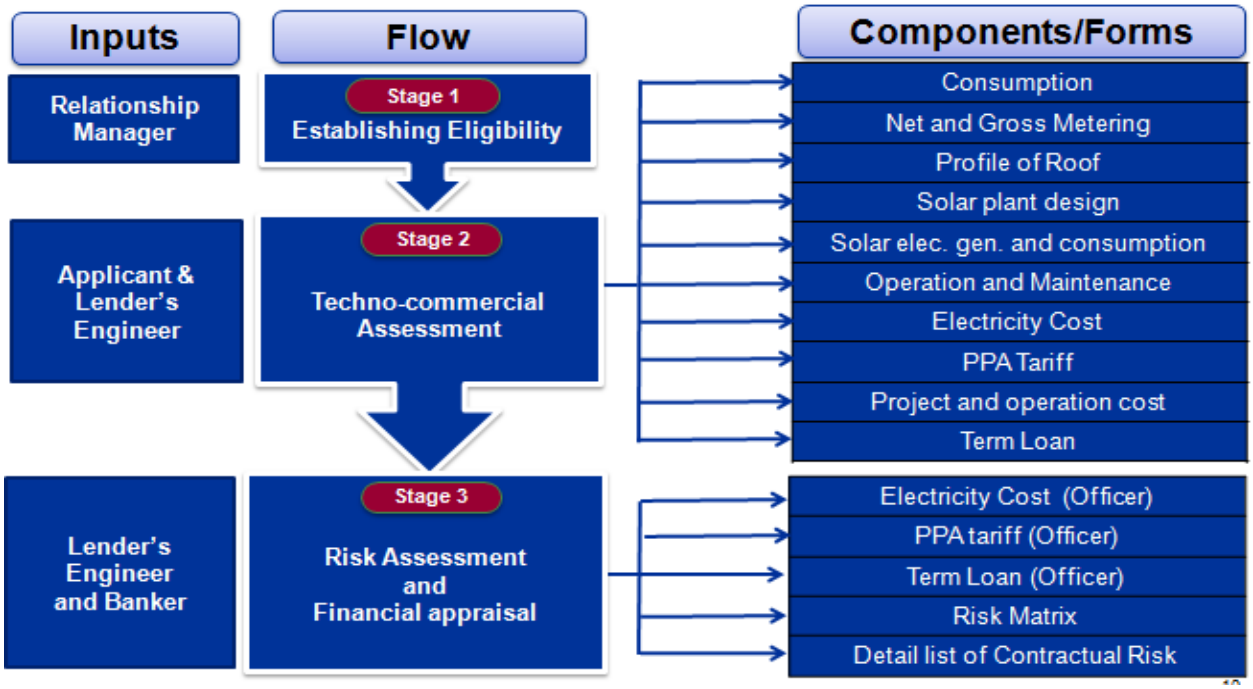


Figure - Overview of SRET Flow

Overview of the Forms

The overview of the forms is provided in Table 1 to guide the user on the component under each stage in the overall structure of SRET. It also indicates the responsible entity or user required to fill the respective form.

Table - Overview of Data Forms in SRET

Stage	Forms[2]	Reference Screenshot	Description[3]
STAGE 1	1	Evaluating/ Establishing Eligibility **Reference [4] - Figure 4**	This is a qualitative check list of eligibility criteria **filled by the applicant** and submitted to the banks' Relationship Manager for review. Based on the data filled, challenges to the projects viability are identified which will support the bank/FI to decide whether to proceed to stage 2 or not.
STAGE 2	2	Self-Consumption **Reference - Figure 7**	This form should be **filled by the applicant** if the Metering Arrangement selected in Stage 1 is "Self Consumption". Applicant will fill the following data in this form: • Baseline[5] load profile of the End User[6] as per its consumption pattern. • Monthly electricity consumption pattern in the baseline scenario (24 hours) based on electricity bills and records of past 12 months. • Expected energy consumption mix[7] (during daytime/general shift). The data filled will form the summary of the SRET which will help in supporting the decisions.
	2	Net and Gross Metering **Reference - Figure 7**	This form should be **filled by the applicant** if the Metering Arrangement selected in Stage 1 is "Net Metering" or "Gross Metering". The SRET has an inbuilt database of Net Metering Regulations applicable for selected Indian states where the project can be located. The database was last updated on September 9, 2015 and needs to be updated to reflect the amendments in the regulations. Based on the Indian state selected in Stage 1, the SRET pulls out the parameters specified under the Regulations, if applicable, in this form.
	3	Profile of Roof **Reference - Figure 9**	This form captures the profile of the roof and the risks which may hinder the project's operation. The parameters are **filled by the applicant and lender's engineer** based on the survey of the

[2] The detail description of the main forms in SRET is included in this manual. Please navigate to the Form section to read more about the Form. For example to read more about the Profile of roof please refer to Form 3- Profile of Roof.

[3] Description of – Who will fill? What are the inputs? What are the outputs?

[4] Reference screenshot of the data form in the manual

[5] Baseline refers to the electricity consumption in the absence of the solar rooftop project.

[6] End user will be the one who will be consuming the electricity generated from the solar rooftop project

[7] MIX shall capture all the source of electricity in the baseline as shown in the Figure 7.

Stage	Forms[2]	Reference Screenshot	Description[3]
			rooftop. Based on the survey and the data filled in this form, the lender's engineer will provide its recommendation on the roof and which shall be considered for financial appraisal. These inputs are also used to validate the cost of the project.
	4	Solar Plant Design **Reference - Figure 10, 11 and 12**	This form captures the data **from the applicant** on the technology, make, certification, warranties and recommendation of the lender's engineer on the PV module, inverters and balance of the plant. These inputs also form the basis for the recommendation on the cost of the system.
	5	Solar Electricity Generation and Consumption **Reference - Figure 13**	This form captures the simulation of the solar electricity generation based on the models like PV Syst., which will be carried out **by the applicant**. The lender's engineer validates the number by conducting their simulations in the simulation models. The data is fed into the financial model at the back end of the SRET.
	6	Operation and Maintenance **Reference - Figure 14**	This captures the operations and maintenance (O&M) plan for the project **provided by the applicant**. The lender's engineer may provide the opinion on the adequacy of the O&M plan for sustainable operation of the plant throughout the tenure of the Power Purchase Agreement (PPA).
	7	Electricity Cost **Reference - Figure 15**	This captures the cost of electricity from all the sources from where the electricity is generated in the baseline scenario - for example utility, diesel generator, other captive plant and the respective escalation trends in last 3 and 5 years, **provided by the applicant**. The data is validated by the lender's engineer and entered in the financial calculations at the back end of the SRET.
	8	PPA Tariff **Reference - Figure 16**	This captures the estimated PPA tariff, tariff structure with respective escalation rate, if applicable and other aspects of the payment like billing cycle, payment security instruments, payment credits, late payment charges, incentive for early payment and guarantee amount. The data is validated by the lender's engineer and entered in the financial calculations at the back end of the tool.
	9	Project and Operation Cost **Reference - Figure**	This captures the procurement status and arrangements, cost of the project with detail breakup, source of funding, capital mix and running

Stage	Forms[2]	Reference Screenshot	Description[3]
		17	cost estimation. The data is filled by applicant, validated by the lender's engineer and entered in the financial model at the back end of the tool.
		Term Loan	This is as proposed **by the applicant** to the bank/FI.
STAGE 3	**11**	Electricity Cost (Officer) **Reference - Figure 21**	The names of the heads under this form are a repetition of Serial Nos. 8, 9 and 11. At this stage, the bank officer undertakes an appraisal and provides lending conditions as against what has been proposed by the applicant. Also, at this stage with the prevailing conditions, the bank has already taken a decision to accept the proposal except the risk assessment which is carried out as mentioned in SL No. 15 below.
	11	PPA Tariff (Officer) **Reference - Figure 21**	
	11	Term Loan (Officer)	
	10	Risk Matrix **Reference - Figure 18, 19 and 20**	The Risk Matrix is the most crucial part of the SRET with a comprehensive listing of potential risks at different stages of the project. A methodology is adopted as explained in the flow chart (Figure 19), which starts with identifying the risk, mapping the severity of the risk, identifying the mitigation measures and the relevant party who can address/ mitigate or own the risk.
		Detail List of Contractual Risk	This is a comprehensive checklist of the contractual risks which can be used to structure the agreements or the bank can review agreements using this checklist.
	12	Summary Reports **Reference - Figure 23 and 24**	The summary report captures the outcomes of the evaluation at each stage in the SRET and also provides recommendations of the lender's engineer and the banker.

The backend part of the tool, which is manually hidden, includes the calculations and database. The calculation sheet pulls the data from the forms, derives useful financial parameters and feeds it to the summary sheet. On the other hand, based on the state of the project location selected (in the Establishing Eligibility form), the database on Net Metering and Gross Metering at the backend of the tool filters the information applicable for the selected state and feeds it into the form.

A different set financial calculation sheets (same as for applicants) are integrated for banks and FIs also to run the appraisal. The data feed by the banks and FIs while appraising in third stage are connected to these calculation sheets. The database on Net Metering and Gross Metering are common to Stage-2 and Stage-3.

Table - Overview of Calculations in SRET

Back End Components	Applicant	Bank/FIs
Financial Calculations in SRET	Depreciation Schedule (Applicant)	Depreciation Schedule (Officer)
	Profit and Loss Statement (Applicant)	Profit and Loss Statement (Officer)
	Income Tax (Applicant)	Income Tax (Officer)
	DSCR (Applicant)	DSCR (Officer)
	Revenue and Expenses (Applicant)	Revenue and Expenses (Officer)
	Project IRR	Project IRR
Database in SRET	Database on Net Metering Regulation	
	Database on Gross Metering Regulation	

SRET NAVIGATION AND FORMATS

Navigation

SRET is an Excel-based tool where the forms can be accessed by clicking the tabs. The tabs are also mostly named after the Form headings with clear indication of the Stages of the Form and color coding which helps to differentiate among stages. However there are several tabs and accommodation of all the forms and navigation through these tabs is complicated in MS Excel. Hence, for the convenience of the user, navigation facilities have been integrated in the SRET. At any stage or in any form, the user can click to navigate to the summary reports and can also go back to the first page “Tool Flow” by clicking the *Navigation Links* as shown in Figure 4.

The SRET also has navigation buttons to view the previous or next forms, except in the case of the beginning and the end of the stage, where single navigation buttons have been provided.

Working with the Forms

The forms are provided with cells to fill in the data either manually or to select the applicable option from the built in list in the form. Some of the cells in the form are also computed using links. These data cells in the form can be distinguished based on legends as shown in Table 3.

Note- It is recommended to use the SRET in Full Screen mode in MS Excel (View>Full Screen). Please use the Zoom scale to adjust the size and view of the Forms.

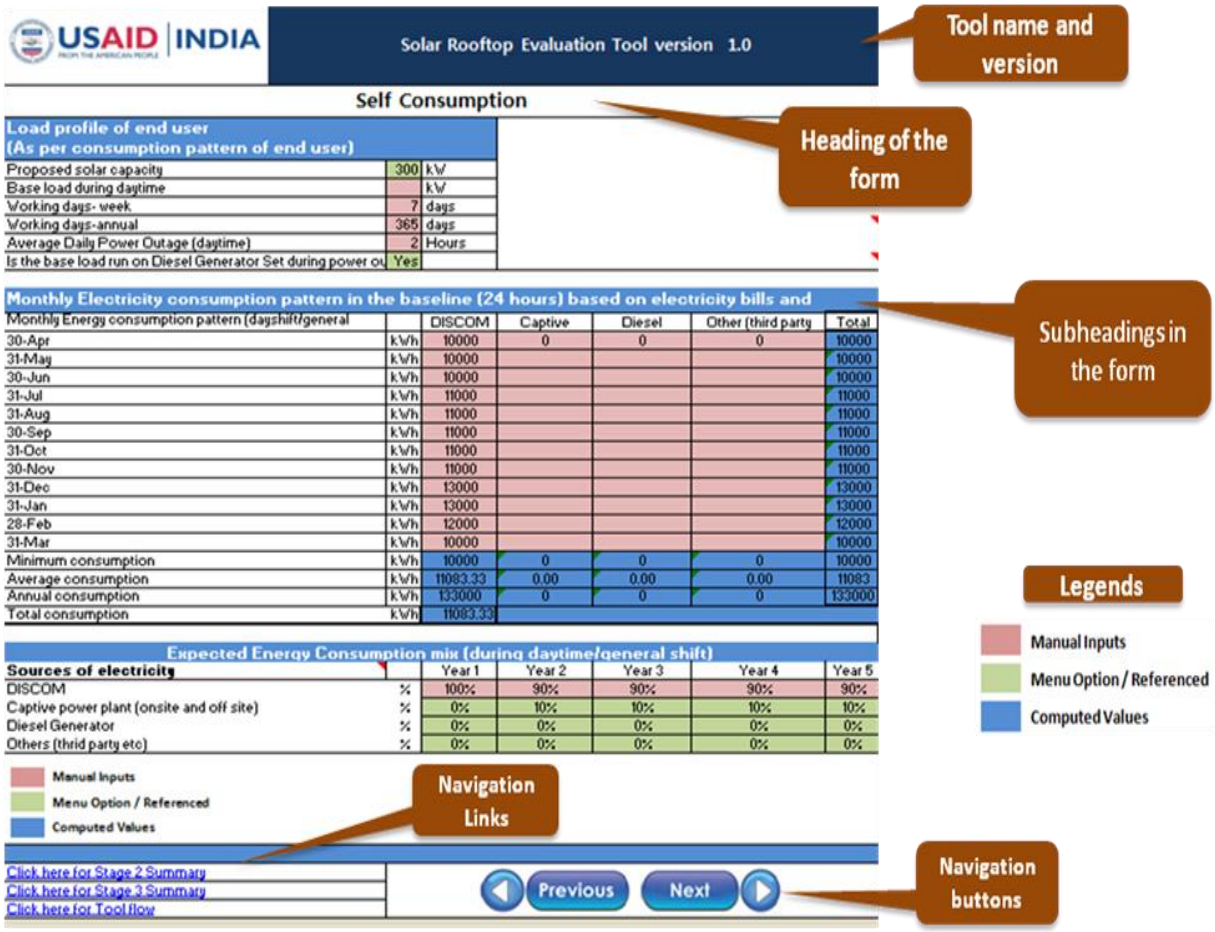


Figure - SRET Formats and Navigation (An example)

Table - Dialogue box

	Manual Inputs
	Menu option (Drop Down List)/ Referenced
	Computed Values

FORM 1 – EVALUATING ELIGIBILITY

Please refer "Stage 1 -Eligibility Criteria" tab in the tool

Overview of Screenshot – Evaluating Eligibility

The Stage 1 screens the project eligibility using a qualitative check list as highlighted in Figure 5. While this checklist is crucial it has been kept generic and concise to allow time and resource effective preliminary evaluation for the lending institutions.

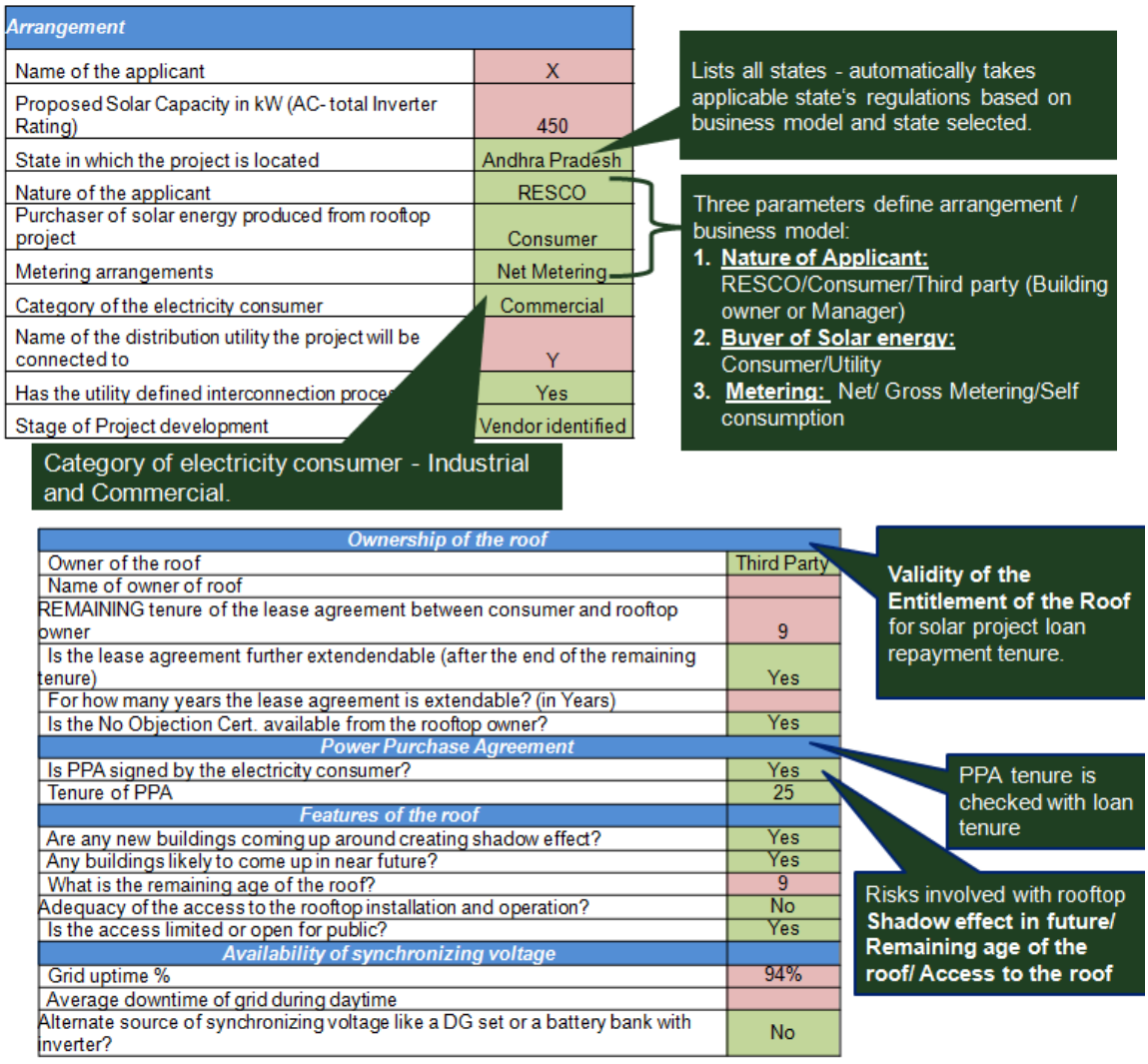


Figure - Evaluating Eligibility

Detailed Description of the Data Field

Evaluating eligibility at Stage 1 will be undertaken using the following components:

- **Application Number (No.)** – The application number will be allocated by the bank to track the application from the database of the proposals maintained by the bank.

- **Name of the Applicant** – The combination of "**Application Number**" and "**Name of the Applicant**" will be used as the unique database key to track application from the database.

Arrangements/Business Models

Business models play a critical role in defining the commercial arrangements amongst the stakeholders as well as the risk profile of the project. A number of permutations and combinations can be developed under the solar rooftop business models. The FIs/banks will need to evaluate the key risks and commercial arrangements attached to these business models. Table 4 outlines the various permutations and combinations of key stakeholders and their relationships for arriving at the business model adopted for a typical solar rooftop proposal.

Table - Arrangements

Owner of roof	Applicant (owner of the solar plant)	Who consumes Solar energy?	Metering scheme
Consumer	Consumer	Consumer	Self Consumption
Consumer	Consumer	Consumer	Net Metering
Consumer	Consumer	Utility	Gross Metering
Third Party	Consumer	Consumer	Self Consumption
Third Party	Consumer	Consumer	Net Metering
Third Party	Consumer	Utility	Gross Metering
Third Party	Third party	Consumer	Self Consumption
Third Party	Third party	Consumer	Net Metering
Third Party	Third party	Utility	Gross Metering
Consumer	RESCO	Consumer	Self Consumption
Consumer	RESCO	Consumer	Net Metering
Consumer	RESCO	Utility	Gross Metering
Third Party	RESCO	Consumer	Self Consumption
Third Party	RESCO	Consumer	Net Metering
Third Party	RESCO	Utility	Gross Metering

- **Nature of the Applicant:** The applicant is referred to the owner of the solar rooftop system which could be any of the following:
    - *Renewable Energy Service Companies* (*RESCO)* – RESCOs are corporate entities who execute solar rooftop projects. They invest in the solar rooftop system and enter into PPAs with the consumer.
    - *Consumer* – The consumer of the electricity from the solar rooftop system either invests in the systems themselves or executes a PPA with a RESCO for the supply of power from the solar rooftop system. In case the owner is the applicant, the owner would like to own the system for self-consumption.
    - *Third Party* – The Building Owner/ Manager is referred as the Third Party who may also invest in the project and execute a PPA with the consumer.

- **Purchaser of solar energy produced from rooftop project:** The purchaser of the solar energy will be either of the following :
    - Self-consumption
    - Consumer and selling excess electricity to the Utility under the net metering arrangements if the state has the provision
    - 100% consumption by the utility under the gross metering if the state has the provision
- **Metering Arrangement:** The metering arrangements will be for self-consumption or Net Metering or Gross Metering as explained under data field *Purchaser of solar energy produced from rooftop project*. Various arrangements amongst the a*pplicant, purchaser of solar energy produced from the solar rooftop project* and the *owner of the roof with different* m*etering arrangements* are enumerated in Table 4.

Other relevant data to be captured under Arrangements

- **State in which the project is located:** This data field is provided with a list of all the states in India. Based on the selection of the state by the applicant, the SRET will display the prevailing net metering and gross metering framework in the state. For the states where net metering or gross metering regulations have not yet been introduced, the "**Metering Arrangement**" data field will show *Net Metering not available* or *Gross Metering not available* as shown in figure 6.

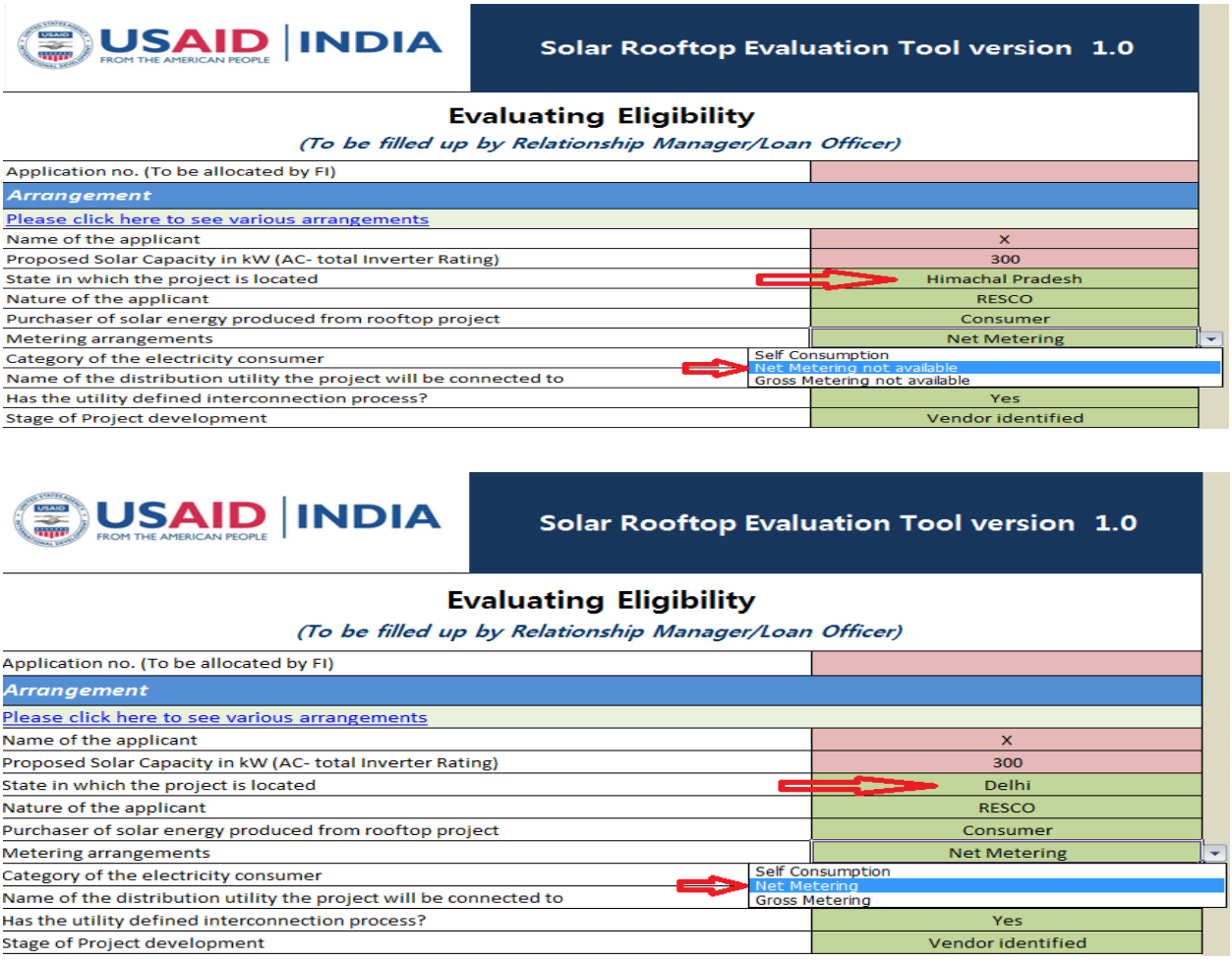


Figure - Status of Net Metering the state of project location

- **Category of the electricity consumer:** The SRET is currently designed for industrial and commercial consumers. Hence the drop down list has the option to choose between *industrial and commercial consumers.*
- **Name of the distribution utility the project will be connected to:** The applicant will enter the name of the state utility to which the project will be connected to and if it has a **defined interconnection process.**
- **Stage of Project development:** The applicant will select the project status from the list.

Ownership of the Roof

The ownership of the roof can rest with the consumer or a third party who then leases or rents it to the consumer (tenant). For FIs, evaluating a solar rooftop project becomes critical to assess whether the contractual relation between the rooftop owner and the tenants/consumers is adequate to cover the risk of early requisition of the premises. Such a risk will eventually place the PPA in jeopardy. This necessitates a check on the sufficiency of the remaining tenure of the lease agreement (between the consumer and rooftop owner) to cover the loan repayment tenure. The mitigating option needs to be evaluated on whether the lease agreement is extendable to a period to meet loan repayment tenure. A "No Objection" certificate or a contractual agreement between the third party and the rooftop owner (in case the premises are leased to a tenant and the PPA is being signed by the tenant) is also recommended.

- **Ownership of the roof:** The owner of the roof needs to be selected as consumer or a third party with a lease or rent agreement with the consumer as its tenant.
- Indicate the **remaining tenure of the lease agreement between consumer and rooftop owner.**
- Status of "**No Objection" certificate** from the rooftop owner. Whether it has been obtained or not?

Power Purchase Agreement

The status of the PPA execution and the tenure of PPA are critical information for loan appraisal and needs to be provided by the applicant. The SRET will raise a "Defect" in case the PPA tenure is less than the loan tenure.

Features of the Roof

- Are any new buildings coming up around the project rooftop create any shadow effect?
- Any buildings likely to come up in the near future?

The above information will be provided by the applicant related to the shadow effect on the selected rooftop for solar rooftop project installation. A check is recommended on whether the surrounding buildings have already reached the stipulated "building height" ceiling as per the Municipal Corporation of the area where the project rooftop is located. Shadowing effect on the roof in the future results in loss of electricity generation.

- **Is the access to the rooftop adequate for solar installation and operation?**
  The access here refers not only for individual but also for the provisions for solar installations and operations. For example, are there access provision (stairs) to carry the heavy panels and inverters to the rooftop? Accordingly, the applicant will provide the information on the access to the rooftop.
- **Is the access limited or open for public?**
  An open access to the public could be a safety threat to the project. The applicant will provide information if the access to the public can be restricted or not based on the nature of the premises.

Availability of synchronizing voltage

- **Grid uptime in Percentage (%)**
  Grid uptime defines the availability of the grid in a year after discounting the downtimes including failures, maintenance and any other reason. The solar projects are equipped with intelligent inverters which sense the synchronizing voltage (also called reference voltage) from the grid to generate electricity. In the event of grid downtime the inverter stops the generation of solar energy due to the absence of synchronizing voltage. Hence a grid uptime in the area of solar project instalment is critical. The data on grid uptime can be either obtained from the Distribution Company (DISCOM), or if such records are not maintained, it can be calculated from the historical usage of electricity (in hours) sourced from options other than grid like diesel generator set at the project site.
- **Average downtime of grid during daytime**
  The average downtime of grid during daytime is more relevant for solar rooftop projects as the solar ideally operates between 8 AM to 5 PM.

FORM 2 –SELF CONSUMPTION & NET AND GROSS METERING

Please refer "Stage 2- Consumption" and "Stage 2- Net & Gross Metering" tab in the tool

Overview of Screenshot– Self Consumption & Net and Gross Metering

Based on the options selected in Stage 1 under the Arrangement section, the proposal will be for 100 percent Self-Consumption or with Net/Gross Metering. There are separate tabs integrated in the SRET to deal with 100 percent Self-Consumption or Net/Gross Metering. For example, if under the Arrangements > Metering Arrangement section, Self-Consumption is selected then at the Stage 2- Self Consumption form will be available and will need to be filled. Similarly, if Net Metering or Gross Metering is selected then at Stage 2- Net or Gross Metering will be selected. The SRET has inbuilt database of state-wise Net and Gross Metering regulations which gets automatically displayed in this form based on the state selected by the applicant.

SELF CONSUMPTION

Load profile of end user (As per consumption pattern of end user)	
Proposed solar capacity in KW	300
Base load during daytime in KW	
Working days- week in days	7
Working days-annual in days	365
Average Daily Power Outage (daytime hours)	2
Is the base load run on Diesel Generator Set during power outage?	Yes

NET/GROSS METERING

Grid connectivity of end user	
Sanctioned demand in KW	500
Contracted demand in KW	200
Power factor	0.95
Transformer capacity in KVA	
Sanctioned demand in KW	475
Consumption voltage KV	33.00kV

Monthly Electricity consumption pattern in the baseline (24 hours) based on electricity bills and records of past 12 months

Monthly Energy consumption pattern (dayshift/general shift)		DISCOM	Captive power	Diesel	Other (third party etc)	Total
30-Apr	kWh	10000	0	0	0	10000
31-May	kWh	10000				10000
30-Jun	kWh	10000				10000
31-Jul	kWh	11000				11000
31-Aug	kWh	11000				11000
30-Sep	kWh	11000				11000
31-Oct	kWh	11000				11000
30-Nov	kWh	11000				11000
31-Dec	kWh	13000				13000
31-Jan	kWh	13000				13000
28-Feb	kWh	12000				12000
31-Mar	kWh	10000				10000
Minimum consumption	kWh	10000	0	0	0	10000
Average consumption	kWh	11083.33	0.00	0.00	0.00	11083
Annual consumption	kWh	133000	0	0	0	133000
Total consumption	kWh	11083.333				

Expected Energy Consumption mix (during daytime/general shift)

Sources of electricity		Year 1	Year 2	Year 3	Year 4	Year 5
DISCOM	%	100%	90%	90%	90%	90%
Captive power plant (onsite and off site)	%	0%	10%	10%	10%	10%
Diesel Generator	%	0%	0%	0%	0%	0%
Others (thrid party etc)	%	0%	0%	0%	0%	0%

Figure - Self Consumption and Net and Gross Metering

Detailed Description of the Data Fields

Baseline consumption parameters

- **Load Profile of End User**
  The rooftop solar power plant will be designed to match the overall annual usage for Net/Gross Metering and the base load of the consumer during the day time for self-consumption. The load profile of the consumer in terms of the working days (days for which the consumer will be consuming solar electricity) also have the impact on the generation. For the non-working days, the solar electricity generation will be lost. As explained under the availability of synchronizing voltage, in the absence of any reference voltage during power outage, the solar roof top plant will shut down.

- **Monthly Electricity Consumption**
  Monthly electricity consumption in the baseline scenario based on the historical electricity bills from past year is critical for load profile assessment. This is an important input for the design of the capacity of the project.

- **Energy Consumption Mix**
  The energy consumption mix comprises of the source of electricity in the baseline. It could be from distribution utility, captive power plant, diesel generators or any other sources.

- **Net and Gross Metering**
  In addition to the baseline consumption parameters, the Net and Gross metering connections also include the conditions issued by state nodal agency/DISCOM wherever applicable. The conditions majorly defined the eligibility of the consumers on the following:

  - Eligible Voltage levels
  - Eligible Consumers
  - Voltage wise capacity limits specified
  - Capacity limits for LT Consumers
    - Lower Limit
    - Upper Limit
  - Capacity limits for HT Consumers
    - Lower Limit
    - Upper Limit
  - Minimum capacity (kWp)
  - Maximum capacity
    - % of sanctioned load
    - % of distribution transformer capacity
    - Kilowatt Peak (kWp)
  - Settlement cycle (Annually/Monthly/other)
  - Settlement period (Duration From – To)
  - RECs
  - RPO

- Tariff
    - with subsidy
    - without subsidy
    - limits on export power
    - limits on export power (% of import power)

Note: In this form, the SRET raises flags or Defects which are indicated in Red text in figure 8.

Self Consumption

Load profile of end user (As per consumption pattern of end user)			
Proposed solar capacity	300	kW	
Base load during daytime	300	kW	
Working days- week	6	days	1 day generation may be lost weekly.
Working days-annual	200	days	165 day generation may be lost annually.
Average Daily Power Outage (daytime)	2	Hours	
Is the base load run on Diesel Generator Set during power outage?	No		Possible loss of solar generation due to lack of reference voltage.

Figure : Self Consumption- Defects

FORM 3–PROFILE OF ROOF

Please refer "Stage 2- Profile of Roof" tab in the tool

Overview of Screenshot – Profile of Roof

There is a need for a physical survey of the site by the lender engineer (i.e. roof) before filling or validating the data in this form. The form as shown in figure 9 is designed to accommodate a collection of rooftops in case the project is applying for a loan for aggregated roofs. Based on the data filled, the lenders engineer can comment if the roof/collection of rooftops qualify for further evaluation along with any other qualitative comments.

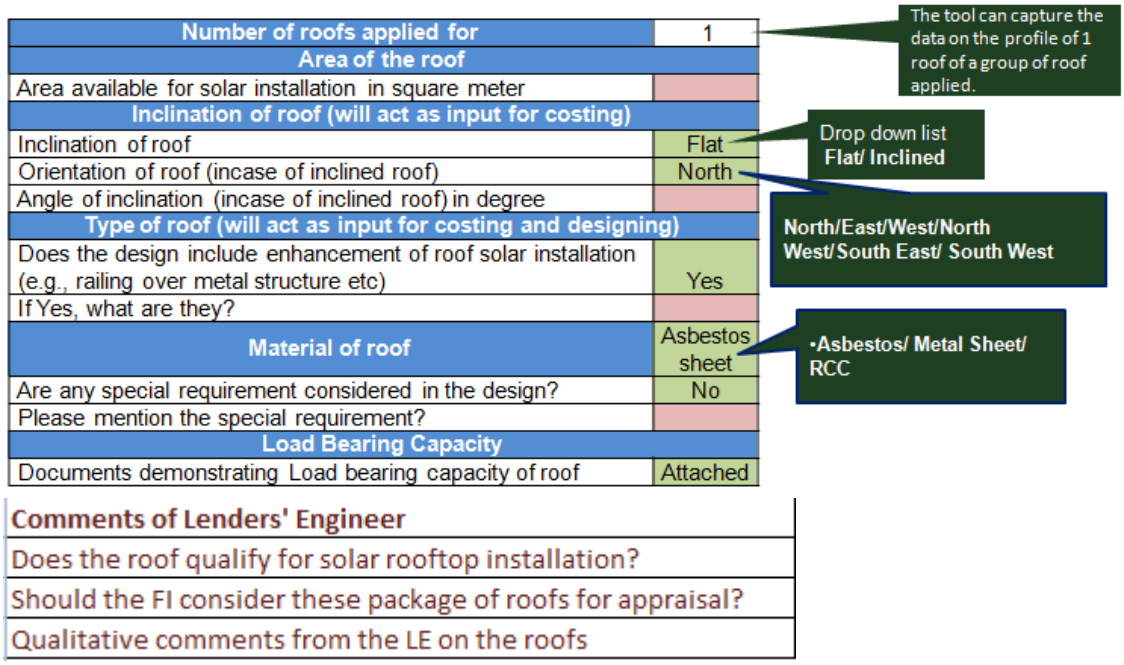


Figure - Profile of Roof

Detailed Description of the Data Fields

Profile of Roof

The evaluation of the profile of the rooftop is critical while considering its suitability for solar rooftop plant installation. It includes:

- Load bearing capacity of the roof - This is to assure the lender that the roof is strong enough to bear the load of the solar panels, inverters, mounting structures and other associated activities during the construction and operation periods of the project. An independent expert (qualified/certified civil and structural engineer) can assess the load bearing capacity of the roof and issue an appropriate certificate on the age of the roof and the load bearing capacity of the roof.
- Inclination of the roof - The inclination angle of the roof is another critical factor which determines the quantum of the solar radiation that falls on the roof, and has a direct impact on solar energy generation.

- Roof material - The type of the material used to make the roof defines the need for any additional enhancements that may be required to render the rooftop suitable for installation of the solar plant. This also has an impact on the project cost as additional enhancements will add to the project cost.

FORM 4 –SOLAR PLANT DESIGN

Please refer "Stage 2- Solar Plant design" tab in the tool

Overview of Screenshot – Solar Plant Design

The data on rooftop solar plant design will be filled by the applicant/lender's engineer. The applicant can be further asked to provide the documents to support the data filled in this forms such as technical specifications, certificates, warranties and the design layout of the solar plant as shown in figure 10. The data/supporting documents provided by the applicant will be validated by the lender's engineer.

Capacity of solar PV in KWp		
Modules		
Name of manufacturer		
Module model		
Technology		Mono-crystalline
Module capacity in Wp		
No of modules		
Annual Deration in %		0.50%
Certification	IEC 61215 / IS14286/ IEC 61646	Yes
	IEC61730 (P1-P2)	Yes
	IEC 61701 / IS 61701 (Incase of corrosive)	Yes
Test reports	From Accredited Lab following IEC	Not Attached
Warranties		
Output peak warranty		
First 12 years	90%	
At the end of 25 years	80%	
Layout for Solar plant Design	Attached	

Figure - Solar Plant Design

The SRET also captures similar data for inverters, module mounting structures, DC cables, etc., in the forms as shown in Figure 11.

Invertors			
Name of manufacturer			
Invertor model			
Invertor capacity	kW_{DC}		
	kW_{AC}		
No of invertors	nos		
Certification			
Effeciency Measurement	IEC 61683 / IS 61683	Yes	Attached
Environmental	IEC 60068-2 (1, 2, 14, 30) / Equivalent BIS Std.	Yes	Attached
Grid Connectivity standard	IEC 61727/IEEE 1547/IEEE 1547.1	Yes	Attached
Electromagnetic compatibility & Electro Magnetic Interference	IEC 61000-6-3(>16 Amps)/IEC 61000-6-4(<16 Amps)	Yes	Attached
Ingress protection	IP 65 (for outdoor)/	Yes	Attached
Test reports	From IEC Accredited	Not Attached	
Module mounting structures			
Type of structure			
Material used for structures			
Are the mounting structure certify to stand the wind speed?		Yes	Attached
DC Cables			
Name of manufacturer			
Model			
Does th conductor sizing is adequate as per current carrying capacity?		Yes	
	IEC 60227 / IS 694	Yes	Attached
Certification	IEC 60502 / IS 1554 (Pt. I & II)	Yes	Attached
Certification for Balance of Plant			
	IEC 60947 part I,II, III	Yes	Attached
Switches/Circuit Breakers /Connectors	IS 60947 Part I,II,III	Yes	Attached
Junction Boxes /Enclosures for Inverters/Charge Controllers	IP 54(for outdoor)/ IP 21(for indoor) as per IEC 529	Yes	Attached
Earthing	IS 3043	Yes	Attached
Switches/	IEC 60947 part I,II, III /	Yes	Attached
Layout for Solar plant Design			

Figure - Solar Plant Design (1)

Based on the validation of the data provided by the applicant, an opinion will be filled in by the lender's engineer as shown in figure 12.

Opinion of Lenders' Engineer on Solar Plant Design	
Do Lenders' Engineer recommend the Solar plant design?	No
If **NO**, please include the lender's engineer recommendations as against the applicable part of the project	
Modules	
Inverters	
Module of mounting structure	
DC cables	
Certification for Balance of plant	
Are the solar panels supplied by Tier 1 Manufacturers?	
Are the equipments covered for third party insurance?	
Do applicant accept the recommendation and amend the design?	Yes

Figure - Solar Plant Design (2)

Detailed Description of the Data Fields

Solar Plant Design

It is critical that the components of the solar plant conform to the international and national standards as prescribed by the Ministry of New and Renewable Energy (MNRE). These include:

- **Annual deration of solar module**: Solar modules experience a deration over time which is usually captured through an annual deration factor which is due to the

external conditions and the ageing of the equipment. The deration levels need to be incorporated into the generation figures and the equipment also needs to meet the deration levels as required by MNRE for solar modules.

- **Warranties** for the solar PV modules shall be assessed if it warrants the PV module free from material and manufacturing defect and failures. The warranty period for power output and the output level shall also be critically checked from the PV module supplier.
- **Performance test reports** for the inverters from IEC accredited labs.
- **Certification** on efficiency measurement, environment, grid connection standards, electromagnetic compatibility and electromagnetic interference and ingress protection of the inverter.
- **Certification** of the mounting structure to withstand the wind speed.
- **Adequate sizing** of the conductor as per the current carrying capacity.
- **Certifications:** Adherence to national standards and requirements as given by MNRE.

FORM 5 – SOLAR ELECTRICITY GENERATION AND CONSUMPTION

Please refer "Stage 2- Solar Gen & Cons" tab in the tool

Overview of the Screenshot - Solar Electricity Generation and Consumption

Note: The monthly generation pattern by the solar PV modules simulated using models shall be used to project the generation. The generation will be provided by the applicant and reviewed by the lender's engineer as shown in figure 13.

Solar Generation and Consumption

Proposed Solar PV capacity	300	kWp
Connected Voltage	11	KV

Monthly Generation pattern (submitted by developer)		
30-Apr	30000	kWh
31-May	30000	kWh
30-Jun	32000	kWh
31-Jul	32000	kWh
31-Aug	34000	kWh
30-Sep	34000	kWh
31-Oct	36000	kWh
30-Nov	36000	kWh
31-Dec	36000	kWh
31-Jan	30000	kWh
28-Feb	32000	kWh
31-Mar	32000	kWh
Total Generation	394000	kWh
Estimated PLF	15%	

Check list of simulation carried out by Lenders' Engineer	
Is solar generation loss during no-work days considered?	Yes
Is solar generation loss due to no availability of reference voltage considered?	Yes

State	Karnataka
Settlement cycle	Monthly
No of months in a settlement	1
Limit on export	Not Specified
Limit of export	NA

Consolidated Energy Accounting	As per Developer	As per Lenders' Engineer
Total Solar Energy generated	394,000	338,000
Total Solar Energy Consumed	133,000	133,000
Unutilized Solar energy (incase of **Self Consumption**)	-	-
Uncompensated Solar energy (incase of **Net metering**)	-	-
Amount of Energy displaced by Solar energy	133,000	133,000
Energy imported in addition to solar energy consumed	-	-
Energy compensated under Net metering	261,000	261,000

Figure - Solar Electricity Generation and Consumption

Detailed Description of the Data Fields

Generation pattern on monthly basis will be fed in to the software or model used to simulate the solar electricity generation by the applicant.

FORM 6–OPERATION AND MAINTENANCE

Please refer "Stage 2- O&M Plan" tab in the tool

Overview of the Screenshot - Operation and Maintenance Plan

Operation and Maintenance Plan will be checked for the following and filled into the SRET as shown in figure 14 accordingly:

- Cleaning of solar panels regularly and periodically
- Adequate and qualified manpower for O&M
- Availability of spares at easily accessible distances to support the O&M
- Remote monitoring of the operation including arrangements for report generation

Operation and Maintenance Plan		
Is there a team deployed at site	Yes	
Availability of engineer with a distance of	km	50
How often the panels will be cleaned?	days	45
Frequency of preventive maintanance in an year	times	2
Availability of trained manpower with the applicant	Yes	
Service centre with spares available at a distance of	km	120
Does the O&M include the remote monitoring	Yes	
Opinion of Lenders' Engineer		
Is the O&M Plan provided by developer adequate?	Yes	
If no, what are the necessary changes to the plan?		

Figure - Operation and Maintenance

FORM 7–ELECTRICITY COST

Please refer "Stage 2- Elec. Cost" tab in the tool

Overview of the Screenshot - Electricity Cost

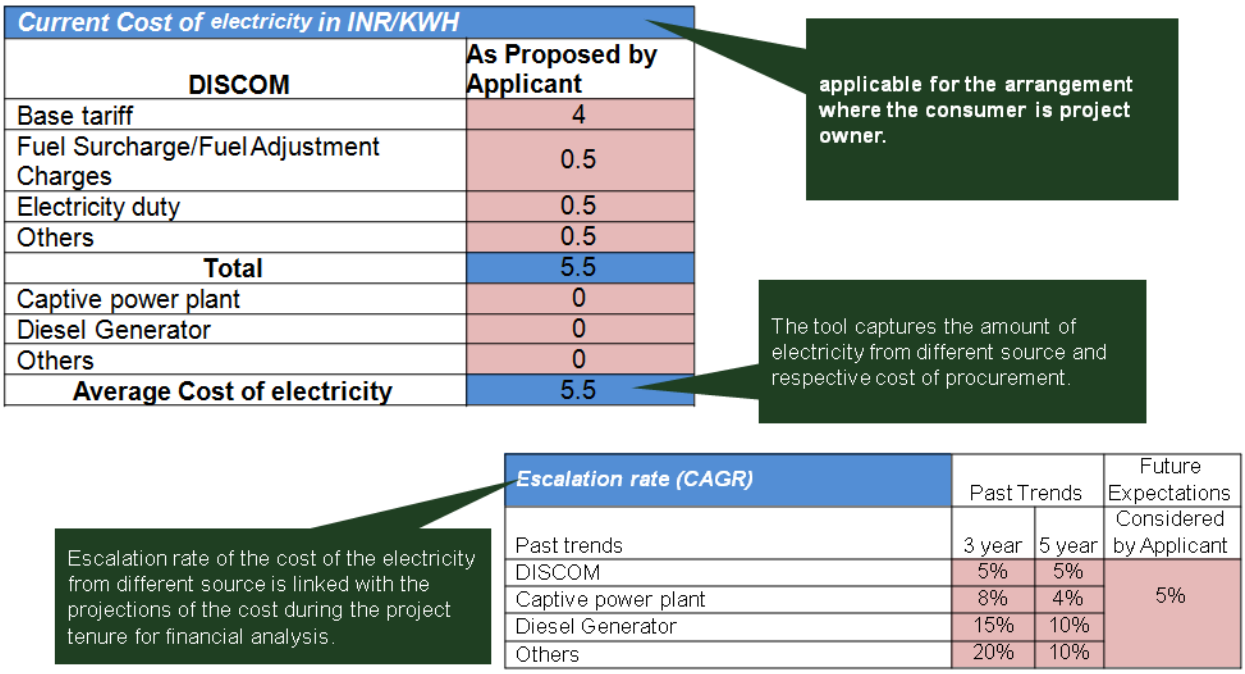


Figure - Electricity Cost Proposed by Applicant

Detailed Description of the Data Fields

Electricity Cost – The benefits for the project are calculated based on the savings made on the baseline average electricity cost paid by the consumer. The average electricity cost is estimated based on the weighted average cost of the energy source mix e.g. the cost paid to the distribution utility or cost towards captive power plant or the cost of diesel generator set based power. Utility bills for the past financial year and supporting documents can be used as the source for this data. For revenue projection purposes, the historical increase (in percentage (%)) of the electricity cost will be used for arriving at the cost escalation. Please refer figure 15.

FORM 8 – PPA TARIFF

Please refer "Stage 2- PPA Tariff" tab in the tool

Overview of the Screenshot – PPA Tariff

Tariff in INR/kWh	7
Tenure of the PPA in Years	15

Tariff Structure and escalation rate		
1. Constant Tariff throughout the PPA tenure		base tariff 7 RS/KWH
2. Constant Escalation in Tariff		base tariff 7 RS/KWH
Escalation Rate		7%
Frequency of Escalation		In 5 years
3. Variable Escalation in Tariff		base tariff 7 RS/KWH
Beginning year	Ending year	Annual Escalation rate
1	5	5%
6	10	6%
11	15	7%
16	25	8%

Other parameters in PPA	
Billing Cycle	Monthly
Is there any payment security provided?	Yes
If Yes, for how many months? In Months	2
What is the payment security instrument?	Letter of Credit
Payment credit availability in Months	2
Penalty for late payment in INR/kWh	
Is there any incentive for early payment?	Yes
If yes how much? In INR	
Amount of Guarantee? In INR	
Net Metering in INR/KWH	0

Figure - PPA Tariff proposed by Applicant

Detailed Description of the Data Fields

Power Purchase Agreement- This is the agreement between the seller and purchaser/ consumer of solar electricity and it governs the conditions under which the seller provides solar power to the consumer during the PPA period. The agreement outlines the tariff and the price per unit of electricity purchased besides a number of other conditions related to payments, disputes, roles and responsibilities of parties, etc.

- Tariff- The tariff is fixed for the complete tenure of the PPA, however the structure of the tariff can be combination or any of the following:
  - Constant Tariff – Under this condition, a constant levelised tariff is agreed upon for the tenure of the agreement.
  - Constant Escalation – A tariff structure which starts from a base tariff in year one and escalates based on a predefined rate can also be used. The period of escalation may vary from 5 years, 10 years, 15 years or for full tenure of PPA.
  - Variable Escalation – A variable tariff with variable escalation can also be used. For example 5 percent from 1st to 5th year, 6 percent from 6th to 10th year, 7 percent from 11th to 15th years and so on.
- The tariff structure as agreed in the PPA will be used to derive the parameters (as discussed above under Tariff) to support the lending decision.
- Payment Security Mechanism - A mechanism which is adopted to avoid the default against performance and payment for solar power. It could be a Letter of Credit or a Bank Guarantee. It gives the party the authority to retain the amount equivalent to the amount defaulted by another party.

- Penalty for late payment – Late payment is a critical risk which may lead to a default on debt payment. The contract needs to carry late payment charges to incentivize timely payment of dues.

Please refer figure 16.

FORM 9 – PROJECT AND OPERATION COST

Please refer "Stage 2- Costs (Project&Op)" tab in the tool

Overview of the Screenshot – Project and Operation Cost

Costs (Project & Operations)

Stage of procurement		Vendor identified
Type of procurement		To be provided by turnkey vendor
Name of the Turnkey/EPCM Contractor		
O&M Arrangement		Turnkey vendor
Check Product Warranty Period - is it 5 years	years	
Construction Period	Months	6
Is the Performance ratio guaranteed		No
'Does the warranties be covering the major technical risk		No
Opinion of Lenders' Engineer		
Is the Contractor capable of executing the porposed project?		Yes
If no, what is the reason?		
Is the warranty period adequate to cover considerable technology?		Yes
Will the warranty be covering major technology risks of the project?		Yes
Is the performance/generation guarantee adequate to cover the technology risks?		Yes
If no, what should be the performance/generation guarantee required?		
Can the project be executed within the construction period mentioned by developer?		Yes
If no, what will be the estimated construction period?		
Capacity of solar PV	kWp	300
Cost of project		
PV Modules	INR Lakh	80
Invertor	INR Lakh	45
Module Mounting strucutre	INR Lakh	15
Roof strengthening (if any)	INR Lakh	10
Cables	INR Lakh	5
Balance of plant	INR Lakh	10
Others	INR Lakh	5
Preliminary and pre-operative	INR Lakh	2
Taxes	INR Lakh	5
Total		**177**
Opinion of Lenders' Engineer		
Are all costs considered?		Yes
Is Project cost inline with current market trend?		No
If no, what is the justification for the project to be considered?		
Source of funding (from Applicant)		
Capital subsidy	INR Lakh	26.55
Proposed term loan (by Applicant)	INR Lakh	150
Proposed equity	INR Lakh	0.45
Total		**177**
Debt/Equity Ratio (Proposed by Applicant)		**333.3**
Source of funding (from Bank)		
Proposed Term Loan (by Loan Processing Officer)	INR Lakh	100
Required Equity		50.45
Debt/Equity Ratio (Proposed by Loan Processing Officer)		**2.0**
Annual O&M Cost	INR Lakh	1
Annual escalation	%	5%
Cost of Insurance	% of project cost	0.1%
Spares	% of project cost	0.1%
Opinion of Lenders' Engineer		
Are all operating costs considered?		Yes
Are operating costs inline with current market trend?		Yes
If no, what is the justification for the project to be considered?		

Figure - Project and Operation Cost

Detailed Description of the Data Fields

Cost of the Project - Like any other power plant, the cost of the solar rooftop projects can be broadly categorized into capital cost and the operation cost. The project cost majorly comprises of the cost of solar PV and inverters, which forms the substantial part of the total project cost (around 70-75 percent). The cost of the rooftop and any costs related to enhancement (such as civil work) of the suitability for solar power installation, are significant components of the project cost. The module mounting structure, cables and Balance of the System along with preliminary and pre-operative expenses, taxes and insurances form the overall project cost. The project cost may vary project to project depending upon the source of technology procurement (local or foreign vendor) and procurement type (engineering, procurement and construction management; turnkey vendor or self-procurement).

Source of funds- The funds excluding the Government subsidies are sourced majorly from banks in form of debt about 60%-80%, the Government subsidies forms 15% of the total project for eligible projects (for example projects eligible as per MNRE guidelines to avail the subsidies) and equity.

- **Debt financing** forms the Term Loan amount with an interest rate and repayment loan and repayment period. Indian banks are providing debt financing for solar projects in the following ways:
  - Project Finance - Long-term financing based on their projected cash flows rather than the balance sheets of the project owners. The collaterals are the project assets which can be evaluated for their technical and commercial values as explained in previous sections.
  - Limited Recourse Financing – Lenders' asked for additional collateral apart from the project asset by having a supporting balance sheet by an associate company.
  - Refinancing – An arrangement to substitute the existing loan by a new one to take the leverage of better interest rates. If the project has reached the operation stage, attractive lending can be done against the reduced risks.
  - Construction or Bridge Finance – This is a short term lending to support the liquidity in the project.
- **Equity** is paid up by the owner or the investor in the project. The equity ownership can be changed during the project tenure if the project contracts allow the same.
- Available **sources of finance** – There are several sources for debt finance in Indian solar market. These include:
  - Indian commercial banks
  - Non-banking financial companies through infrastructure funds, power sector financing agencies and investment banks
  - Multilateral and bilateral development funding agencies
  - Export credit agencies
  - Other sources of funds such as currency hedging and Green Bonds.

FORM 10 – RISK MATRIX

Please refer "Stage 3- Risk Matrix" tab in the tool.
In addition to the Risk Matrix the tool also have a detail list of contractual risk for the rooftop solar project. Please refer "Stage 3-Cont Risk Detail".

Overview of the Screenshot – Risk Matrix

The SRET provides a risk matrix, which identifies and analyses (qualify and quantify) the risks which the solar rooftop project can face either during installation or operation. The process, defined in Figure 18, includes risk identification, categorisation and potential mitigation analysis. It starts with identifying the risk, the severity of the risk, mitigation measures and the relevant responsible party who can mitigate or assume the risk.

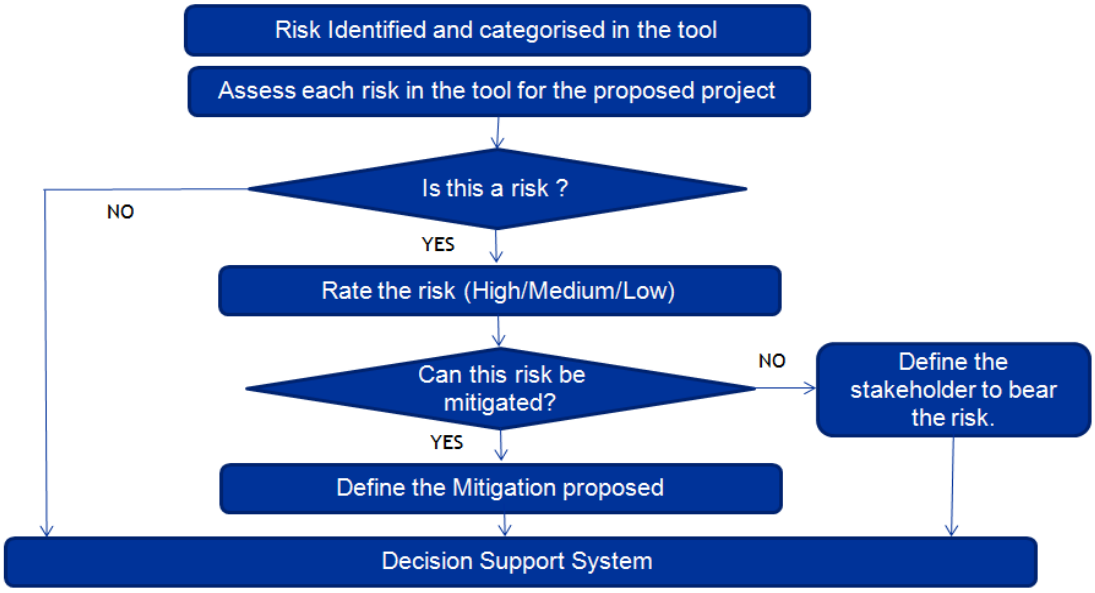


Figure - Procedure to fill the Risk Matrix

A sample risk analysis form has been highlighted in Figure 19.

Ownership of the project & rooftop	Is this a risk?	How critical is the risk?	If yes, is it mitigable ?	If yes, what is the mitigation proposed?	If no, who should bear the risk and is that stakeholder bearing the risk?
In RESCO mode, if the PPA is with the consumer, is there a risk of the consumer undertaking early termination of the contract?	Yes	Medium	Yes	**To include the Novation clause with penalty in PPA**	
In case of third party ownership of rooftop, is there a risk of the lease agreement between the rooftop owner and the consumer being terminated early (before the end of the loan tenure)?	No				
In RESCO mode, if the PPA is with the rooftop owner, is there a risk of the rooftop owner undertaking early termination of the contract?	Yes	Medium	Yes	**To include the Novation clause with penalty in PPA**	
Does the signee of the PPA have a good payment record (for services)?	Yes	Medium	Yes	**PG or Revolving LC**	

Figure - Sample of parameters under Risk Matrix in the SRET format

Other categories and potential risk included in the matrix are given in Figure 20.

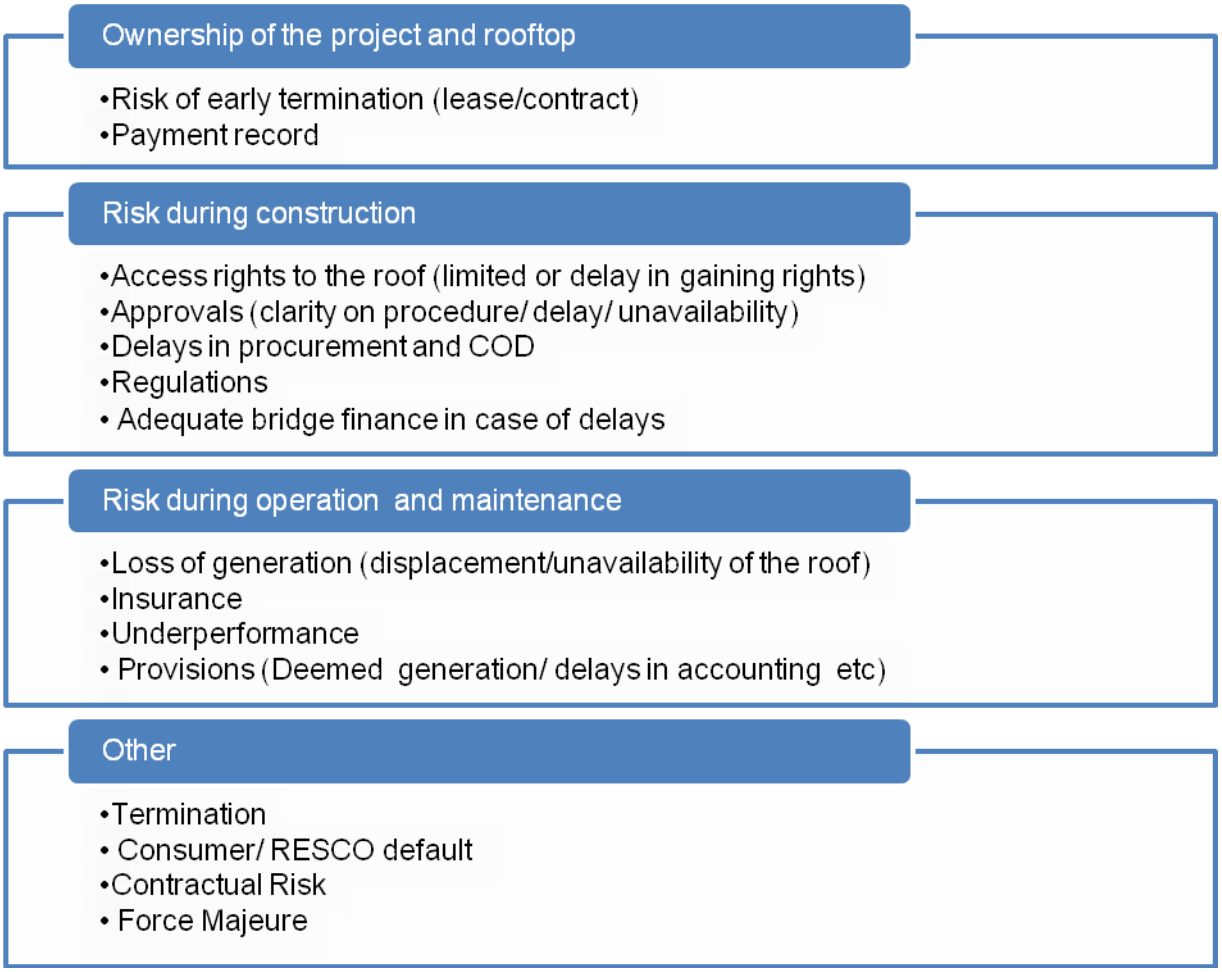
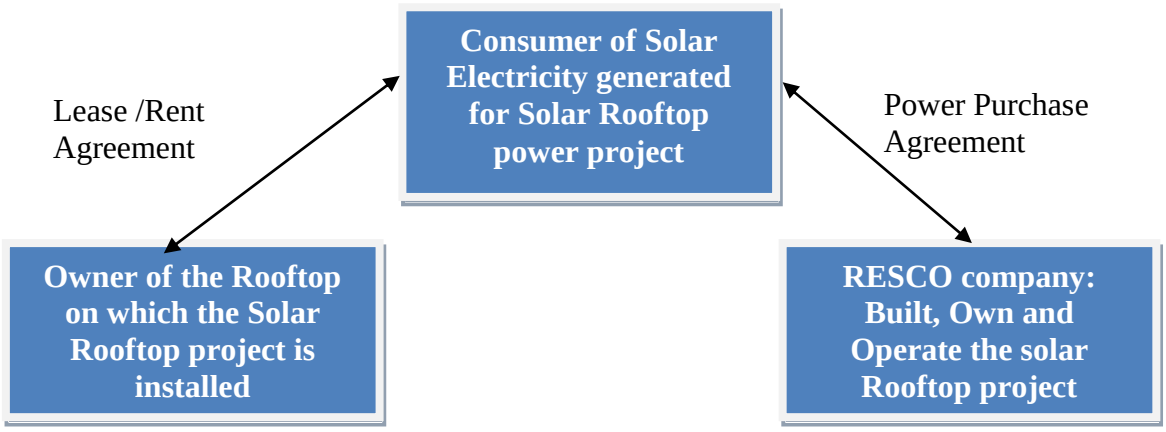


Figure - Detail category-wise list of parameters under Risk Matrix

Detailed Description of the Data Fields

- **Early Termination of the PPA**
  This is a risk where the project owner is a RESCO who has applied for loan against the PPA with the consumer. It is critical to assess the early termination of the PPA, due to any factor identified in the PPA between the RESCO and the rooftop owner. This may lead to termination of the PPA resulting in severe negative implications on the loan repayment. It is critical to evaluate whether appropriate remedies have been taken to protect the RESCO and through the RESCO, the lenders, under the contract. The PPA needs to address the following issues in the event of early termination:
  - Who will repay the loan? In the event of default by the RESCO, a guarantor (as defined in the loan agreement) is stipulated who will be held responsible to repay the loan. In the absence of such a guarantor, the collateral needs to be sufficient to repay the loan amount and the accrued interest rate.
  - What are the conditions for loan repayment? The loan agreement defines the loan repayment conditions. However it will need to clearly capture the conditions for loan repayment in case of default as explained in the above point.
  - What will be the modalities of disposing the collateral mortgaged against the loan to repay the debt?

- **Early termination of the lease agreement for the roof**
  This is a risk in a scenario where the owner of the project is not directly involved as a party to the PPA. Commitment of the rooftop owner is an important issue which will be ensured by a separate agreement (a lease or a rent) between the owner and the consumer. Solar rooftop projects are complex as they also include the risk of early termination of the rooftop lease/rent agreement and the parties involved in this agreement maybe different from the parties involved under the PPA. For example, if the consumer is not the owner of the rooftop (as shown in figure below) but consumes the solar electricity from the rooftop plant owned by RESCO, the RESCO will need to have a long term lease/rent agreement with the rooftop owner to ensure that the roof is available for solar project operation in case of termination of the consumer and the rooftop owner.



- **Payment Security**

The credibility of the purchaser/consumer of solar electricity needs to be evaluated. It can be based on the history of payments made by the purchaser/consumer for services received for similar services. For example, electricity bills and payments to the utility under its existing business(es) can be verified. A detailed analysis of the financial background of the consumer/purchaser also helps to evaluate the payment credibility of the purchaser/consumer.

Risk during Construction and Mitigation

- **Delay in Procurement of Roof**
  There are two major hindrances in the procurement of roof:
  - *Legal access to the roof*- As explained under the previous section on roof ownership, it is critical to identify the legal owner of the roof and the modalities needed to have access rights to the solar rooftop installation based on the supporting lease contracts. If required, a revision in the conditions in the lease and its tenure to match the mitigating measures identified in previous section may be required which may delay access to the roof.
  - *Physical Access to the Roof* - The physical access to the roof will be evaluated based on its suitability to facilitate movement by installation personnel but also to facilitate installation of equipment of the solar rooftop plant such as solar panels, inverters, mounting structures, etc. Adequate access infrastructure such as stairs and passages or lifts to transport the equipment needs to be ensured. It is to be noted that suitable temporary arrangements could also be made to facilitate the access but they will add to the cost of the project and lead to complications during the operation and maintenance of the projects. Time delays are expected to complete the construction if infrastructure access is not made available.

- **Delay in Procurement of the Solar System Components**
  The procurement of the solar components maybe delayed due to the following reasons:
  - *Lengthy process of appointing the EPC contractor* - It has been observed that large organizations and public sector undertakings that issue tenders for procurement of equipment have to go through several screening levels to get management approval for the same. Such delays can be avoided by upfront consultation with the approving departments to reach a common agreement on the project timeline to float the tenders.
  - *Inadequate plan to procure the solar system components* - Its needs to be evaluated whether realistic planning has been undertaken by the project developer for procurement of equipment including potential delays in overseas consignments, custom approvals, unavailability/shortages/overbooked scenarios and other administrative procedures. Identification of clear milestone dates and contingency plan are the features of an effective procurement plan which need to be showcased in the proposal.
  - *Inadequate design or revisions to it* - The designs need to be in line with the standards, protocols and standard technology configurations prevailing in the market at that time.

- *Performance ratings of vendors and contractors involved in procurement* - It is recommended to check the rating of channel partners from the list of empanelled partners published by MNRE regularly. If such ratings are not available then the lenders engineer can comment on the quality of the equipment and the supplier based on performance from commissioned projects as well as market feedback.

- **Project Approvals from the Authority**
  The project approval can be obtained in concurrence with the construction activity. To avoid the delays in obtaining approvals, it is important to identify all the approvals required for the particular project location and the relevant authorities who will issue the same.

  Tentative List of Approvals Required for Solar Rooftop Projects:

  - No Objection Certificate from Structural Engineer on the load bearing capacity of the roof
  - No Objection Certificate from Civil Aviation Department, if applicable
  - Import/Export Certificate
  - Permission for laying power evacuation lines by Chief Electrical Inspector
  - Permission for 'Implementation of Metering Code', 'Protection System' to be obtained from host Distribution Utility or the State Transmission Utility or the Central Transmission Utility as the case may be

  Note: It is also important to check with other relevant authorities if there are approvals applicable for the location of the project to avoid any delay in project execution.

- **Net Metering/Gross Metering Regulations**
  If the regulations on Net Metering/Gross Metering have not been defined, there is a need to evaluate how the excess electricity (electricity amount in addition to self-consumption) will be consumed and managed. It is crucial to identify if the revenue generated from Net Metering is also linked to the project revenue or loan repayment and accounted in the internal rate of return (IRR) calculations. If the regulations on Net Metering/Gross Metering have been defined, the regulations need to be reviewed to confirm whether the consumer is eligible to install projects**.**

- **Grid Interconnection Process**
  The plant will be designed in complete adherence to the grid interconnection requirements of the State Distribution Utility and the Chief Electrical Inspector. In case grid interconnection process has not been defined, the State Distribution Utility shall be consulted for the required procedures to be followed at the time of designing the solar rooftop power plant.

- **Bridge Finance**
  The need for bridge financing will be identified if there is considerable delay in arranging the long term loan. The source of bridge finance (short term loan) will need

to be identified after assessing the shortfall (gap) in financing required during the construction stage of project implementation.

Risk during Operation and Mitigation

- **Deemed Generation:** This is a concept to address any loss of generation due to any reason beyond the control of the rooftop developer and not covered under Force Majeure. Deemed generation protects the developer and the lender from delays in the repayment of the loan. It is crucial to assess whether the deemed generation clause has been included in the contract and appropriately worded to cover all eventualities. The key eventualities have been highlighted below:
  - In the event of consumer failing to off-take the electricity generated due to non-availability of reference voltage or lack of demand
  - Non-availability of adequate space for solar rooftop installations or unplanned displacement of the system
  - Any loss of generation due to shadow by new buildings or objects in the future
- **Insurance Cover:** It is crucial to evaluate the project for insurance for all stages from construction to operation**.**
- **Penalty for Underperformance:** The loan repayment is based on an estimated revenue earned based on certain estimated performance of the rooftop system. A benchmark will be agreed on minimum guaranteed performance with a penalty for under performance. For example, a benchmark Capacity Utilization Factor (CUF) can be defined in the contract and penalties for underperformance.
- **Delay in Administrative Approvals such as Receipts:** This may also have a significant impact on loan repayment. It is important to evaluate whether the contract has standard procedures and timelines defined for the administrative documentation and respective transactions. An effective contract will have penalties for such delays as well.
- **Damages or Breakdown in Rooftop System:** This may also have an impact on loan repayment. Hence the remedies for the same should also be integrated into the contract. Change in regulations is beyond the control of the developer and any additional cost incurred due to changes in regulations shall be paid by the consumer.

Risk of Default

The event of default and the respective remedies on the accounts of both seller and purchaser will be covered in the contract.

- **Consumer Default –** The occurrence of default on consumer side will not be limited to but cover the following:
  - How many months of delay after the credit period will be considered as default?
  - For non-availability of synchronizing power, what percent of operating hours lost is considered as default?
  - For non-availability of access to roof, what percent of days in a year is considered as default?
  - In case of temporary non-availability of roof, what period of non-availability of roof is considered as default?
  - In case of damage of major equipment caused by consumer, to what extent of damage leads to termination?

- **Seller/RESCO Default** – The occurrence of default on seller/RESCO side will not be limited to but cover the following:
  - How many months of non-availability of solar plant will be considered default?
  - How many years of not achieving minimum guaranteed (Benchmark) CUF leads to default?
  - Are there any pre mature termination clauses?
  - What will be the impact of pre-mature termination on project feasibility?
  - What is the compensation for pre mature termination?
  - Are there any other termination clauses?
  - What will be the impact of pre-mature termination on project feasibility?

- **Risk of Non-indemnity –** Indemnified clause is included to indemnify, hold harmless and defend the parties to the agreement from and against any and all loss and/or damages. The situation where the indemnity clause is applicable will be clearly defined. For a fair agreement it is important to assess that indemnity clauses adequately indemnify both the parties.

- **Dispute Resolution –** The dispute resolution process will be clearly laid out in the agreement with the appointment of authorities to resolve the dispute. The arbitration process will also be clearly defined in case the dispute is not resolved in the given period.

- **Buyout –** In case the buyout condition is included in the contract, the contract will also clearly define the circumstances situations where the Buyout Clause will be invoked and the price at which the buyout will be undertaken.

FORM 11 – APPRAISAL BY BANK OFFICER

Please refer "Stage 3- Elec. Cost(Officer)", "Stage 3- PPA Tariff(Officer)" and "Stage 3- TL(by Officer)" form in the tool

Following tabs are used by Bank Officer to conduct the appraisal and provide its data in Stage 3. The forms are kept same as Stage 2 with additional data fields to be filled by the Bank officer as shown in the figure 21.

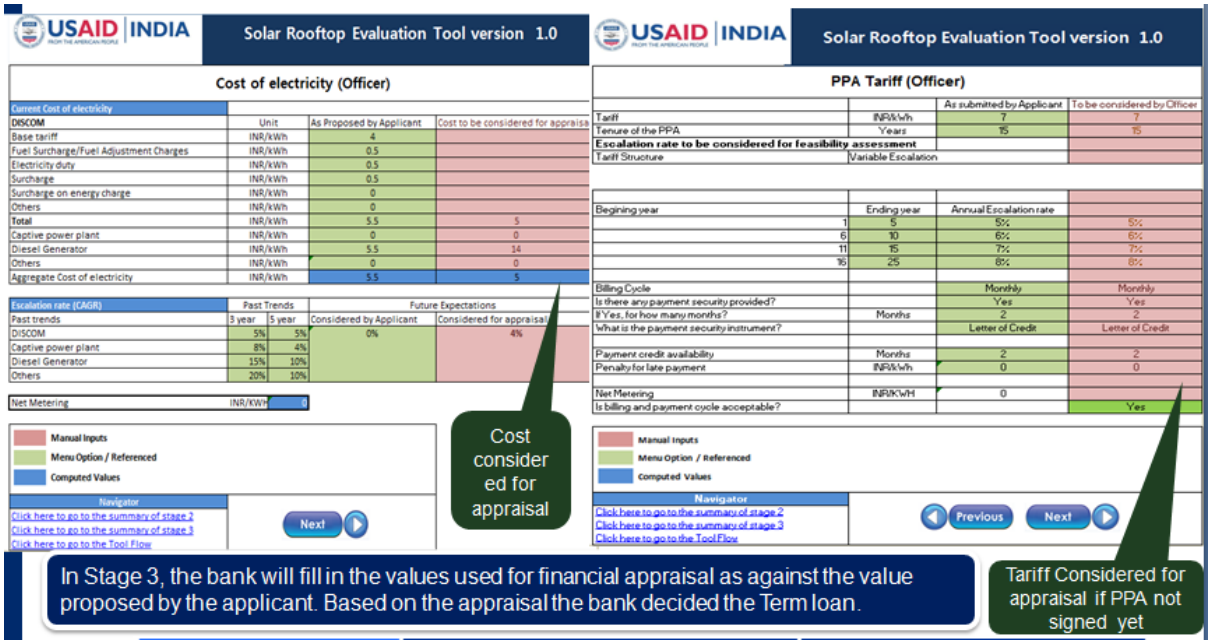


Figure - Appraisal by Officer at Stage 3 of the tool

The term loan is not indicated in above screenshot which also undergo an appraisal by the Bank officer.

FORM 12 – SUMMARY REPORTS

Please refer "Stage 1 -Eligibility Criteria", "Summary- Stage 2" and "Summary- Stage 3" tab in the tool

Overview of the Screenshot – Summary Reports at various stages

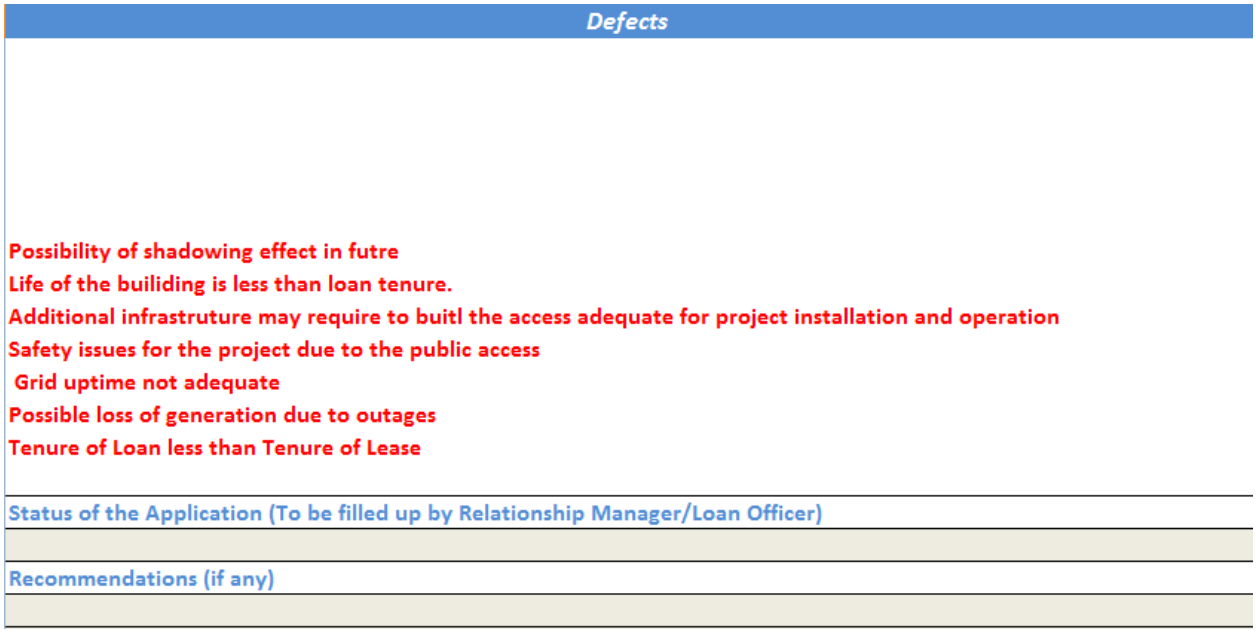


Figure - Findings at Stage 1- Evaluating Eligibility

Based on the data filled in the summary sheet, the following flags are raised as "Defects" at the end of the sheet as shown in figure 22. These findings provide a qualitative framework for enabling the bank/FIs to proceed further to Stage 2.

1. Whether Net Metering regulations are available or not in the state where the proposed[8] project is to be located?
3. Whether the interconnection process has been defined in the state where the proposed project is located?
4. Whether the vendor for the proposed project has been identified? The project, at the very initial stages of planning, may not have sufficient information for financial closure if the vendor has not been identified.
5. What is the possibility of the shadowing effect in the future due to buildings coming up in the vicinity of the site?
6. Whether the rooftop as well as the structural strength of the building will be adequate to cover the loan tenure?
7. Whether the rooftop has adequate access infrastructure for solar installation and operation? Will it require additional infrastructure to build access for project installation and operation?

[8] Proposed project- For which the loan is applied

8. What are the safety issues for the project if the project has public access?
9. Whether Grid uptime is less and whether it is less than 95 percent[9]?
10. What is the possible loss of generation due to outages in the absence of alternate source of synchronizing voltage?
11. Whether the PPA has been signed or not?
12. Is the tenure of loan less than tenure of lease?

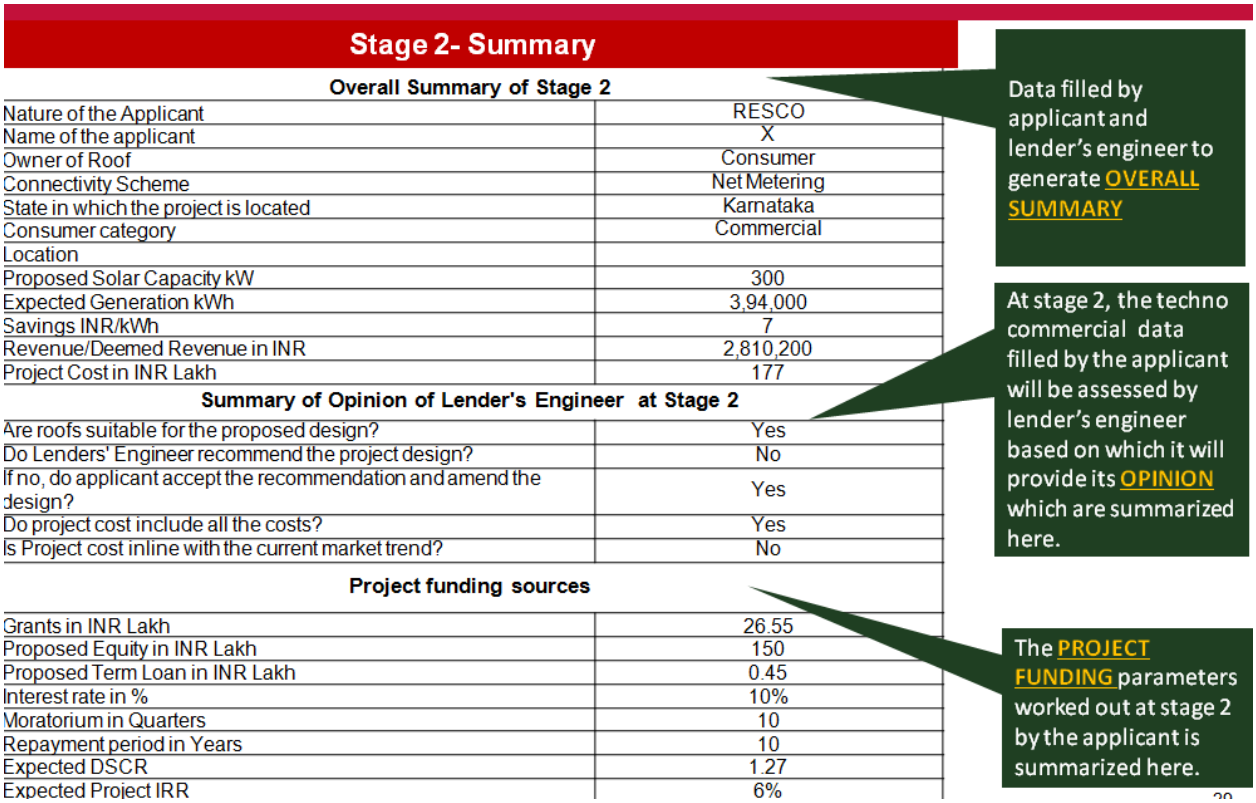
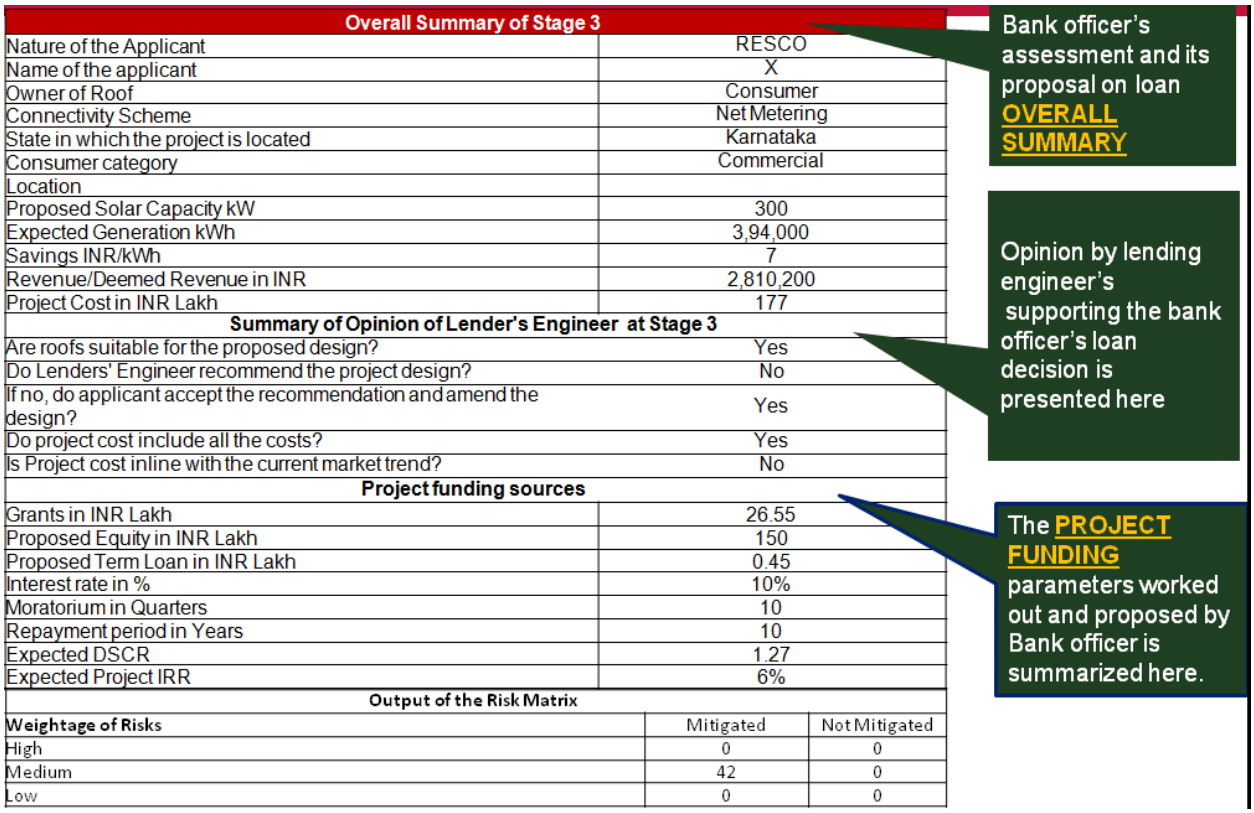


Figure - Summary of Stage 2

Stage 2 summary comprises of proposal of the Applicant and the opinion of the Lender's Engineer on the proposal as shown in the figure 23.

9 Minimum Grid uptime considered in tool is 95%. It can be customized by the banks/FIs



Overall Summary of Stage 3	
Nature of the Applicant	RESCO
Name of the applicant	X
Owner of Roof	Consumer
Connectivity Scheme	Net Metering
State in which the project is located	Karnataka
Consumer category	Commercial
Location	
Proposed Solar Capacity kW	300
Expected Generation kWh	3,94,000
Savings INR/kWh	7
Revenue/Deemed Revenue in INR	2,810,200
Project Cost in INR Lakh	177
Summary of Opinion of Lender's Engineer at Stage 3	
Are roofs suitable for the proposed design?	Yes
Do Lenders' Engineer recommend the project design?	No
If no, do applicant accept the recommendation and amend the design?	Yes
Do project cost include all the costs?	Yes
Is Project cost inline with the current market trend?	No
Project funding sources	
Grants in INR Lakh	26.55
Proposed Equity in INR Lakh	150
Proposed Term Loan in INR Lakh	0.45
Interest rate in %	10%
Moratorium in Quarters	10
Repayment period in Years	10
Expected DSCR	1.27
Expected Project IRR	6%

Output of the Risk Matrix		
Weightage of Risks	Mitigated	Not Mitigated
High	0	0
Medium	42	0
Low	0	0

Figure - Summary of Stage 3

The summary of Stage 3 comprises (a) the appraisal by Lender on the proposal of the applicant, (b) lending conditions based on the output of the Risk analysis and (c) recommendation of Lender's Engineer as shown in the figure 24.

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