Criteria for rating solar power projects

Executive Summary

Solar power projects depend primarily on solar radiation - also called insolation - to generate electricity. As a result, they have lower fuel availability risk than conventional sources of power generation. Moreover, solar power is emerging as a major source of power in the renewable energy space because of policy push from the government and rapid decline in capital cost.

Solar power projects face risks that are unique such as radiation variation, technology, solar panel quality, and counterparty payment. Since electricity generation is primarily dependent on solar radiation, the business is exposed to nature's vagaries. However, unlike wind, solar radiation varies relatively little year to year, and displays relatively less seasonality in a year. There are significant technology risks in solar power projects because, barring some exceptions, both technologies and manufacturers are new, rapidly evolving, and often owned by relatively new companies with moderate-to-weak credit quality.

Counterparty payment risk pertains to payment delays by state power distribution companies (discoms). CRISIL believes that solar power projects can mitigate these risks by maintaining adequate debt service coverage ratio (DSCR) and liquidity buffer. CRISIL's analysis of solar power projects takes into account all the risks that impact their credit quality and the risk-mitigating initiatives adopted by sponsors. The analysis also factors in the risk of power purchase agreement (PPA) renewal and considers the benefits of portfolio diversity.

Scope

Here we discuss the risks that utility-scale solar power projects are exposed to, and the rating methodology that CRISIL has adopted in assessing their credit quality.

Methodology

CRISIL's framework for assessing the rating of a solar power project is indicated in *Chart 1.* This methodology is similar to any other project finance assessment.

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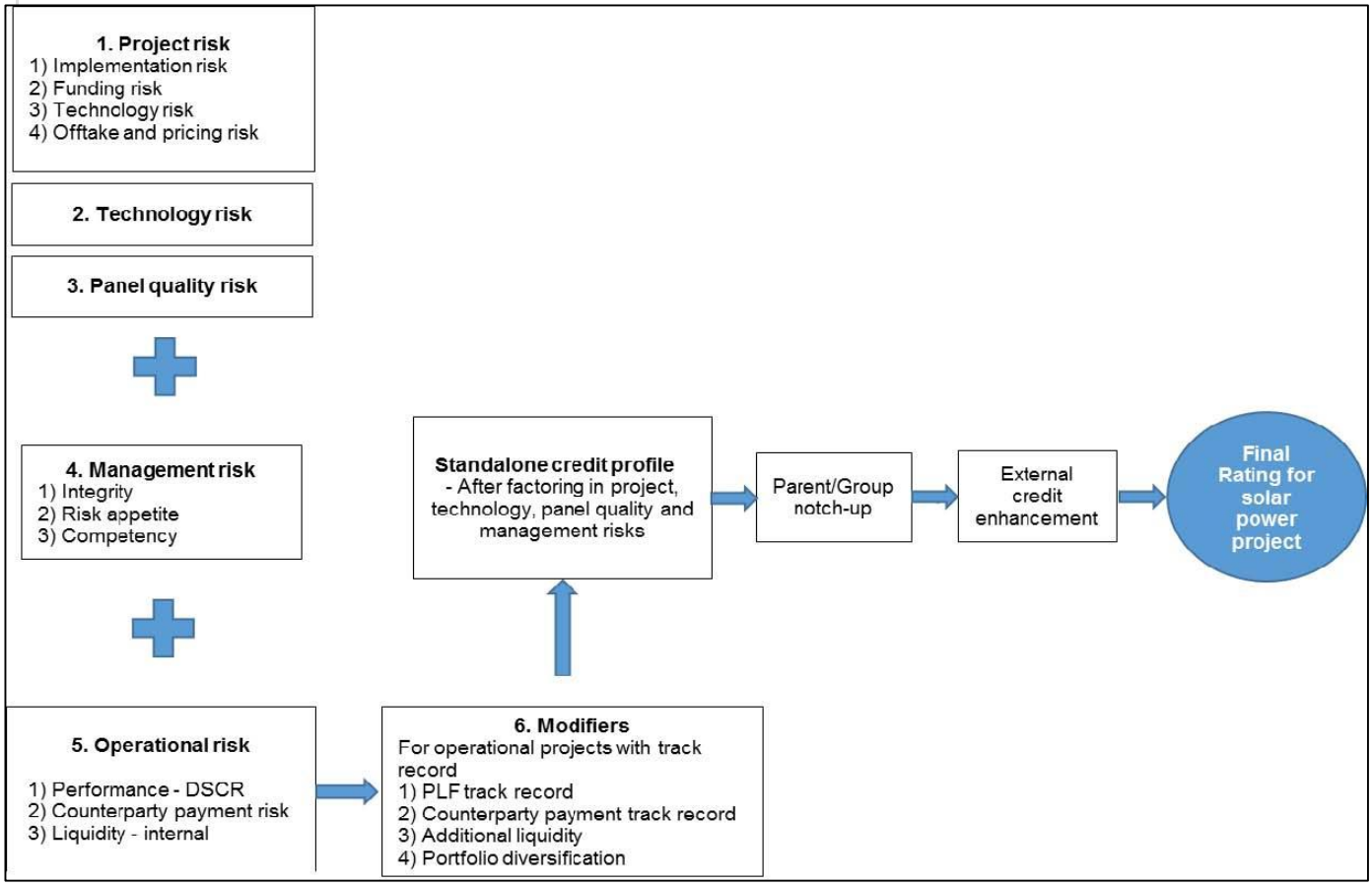
Chart 1: Framework for rating solar projects



1. Project risk

For solar power projects that are under implementation and yet to enter the operational phase, the rating has to consider project risks (*see Table 1*):

Table 1: Factors to assess project risk

Key project risks	Explanation
Implementation risk	Implementation risks are fewer for solar power projects. However, land availability and power evacuation because of delays in commissioning of transmission lines could be a major hindrance to timely completion of projects.
Funding risk	Availability of funding - both debt and equity - is critical for timely completion of the project
Offtake and pricing risk	Power purchase agreement with a distribution company or captive power consumers reduces the market risk once the solar power project is commissioned.

Solar power projects are relatively less challenging to set up than coal-fired ones. Hence, during implementation, solar projects may have a rating of 'BBB-' provided the sponsor has a track record of timely completion of projects, and subject to CRISIL's assessment of the project's post-implementation debt-servicing ability and liquidity. However, due to risks associated with implementation and stabilisation of projects, it is likely that the rating will be no higher than 'BBB-' for projects in the implementation or stabilisation phase.

Solar power projects face stabilisation risks after construction is complete. It is only when the operations have stabilised that the operational metrics may be tested for base-case assumptions. The stabilisation phase may vary from one year to a maximum of two years. Since the stabilisation phase may throw up surprises in terms of plant load factor (PLF) and payment track record, the rating is unlikely to be higher than 'BBB-'.

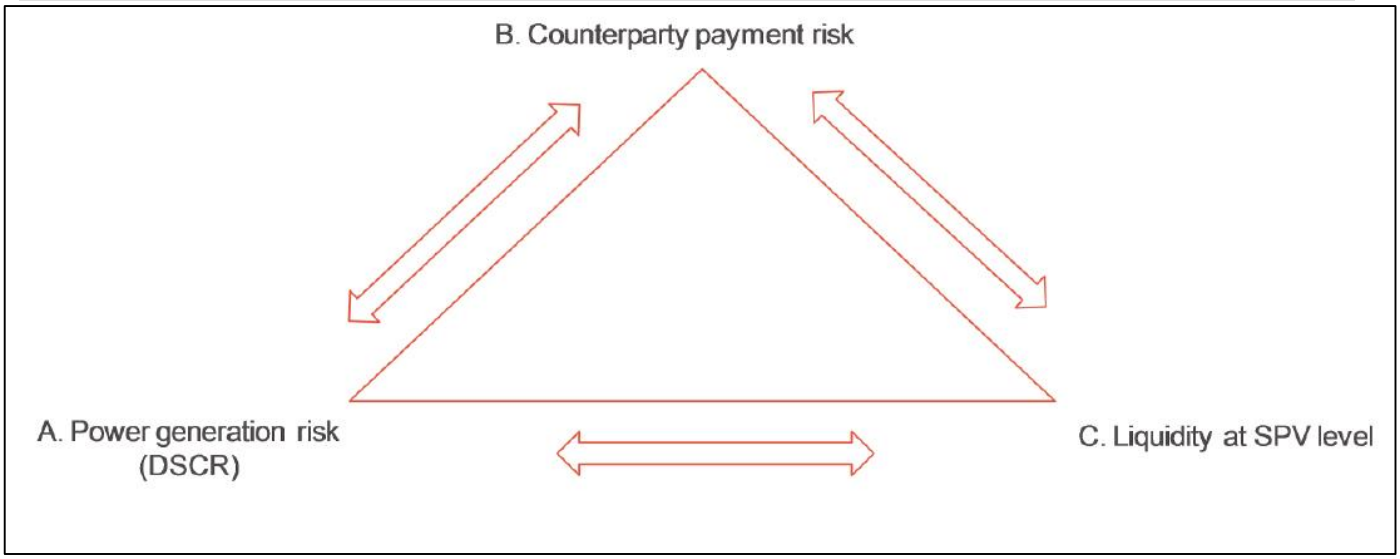
2. Management risk

CRISIL's evaluation involves assessment of the management in three broad categories: integrity, risk appetite and competency. *For details, please refer to CRISIL's article, '*Rating Criteria for Manufacturing Companies' *available on www.crisil.com.*

3. Operational risk

Operational solar power projects primarily face power generation risk and counterparty payment risk. These are mitigated by adequate liquidity and DSCR.

Chart 2: Framework for capturing operational risks



a. Power generation risk:

A solar power project SPV (special purpose vehicle) will depend on cash flows generated by the asset for debt servicing. The cash flows will, in turn, depend on electricity generated because of solar radiation. Variability in solar radiation may be inter- or intra-annual.

Inter-annual variations: Solar radiation may vary from year to year, though not as significantly as wind speeds. These variations are less than half of what is witnessed in wind[1]. The inter-annual variability of solar power projects, measured by standard deviation, is typically less than 2-3% at a P50 PLF of 19-22%. CRISIL believes that inter-annual variation risk can be largely mitigated by projecting power generation at a PLF of P90 in the base case to arrive at the appropriate DSCRs and rating levels.

Annual seasonality: Solar radiation also displays seasonality, peaking in summer and declining

[1] Refer: www.crisil.com/Ratings/SectorMethodology/MethodologyDocs/V3-Wind-power-criteria-July-8.pdf

in monsoon. However, the seasonality, at least in Indian conditions, is typically less than half of what's seen for wind. The lean season for solar power typically is 3-4 months compared with 6-7 months for wind. (*See section,* "*How does seasonality risk differ between solar and wind projects*?") CRISIL believes that SPVs may mitigate the impact of variability in power generated by maintaining liquidity buffers or by retaining surplus cash generated during peak season for making up the deficit in the lean season.

b. Technology risks

Technology risk is an important credit rating factor for solar PV projects because, barring some exceptions, technologies are evolving/changing. Those used to convert solar radiation to electricity have varying track record of efficiency and degradation rates. *(See box, 'What is degradation in solar panels?)*

Crystalline silicon technology has a long and established track record in capturing solar radiation. It has been operational for quite some time and deployed in a number of utility-scale projects globally. Thin-film technologies (CIGS, CdTe and amorphous), in comparison, do not have such a proven track record. The quality of thin-film technology and its manufacturing process varies between manufacturers. Hence, for thin-film technologies, the reputation of the vendor and credibility of its technology and manufacturing process will play a critical role in determining technology risk. Unproven technologies with moderate reputation and lower track record may be capped at a particular rating category despite higher DSCR and liquidity levels. That's because unproven technology can result in steep degradation and dramatic equipment failures.

c. Panel quality risk:

Solar panel quality also varies by manufacturer. Even with the same manufacturer, the quality of the panel may vary significantly across specifications. For instance, a reputed solar manufacturer may have 30 products across 20 different price points. Solar project developers will try to optimise between quality, price and panel-supplier reputation because of pricing pressure spawned by competitive bidding.

CRISIL analyses the factors given below to assess equipment quality risk. Management interaction and reports by third-party consultants *(part of the project report)* will play a key role in the assessment of these factors. The project rating may be constrained because of concerns over panel quality risk. But this could be offset if satisfactory empirical evidence proves that the panel quality is not detrimental to performance.

What is degradation in solar panels?

Solar panels convert solar radiation into electrical energy. This ability to convert one form of energy into another witnesses a steady and irreversible decline over a period of time. This may involve either a cell or parts of a module or both. The ability to accurately predict power delivery over time is vital to assess the credit profile of a project.

The thumb rule in the industry is ~0.75% system degradation per annum. That translates into 10% degradation over 10 years and 20% over 25 years. Anything significantly more is considered a risk to cash generating ability and, by extension, debt servicing ability. Degradation depends on many factors such as technology, panel quality and maintenance.

How does seasonality risk differ between solar and wind projects?

The table below highlights energy generated by typical solar and wind projects operating in India. In wind projects, nearly 60% of the energy is generated in just 4 months, while in solar projects, the generation is more spread out -- close to 55% in 6 months. Hence, for a solar power project, liquidity required to mitigate the seasonality risk is much lower.

	Solar	Wind
Jan	7%	6%
Feb	8%	5%
Mar	9%	5%
Apr	9%	17%
May	9%	15%
Jun	9%	12%
Jul	8%	12%
Aug	8%	5%
Sep	9%	4%
Oct	8%	5%
Nov	7%	8%
Dec	7%	5%
	100%	100%

i) Reputation of the mod

ii) Module supplier: The reputation of the module supplier is driven by track record, bankability, scale of orders executed, order backlog and technological excellence. The landscape of solar panel suppliers is rapidly evolving with new companies setting up shop, and several others exiting due to weak credit profile. Financial distress at the time of supplying panels to a rated solar power project may result in the supplier compromising on quality leading to low quality of a project. In addition, it is the manufacturer's credit quality that backs the warranties on panels.

iii) **Design quality:** Design quality is primarily driven by type and combination of materials used to build the module. Because of pricing pressure, panel makers may buy cells from cheaper producers and assemble them into panels. Not only cells, the quality of other components such as glass, back-sheet, module junction box and cable connectors could also be compromised. International standards governed by IEC also help in representing a minimum threshold to predict reliability.

iv) Manufacturing quality: Manufacturing quality is primarily driven by the process followed. This can vary from factory to factory, especially in a scenario when many panel manufacturers outsource their module supplies. Hence it is important for a project

developer to look closely at the materials and control quality during production by keeping tab on the process from raw material supply to the finished module.

v) **EPC quality:** Although construction complexity in the case of solar projects is much lower than thermal projects, quality of construction may vary significantly from one EPC player to another. Hence, the reputation of EPC players, their track record, expertise in the industry and bankability are critical when assessing the quality of a project.

vi) **Warranty and insurance:**
Manufacturers of solar panels extend warranties that run for 20 or more years. This provides business certainty and assures project developers performance up to 90% for 10 years and 80% for another 15 years. If panels degrade more and affect project cash flows, the manufacturer will fulfil the warranty by supplying additional panels that will enable achievement of the performance originally warrantied. However, if a manufacturer has shut shop, the warranty is of limited use. To overcome the credit risk in warranty, suppliers back their warranties with third-party insurance. It is critical to understand the nature of such insurance and the extent to which they compensate any material failure in performance warrantied by the panel manufacturer. Modules from other equipment suppliers can be made compatible after minor engineering modifications, which, however, may come at a cost. Similar to panel suppliers, EPC players also provide performance guarantee for 2 years and workmanship guarantee for 5 years.

d. Counterparty payment risk:

Solar power projects also face customer payment risk. They usually have PPAs with discoms or captive consumers. While PPAs tend to reduce the demand risk, operational solar power projects continue to face counterparty payment risk. Even if the SPV generates adequate power and supplies it to a buyer, any delay in payment by the buyer can significantly impact the SPV's credit quality. And payment risks vary from buyer to buyer.

The payment risk is, however, not the same as the counterparty's credit quality. Often, state discoms with weak credit risk profiles continue to make payments to power generation companies, albeit with delays. That's because discoms may get support from their state governments. Some discoms have a better payment track record for their purchases of renewable power.

CRISIL believes that operational solar projects are exposed to risks because of delays in payment by discoms. CRISIL has assessed state discoms based on their payment behaviour over the past few years along with other factors *(see Table 2)* and classified them into payment risk categories 1 to 6.

Table 2: Approach to assess discoms' payment risk category

Risk factor	Aspects analysed
Business profile	• Track record of recent tariff hikes • Aggregate technical and commercial losses • Profit gap (in rupees per unit on subsidy booked basis)

Financial profile	• Networth • Debt • Loss levels
State government ability to support	• Release of subsidy • State government rating
Payment track record	• Payment track record over the last few years

e. Liquidity at the SPV level:

CRISIL believes that maintaining adequate liquidity at the SPV level is critical to mitigate counterparty payment risk and seasonality. The more the delay from counterparties, the higher will be the liquidity that the SPV needs to maintain in order to mitigate counterparty payment risk. Also, seasonality deficit in a typical project is about 2 months of debt servicing.

CRISIL's rating approach factors in solar resource variation and payment risks appropriately and the ratings will vary based on DSCR and liquidity maintained by the SPV. CRISIL uses different levels of DSCRs along with liquidity buffer for various rating categories. The liquidity requirement varies with counterparty risk and extent of seasonality in the project. For example, for a solar power project with DSCR of 1.15 times, counterparty of 'Payment Risk Category 2', and project level liquidity of 4 months, the standalone rating would be 'CRISIL BBB'. Given the sector's inherent risks, and the economic considerations where the developer may want to generate reasonable returns on investment, project DSCRs and liquidity are unlikely to be maintained at a substantially higher level.

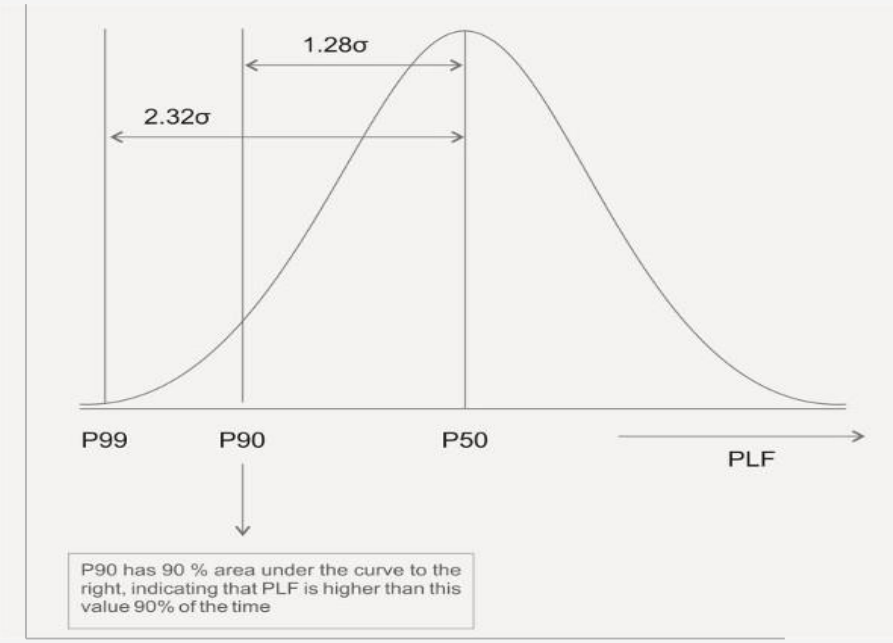
4. Modifiers

There are other project-specific modifiers that may also impact the SPV's credit quality. CRISIL assesses each of these and factors it into the credit evaluation.

a) ***PLF track record:*** CRISIL considers a P90 PLF[2] for projects to arrive at DSCR. Thus it is expected that the average annual PLF will be greater than the P90 PLF in 9 out of 10 years. However, if the project has a PLF track record that is much weaker — for instance, if its output has been at a sub-P90 level for 2-3 years — it could indicate either degradation is faster or solar radiation is not as per expectation. This will constrain the cash generating ability and thereby the rating of the solar power project. On the other hand, if the PLF in the first few years is materially higher than P90 levels - for instance, if it ranges between P50 and P75—it is still consistent with the expected power curve. If a new study indicates that the new P90 PLF is higher than the one assumed earlier, CRISIL will use the new P90 PLF in its assessment.

Why use P90 PLF levels to calculate DSCR?

In the case of solar projects, output is dependent on solar radiation, which is an exogenous factor and subject to variation. This uncertainty is offset by assigning probability to different PLF levels. Based on meteorological and ground-level data, solar radiation at a given site may be assessed. These may be combined with the panel's power output curve to arrive at the expected average annual PLF, which may termed as P50. As can be seen from the following chart, there is equal probability that the PLF in a given year may be higher or lower than P50. On the other hand, P90 is the PLF level that a solar panel is 90% likely to exceed in a given year.



[2] Please refer Crisil's wind criteria to understand why P90 PLF is considered for renewable projects based on wind and solar
www.crisil.com/Ratings/SectorMethodology/MethodologyDocs/V3-Wind-power-criteria-July-8.pdf

In the early years of a solar panel, there may be estimation errors and/or sharp deviations in actual energy output compared with estimates through studies. These may crop up because of errors in solar radiation assessment, which is a combination of meteorological satellite data and ground-level data. Furthermore, quality of air due to pollution and suspended air particles can alter solar radiation reaching the panel.

The standard deviation for PLF estimation is typically in the range of 2-3% with a P50 value of 20%. Hence, the variation in PLF in solar may not be very high compared with say a wind project where the variation is high at 4-6%. However, to factor in estimation error and resource variability risk, CRISIL uses the P90 level of annual PLF when calculating DSCR. Also, in international experience, solar power estimates are made using P90 PLFs. Global credit rating agencies such as Standard & Poor's use P90 PLFs in their base-case scenarios and P99 PLFs in their stress case scenarios.

b) ***Payment track record:*** CRISIL has categorised payment risk of the counterparty based on which a base-case assumption of likely payment delay is assumed. However, if the observed payment pattern for specific solar projects is materially different from the base-case assumption for a substantial period of time, this will be taken into account while arriving at the rating.

c) ***Liquidity at the parent level:*** The liquidity requirement for mitigating the seasonality-related resource deficit and payment risk should be available at a project level. However, if the SPV's parent has a policy of maintaining liquidity buffer on its balance sheet for addressing any cash flow mismatches at various SPVs it has sponsored, CRISIL also takes this into account when assessing the rating of SPVs.

d) ***Portfolio diversification:*** CRISIL believes that portfolio diversification through geographical and counterparty diversification leads to reduction in risk. Solar farms spread across locations and supplying to different counterparties tend to reduce the risks related to resource variation and counterparty payment. CRISIL notches up the rating of an SPV if it has greater stability in cash flows on account of portfolio diversification.

e) ***PPA tenure and renewal risk*****:** If the PPA tenure is lower than the tenure of debt, the SPV will be exposed to pricing risk. So the lesser the tenure of the PPA compared with the debt tenure, the greater will be the risk.

Also, if the PPA is priced close to or is lower than the prevailing market rate, renewal risk is low. On the other hand, if current tariff considerably exceeds the prevailing market rate, the project will be exposed to renewal risk once the PPA expires. Therefore, the higher the current tariff is over the market rate, the greater is the project's risk exposure.

Also, the liability structure could be such that the entire principal is not amortised over the tenure of the debt, leading to a large bullet payment at the end of the tenure. This exposes the project to refinancing risk. CRISIL will assess these aspects and adequately factor in the risk when arriving at the rating of the solar power project.

The above methodology, which includes assessment of project risk, management risk and operational risk along with other modifiers impacting the credit quality of the solar power project, is used to arrive at the standalone rating of the SPV. Additionally, CRISIL may also consider parent/group support or any other external credit enhancement mechanisms to arrive at the final rating of debt instruments of the SPV.

Conclusion

CRISIL's rating methodology for solar power projects involves extensive analysis of all the risk factors pertaining to solar power projects. The analysis focuses primarily on the adequacy and stability of cash flows for debt servicing. The rating methodology also takes into account risk mitigation initiatives the SPV has set in place for factors that impact cash flow adequacy and stability. In addition, CRISIL may also factor in parent/ group support or external credit enhancements in the form of guarantees (partial or full) when assigning credit ratings. The criteria for parent/group support and for evaluating partial guarantee instruments are covered under other articles on the CRISIL website.

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About CRISIL Ratings

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