CRISIL’s criteria for rating solar power projects

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Executive summary

Solar power is emerging as a major segment in the renewable energy space because of the push from the government and the rapid decline in capital cost. Solar power projects depend on solar radiation, also called insolation, to generate electricity, and face lower fuel availability risk than conventional sources of power.

Solar power projects face risks such as variation in radiation levels, new technology, solar panel quality, and counterparty payment risk. While vulnerable to climatic changes, the inter-annual variability in solar radiation, unlike wind speed, is relatively low. There are significant technology risks involved in solar power projects because, barring some exceptions such as crystalline silicon, the technology is new, evolving rapidly, and often owned by companies with moderate-to-weak credit quality.

Counterparty payment risk pertains to the risk of delays in payment by state power distribution companies (discoms). CRISIL believes solar power projects can mitigate this risk 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 the sponsors. The analysis also factors in the risk related to renewal of power purchase agreement (PPA) and considers the benefits of portfolio diversity.

Scope

This criteria¹ document covers the risks that solar power projects face, and the rating methodology CRISIL follows for assessing their credit quality.

¹ Link to previous criteria: https://www.crisil.com/content/dam/crisil/criteria_methodology/energy/Criteria_for_rating_solar_power_projects.pdf
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.

**Chart 1: Framework for rating solar projects**

- **Project risk**
  - Implementation risk
  - Funding risk
  - Off-take and pricing risk

- **Technology risk**

- **Panel Quality risk**

- **Management risk**
  - Integrity
  - Risk appetite
  - Competency

- **Operational risk**
  - Performance-DSCR
  - Counterparty payment risk
  - Liquidity-internal
  - Competency

- **Modifiers**
  For operational projects with track record
  - PLF track record
  - Counterparty payment track record
  - Additional liquidity
  - Portfolio diversification

- **Standalone credit profile**

- **Parent/Group notch-up**

- **External credit enhancement**

- **Final rating for solar**
Project risk

For solar power projects under implementation and yet to enter the operational phase, project risk (see Table 1) plays a detrimental role in arriving at the standalone credit rating.

Table 1: Factors to assess project risk

<table>
<thead>
<tr>
<th>Key project risks</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation risk</td>
<td>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.</td>
</tr>
<tr>
<td>Funding risk</td>
<td>Availability of funding, both debt and equity, is critical for timely completion of the project.</td>
</tr>
<tr>
<td>Offtake and pricing risk</td>
<td>PPA with a distribution company or captive power consumers reduces the market risk once the solar power project is commissioned.</td>
</tr>
</tbody>
</table>

Solar power projects are relatively less challenging to set up than thermal power plants and have an established track record of timely completion. The projects are still exposed to risks like land availability, presence of evacuation infrastructure etc. which can play detrimental role in its debt servicing. Nevertheless, these risks are usually lower for projects set up in solar parks and the same is factored in its credit rating.

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 to two years.

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.

Operational risk

Operational solar power projects primarily face generation and counterparty payment risks, which can be mitigated through adequate liquidity and DSCR.
a. Power generation risk:

A solar power project SPV (special purpose vehicle) will depend on cash flow generated by the asset for servicing debt. The cash flow will depend on electricity generated, which is vulnerable to inter- or intra-annual variability in solar radiation.

**Inter-annual variation:** Solar radiation may vary from year to year, though not as significantly as wind speed (variations are less than half of that in wind speed²). CRISIL believes the 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 DSCR and rating.

**Annual seasonality:** Solar radiation is seasonal, peaking in summer and declining in monsoon. However, the seasonality, at least in Indian conditions, is typically less than half of that for wind. The lean season for solar power typically is of 3-4 months compared with 6-7 months for wind. (See section, ‘How does seasonality risk differ between solar and wind projects?’). CRISIL believes solar power SPVs may mitigate the impact of variability in power generation by maintaining liquidity buffer or by retaining surplus cash generated during the peak season to cover the deficit in the lean season.

b. Technology risk:

Technology risk is an important credit rating factor for solar PV projects because the technology is still evolving. Various technologies have varying track record of efficiency and degradation. (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 some time and deployed in several utility-scale projects globally. Thin-film technologies (CIGS, CdTe, and amorphous) do not have such a proven track record. The quality of thin-films and the production process varies among manufacturers. Hence, for thin-film technologies, the reputation of the vendor and the credibility of the manufacturer would be critical factors.
technology and manufacturing process will play a critical role in determining technology risk. Unproven technologies with moderate reputation and limited track record face more risks such as steep degradation and dramatic equipment failure. These risks are factored in while arriving at the credit rating.

c. Panel quality risk:

The quality of solar panels varies among manufacturers. Even for the same manufacturer, the quality may vary significantly across specifications. For instance, a reputed solar manufacturer may have 30 products across 20 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 regarding panel quality. 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. The ability to do so declines steadily and irreversibly over time. The degradation may be in 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 risk 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, to 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.

<table>
<thead>
<tr>
<th>Months</th>
<th>Solar</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Feb</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Mar</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Apr</td>
<td>9%</td>
<td>17%</td>
</tr>
<tr>
<td>May</td>
<td>9%</td>
<td>15%</td>
</tr>
<tr>
<td>Jun</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>Jul</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Aug</td>
<td>8%</td>
<td>5%</td>
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<tr>
<td>Sep</td>
<td>9%</td>
<td>4%</td>
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<tr>
<td>Oct</td>
<td>8%</td>
<td>5%</td>
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<tr>
<td>Nov</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Dec</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
i. **Reputation of the module supplier**: The reputation of the module supplier depends on track record, bankability, scale of orders executed, order backlog and technological capability. The landscape of solar panel suppliers is constantly changing with new companies setting up shop and several exiting due to weak credit risk 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 the project. In addition, it is the manufacturer’s credit quality that backs the warranties on panels.

ii. **Design quality**: Design quality is driven by the type and combination of materials used to build the module. Because of pricing pressure, panel makers may buy cheaper cells 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 help in representing a minimum threshold to predict reliability.

iii. **Manufacturing quality**: Manufacturing quality is driven by the process followed. This can vary from factory to factory, especially in a scenario when many panel manufacturers outsource production of modules. Hence, it is important for a project developer to look closely at the materials and control quality during production by keeping a tab on the process, from raw material supply to the finished module.

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

v. **Warranty and insurance**: Manufacturers of solar panels extend warranties of 20 years or more. 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 flow, 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. Like panel suppliers, EPC players also provide performance guarantee for 2 years and workmanship guarantee for 5 years.

d. **Counterparty risk**:

Solar power projects 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 to a buyer, any delay in payment by the buyer can significantly impact the SPV’s credit quality. Payment risk varies from buyer to buyer.

The payment risk is 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 the respective state government. Some discoms have a better payment track record for their purchases of renewable power.

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 the payment risk category

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Aspects analysed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business profile</strong></td>
<td>• Track record of recent increases in tariff</td>
</tr>
<tr>
<td></td>
<td>• Aggregate technical and commercial losses</td>
</tr>
<tr>
<td></td>
<td>• Profit gap (in rupees per unit on subsidy booked basis)</td>
</tr>
<tr>
<td><strong>Financial profile</strong></td>
<td>• Networth</td>
</tr>
<tr>
<td></td>
<td>• Debt</td>
</tr>
<tr>
<td></td>
<td>• Losses</td>
</tr>
<tr>
<td><strong>State government’s ability to support</strong></td>
<td>• Release of subsidy</td>
</tr>
<tr>
<td></td>
<td>• State government rating</td>
</tr>
<tr>
<td><strong>Payment track record</strong></td>
<td>• Payment track record in the past few years</td>
</tr>
</tbody>
</table>

e. Liquidity at SPV level

CRISIL believes 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 to mitigate counterparty payment risk. Also, seasonal deficit in a typical project is about 2 months of debt obligation.

CRISIL’s rating approach factors in variation in solar radiation and payment risk appropriately. The rating depends on the DSCR and liquidity maintained by the SPV. The liquidity requirement varies with counterparty risk and extent of seasonality in the project. Given the sector’s inherent risks, and the economic considerations where the developer may want to generate reasonable returns on investment, project DSCR and liquidity are unlikely to be maintained at a substantially high level.

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.

i. PLF track record: CRISIL considers a P90 PLF for projects to arrive at the 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 output has been at a sub-P90 level for 2-3 years—it could indicate either faster degradation or less-than-expected solar radiation. 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 the P90 level—for instance, if it is 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?

The output of solar projects depends on solar radiation, which is an exogenous factor and is variable. The resultant 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, which may be combined with the panel’s power output curve to arrive at the expected average annual PLF, which may be termed as P50. As can be seen from the following chart, there is equal probability that the PLF in a given year is 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.

In the early years of a solar panel, there may be estimation errors or sharp deviation 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 2-3% with a P50 value of 20%. Hence, the variation in PLF in a solar project may not be very high compared with say a wind project where the variation is 4-6%. However, to factor in estimation error and resource variability risk, CRISIL uses the P90 level of annual PLF when calculating DSCR. Also, internationally, solar power estimates are made using P90 PLF.

ii. Payment track record: CRISIL has categorised counterparty payment risk based on which a base-case assumption of likely payment delay is made. 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.

iii. Liquidity at the parent level: The liquidity requirement for mitigating the seasonality and payment risks 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 cash flow mismatches at the SPVs it has sponsored, CRISIL takes this into account when rating the SPVs.

iv. **Portfolio diversification:** CRISIL believes 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 impact of risks related to resource variation and counterparty payment. CRISIL notches up the rating of an SPV if it has greater stability in cash flow on account of portfolio diversification.

v. **PPA tenure and renewal risk:** If the PPA tenure is less than the debt tenure, the SPV will face 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 lower than the prevailing market rate, renewal risk is low. On the other hand, if the current tariff considerably exceeds the prevailing market rate, the project will be exposed to renewal risk once the PPA expires. 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 mechanism to arrive at the final rating on debt instruments of the SPV.

**Conclusion**

CRISIL’s rating methodology for solar power projects involves extensive analysis of all the pertinent risk factors. The analysis focuses on the adequacy and stability of cash flow for debt servicing, and considers the risk mitigation initiatives the SPV has set in place for factors that impact cash flow adequacy and stability. In addition, CRISIL may factor in parent/group support or external credit enhancement 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.
About CRISIL Limited

CRISIL is a leading, agile and innovative global analytics company driven by its mission of making markets function better. It is India’s foremost provider of ratings, data, research, analytics and solutions, with a strong track record of growth, culture of innovation and global footprint.

It has delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers.

It is majority owned by S&P Global Inc, a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide.

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