MOODY'S
INVESTORS SERVICE

RATING METHODOLOGY

Production-Dependent Solar Contract Securitizations Methodology

Table of Contents:

Analyst Contacts:

NEW YORK	+1.212.553.1653
Tracy Rice *Vice President – Senior Credit Officer* tracy.rice@moodys.com	+1.212.553.4115
Benjamin Shih *Vice President – Senior Credit Officer* benjamin.shih@moodys.com	+1.212.553.2923
Pedro Sancholuz Ruda *Vice President – Senior Analyst* pedro.sancholuzruda@moodys.com	+1.212.553.1668
SINGAPORE	**+65.6398.8308**
Dipanshu Rustagi *Assistant Vice President - Analyst* dipanshu.rustagi@moodys.com	+65.6311.2605

» contacts continued on the second to last page

CLIENT SERVICES:

New York:	+1.212.553.1653
Tokyo:	+81.3.5408.4100
London:	+44.20.7772.5454
Hong Kong:	+852.3551.3077
Sydney:	+612.9270.8100
Singapore:	+65.6398.8308

This rating methodology replaces *Production-Dependent Solar Contract Securitizations Methodology* published in April 2020. We have clarified the description of how we determine our current trend oil price assumption. The update does not change the substantive approach of the methodology.

Scope

In this methodology, we describe our global approach to rating asset-backed securities (ABS) backed primarily by distributed generation[1] solar photovoltaic (PV) systems and related lease or power purchase agreement (PPA) contracts in which payments depend on the level of solar power produced by the systems. The ABS generally are designed to be repaid through payments made by residential and/or non-residential (commercial, industrial, municipal or small utility or "CIMU") obligors under the solar contracts. Solar developer companies typically originate and service the contracts, install and manage the PV systems and sponsor the ABS.[2]

The approach is largely based on our observations around typical pools of solar PV systems and related contracts, and the state of the distributed generation solar industry in the US and Singapore. The two countries represent different approaches for how utility rates and solar contract prices are set. In the US, utility rates are not benchmarked to energy prices. Instead, regulators set utility rates based on the utility's cost of service plus an authorized rate of equity return determined by the regulators. Solar contracts in the US are typically not anchored to utility rates although we expect solar obligors to use utility rates as a benchmark to assess economic savings from their solar contracts and may seek to modify the economic terms of their solar contracts if dissatisfied with the level of savings. In Singapore, utility rates are driven primarily by changes in energy prices, and solar contracts are generally anchored at a discount to the utility rate. The distributed generation solar industry continues to develop across the globe. As we receive information on these developments from other jurisdictions, we will review and revise our approach if necessary, to reflect those developments.

1 Distributed generation refers to electricity that is produced at or near the point where it is used. Distributed solar generation systems can be located on rooftops or ground-mounted and are typically connected to the local utility distribution grid. Solar obligors that receive distributed solar energy typically include residential, commercial, industrial, and municipal customers as well as small utilities.

2 The stochastic solar power production assumptions differ from those used for solar-related project finance transactions, for which we generally assume a stressed production level rather than a distribution. We do this because project finance transactions typically relate to only one or a few large and discrete assets, thus making it less important to analyze the correlation in production across assets. For more information, see our approach to rating power generation projects. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

Loans and leases that are structured with payments and risks that mimic PPAs are covered under this methodology. For ABS transactions backed by loans and leases that have payments that are not tied to power production, we will generally apply our methodologies related to consumer loans, SME loans, equipment loans and leases, or others, as applicable.[3]

Rating Approach

Asset Overview

Solar ABS are backed primarily by distributed generation solar PV systems and related loan, lease or PPAs. Depending on the jurisdiction, the contracts usually have terms of 10 to 25 years. Leases and PPAs often have renewal options at the end of the contract term. The obligors under these contracts make payments to the solar developer companies that originate the contract and typically sponsor the ABS. Solar developers install and/or maintain solar PV systems for residential and/or non-residential CIMU obligors that generate electricity typically for the obligors' consumption. Solar developers often act as managers responsible for servicing the solar contracts and performing operations and maintenance (O&M) of the solar power systems, including maintenance, monitoring and repairs of the systems on behalf of the securitization.

PPA obligors generally pay a price per kilowatt-hour (kWh) of electricity that the solar PV system produces. The price may vary based on a periodic escalator. PPA payments over a period are a function of the solar contract price and the amount of solar energy produced in the period. In some PPAs the price is fixed at a discount to the obligor's electric utility rate, subject to a floor, a cap, or both. In other PPAs, the price is linked to the applicable wholesale rate.

Lease obligors, on the other hand, pay a fixed monthly installment regardless of the actual solar power generated, and the installment normally rises based on a periodic price escalator. Solar developers usually guarantee a minimum level of solar power generation, with leases often subject to periodic true-up payments for over- or under-production. The true-up feature in leases makes them resemble PPAs in some respects.

Solar customers can also finance the purchase of their own solar PV systems under loan or lease contracts with no ties to power production.

Key Risks

The key risks for solar ABS transactions are (1) variability in solar power production, (2) variability in solar payments due to future contract modifications and/or change in solar prices, (3) obligor defaults, and (4) operations and maintenance risks.

Solar Power Production

Variations in power production affect transaction cash flows because solar contract revenues often depend on the amount of electricity that the systems produce. Solar power production could fall short of expectation because of variability in solar irradiation, system degradation, or the quality of the solar panels or other system components.

[3] For more information, see our methodologies for rating transactions backed by consumer loans, SME loans and equipment loans. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

Solar Payments

Cash flows in solar ABS transactions may vary (1) if obligors seek to increase or restore savings relative to utility rates by modifying their contracts to lower their monthly payments, or (2) if solar prices are linked to underlying drivers such as utility rates, wholesale rates or energy prices (such as oil prices) that can vary.

Obligors' savings from their solar contracts may decrease over time as a result of changes in utility regulations that increase the costs of solar power. In addition, the savings from existing contracts relative to new contracts may decrease over time owing to technological changes that lower prices on new solar contracts but not on existing contracts. We expect obligors who have the means to pay their electricity bills but are dissatisfied with the savings from their solar contracts to be more likely to want to modify their contracts than to default. While the sale of the property or dissatisfaction with savings are not conditions typically identified in solar contracts as circumstances that allow for contract modification, we believe such modifications may nevertheless be granted if transaction managers view contract modification to be more economical than to remove the solar panels or sue the obligors for failure to pay. The risk of contract modification may be more pronounced when an obligor sells their property, or their property is foreclosed upon, as the solar developer may need to renegotiate solar contract prices and increase savings to provide the buyer of the property with an incentive to assume[4] the existing contract or sign a new contract.

Obligor Defaults

Solar ABS cash flows can be impaired due to the inability of underlying obligors, whether residential or non-residential, to make their contract payments. The extent of this risk depends on the credit quality of the obligors, the likelihood that the obligors would prioritize electricity bills over other payments in financial distress, whether contracts may be reassigned when properties are sold or foreclosed upon, as well as the likelihood of a non-residential obligor reorganizing instead of liquidating in a bankruptcy scenario.

Operations and Maintenance Risks

The transaction manager is often responsible for providing ongoing operations and maintenance (O&M) services for the solar power systems, in addition to billing and collections services. The failure of a manager could result in higher transaction fees needed to retain the existing manager if possible or attract a successor manager, as well as payment delays or reductions due to lower solar production and obligor complaints.

As with all rating methodologies, in applying this methodology, where appropriate, we consider all factors that we deem relevant to our analysis. In addition to these quantitative assessments, our rating committees also consider various qualitative factors in their analysis. If, for instance, actual performance or performance trends are not in line with the assumptions described in this methodology, we may consider or reflect that in our analysis. The model outputs derived by our quantitative modeling are important considerations in our rating committee process. However, the ratings assigned by the rating committee incorporate a variety of qualitative factors and may differ from the model output.

Asset-level Analysis and Related Modeling

Solar Asset Analysis Framework

This section describes the factors we consider in our projection of the asset cash flows, summarized in Exhibit 1. Appendix A to this report describes indicative assumptions in modeling solar ABS transactions.

4 An assumable contract is one that allows a new buyer of a property to take over the current owner's existing solar contract with lender approval if necessary.

Appendix B and C provide indicative assumptions and modeling approaches used for US and Singapore, respectively.

EXHIBIT 1

Solar Asset Analysis Framework

Solar Power Production	
»	Our model of solar power production reflects variability in irradiation, the quality of the solar system components, and the degradation of the equipment's capability over time.
»	We take into account the Independent Engineer's production estimates (including degradation) and the manager's historical data on actual production compared to expected.
Solar Payments	
»	We assess the impact of regulatory changes that may affect the savings that obligors receive from their solar contracts, as well as technological advances that may decrease the savings from existing contracts relative to new contracts.
»	If solar contract prices are linked to a specific utility rate, wholesale rate or energy price, we may simulate the underlying variables directly.
Obligor Defaults	
»	We assume that obligors will default on solar contract payments (as opposed to modify) for reasons of financial distress only, because of the essential nature of electricity, and because it is often more economical for solar developers to modify contracts rather than remove solar systems or sue customers for failure to pay.
»	We model defaults by obligors under financial distress considering the credit quality of obligors, historical default rates on utility bills, and the originator's historical default data.
Operations and Maintenance Risks	
»	In our analysis, we consider the likelihood of a manager's failure to perform O&M services and its impact on the cash flows to the ABS transaction.
»	Upon a manager default, we may assume delays or reductions in collections and/or an increase in manager fees to retain a manager that has reorganized or attract a successor manager.

Source: Moody's Investors Service

Solar Power Production

For solar contracts in which payments depend on the amount of power produced from each PV system, we simulate future power production. We generally assume that power production is normally distributed with a median equal to the Independent Engineer's (IE) one-year P50 production estimate (the IE's estimate of median production)[5] and, when available, a 10^{th} percentile equal to the IE's one-year P90 production estimate.[6] IE reports are typically provided in connection with ABS deals.

IE's production estimates typically include adjustments for solar system degradation. If the IE's estimate for power production is not adjusted for system degradation, we lower our estimate of power production at each point in time, based on degradation rate estimates provided by the IE. To do this, we first calculate "degradation-adjusted" median production levels at each point in time by lowering the median production level by the median degradation rate. For example, the degradation-adjusted median production level in year "t" would be given by:

FORMULA 1

$$\begin{aligned} &\mathit{Degradation\ Adjusted\ Median\ Production}(t) \\ &\qquad = \mathit{Median\ Production}\ \times (1 - \mathit{Median\ Degradation\ Rate})^t \end{aligned}$$

Source: Moody's Investors Service

[5] P50 refers to the 50^{th} percentile, in this case meaning that there is a 50% probability that the actual solar power production will exceed this level.

[6] If the P90 estimate is not available, we will make a conservative assumption.

Next, we lower the 10^{th} percentile of the production distribution by the IE's P90 degradation rate. For example, the degradation-adjusted 10^{th} percentile of production in year "t" would be given by:

FORMULA 2

$$\begin{aligned} &Degradation\ Adjusted\ 10^{th}\ Percentile\ of\ Production(t) \\ &\qquad = 10^{th}\ Percentile\ of\ Production\ \times (1 - P90\ Degradation\ Rate)^t \end{aligned}$$

Source: Moody's Investors Service

We then calibrate normal distributions at each point in time to these degradation-adjusted median and 10^{th} percentile estimates. In cases where the IE does not provide degradation rate estimates, we will apply a conservative degradation rate assumption based on previously observed estimates.

We generally assume production is perfectly correlated over time and across contracts. For example, in our simulation if we draw the 20^{th} percentile from the production distribution for a particular contract on day zero, we assume we draw the 20^{th} percentile from the production distribution of all other contracts and for all future time points. Our calibration of the degradation-adjusted production distribution also implies a high negative correlation between power production levels and degradation rates, because we pair the 10^{th} percentile of the production distribution with the IE's P90 degradation rate and the median level of the production distribution with the IE's median degradation rate. Negatively correlated production and degradation levels lead to paths with more extreme drops in production levels than would otherwise have been observed. This is meant to capture the risk of a sharp decrease in production due to a batch of panels from a given manufacturer being found to be defective.

We may make qualitative adjustments to the estimates provided by the IE based on the type and quality of data that the IE provides on the solar PV systems in the pool, including solar power production estimates and system degradation rates. When possible, we will look at production data from comparable areas to assess production and degradation estimates provided by the IE and make adjustments to these estimates where appropriate. We are likely to lower production or increase degradation estimates for pools in which panels and components are produced by lower-quality manufacturers or by those with little or no track record and where we believe the IE's production and degradation estimates do not take this into account. We may also adjust production and degradation estimates in instances where the solar developer has contracted with a third-party installer to install the solar panels. We would base our adjustments on factors including the policies and procedures the solar developer has in place to vet third-party service providers and the track record of such providers when available.

We may further adjust our simulation assumptions regarding solar power production and degradation rates depending on the manager's historical data on actual production. Depending on the track record of the transaction manager, we may apply an additional haircut to energy production to account for the risk that PV systems may be offline for a certain period and unable to produce power. To evaluate this risk, we examine the manager's ability, experience and expertise in monitoring and maintaining PV systems as well as the length of time the manager has been performing such tasks, in part by using the manager's historical O&M performance metrics.

In some cases, lease obligors may pay a fixed installment per month regardless of the actual solar power generated. Solar developers nevertheless usually guarantee a level of production, with leases usually subject to periodic true-up payments for over- or under-production[7] that make the leases resemble PPAs in some respects. For such leases, we assume that the transaction receives cash flows net of true-up payments in cases where the solar power system under-produces power. We would generally provide benefit up to the

7 Over- or under-production is relative to the guaranteed level of production.

P50 level (on a cumulative basis over the life of the contract) for contracts that include netting provisions for system production. If there are no such netting provisions, we will evaluate the benefit on a case-by-case basis by analyzing the originator's historical collections from obligors as a result of overproduction and the provisions of the contractual production guarantees. Without such historical data and without contractual netting provisions, in the case of overproduction, we would typically assume that true-up payments required from the obligor to the transaction are not requested by the manager.[8]

We generally assume all contracts expire at the earlier of the end of the useful life of the panels or the maturity dates of the contracts. IE reports typically provide assessments for the useful life of solar panels and their replacement costs. Typically, contract lives are shorter than the useful lives of solar panels.

Solar Payments

Solar Payments: Utility Rates

In this section we describe our framework for modeling utility rates in two different regimes: one where utility rates are driven primarily by regulation and the other where utility rates are driven primarily by energy prices.

UTILITY RATES DRIVEN PRIMARILY BY REGULATION

For countries such as the US, where utility rates are not benchmarked to energy prices and where regulators set utility rates based on the utility's cost of service plus an authorized rate of equity return determined by the regulators, we simulate utility rates as a Geometric Brownian Motion process. We estimate the growth, volatility and correlation in utility rates based on historical data by jurisdiction.[9]

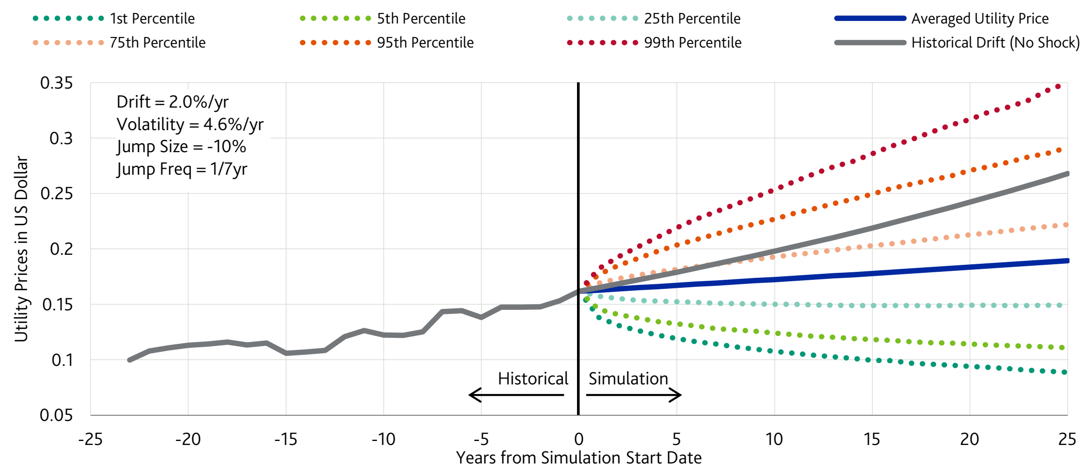
We assume the simulation process for utility rates is subject to periodic shocks from technological developments and regulatory changes. We model these shocks as a drop in utility rates resulting in a change in savings. We base our assessment of the frequency and magnitude of shocks on the recent history of regulatory changes affecting the solar industry and the impact these have had on solar savings relative to utility rates. Exhibit 2 shows an example of the simulated utility rate distribution for California.

[8] We believe managers are unlikely to request obligors to make true-up payments for over-production even if permitted under the contract.

[9] The term "jurisdiction" is used throughout this report to describe for example a state or country.

EXHIBIT 2

Sample Utility Rate Simulation Distribution for California



Note: Simulation parameters are based on historical utility data between 1990 and 2015 and on our assessment of the frequency and magnitude of relevant regulatory shocks. We may revise our estimates for these parameters as necessary to reflect future market developments.

Sources: US Energy Information Administration, Moody's Investors Service

We allow shocks to be correlated across jurisdictions. We assume higher correlations across jurisdictions that may share technological innovations or have a history of coordinating energy-related regulatory policies.

UTILITY RATES DRIVEN PRIMARILY BY ENERGY PRICES

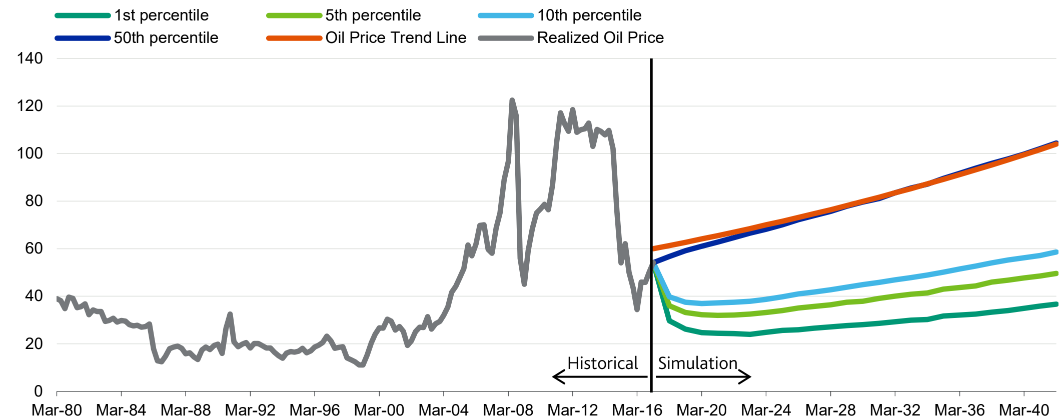
In countries where utility rates are benchmarked to or strongly correlated with an energy price rather than being based on a price set by regulators, we typically simulate the energy price directly and convert it into the utility rate. If no explicit conversion formula is available, we base our adjustment on the historical relationship between the energy price and the utility rate, though we may make adjustments to the estimated historical relationship if we anticipate any structural change in that relationship going forward.

For example, in Singapore where utility rates are driven primarily by changes in oil prices, we model the oil price as a stochastic error-correction process around a trend price level. Our current trend oil price assumption is based on historical data and our view on the equilibrium price for oil, which may be informed by our internal forecasts, when available, or by external forecasts from reliable third-party sources such as the World Bank, the International Monetary Fund and the US Energy Information Administration. Once this starting point has been determined, we typically expect the trend energy price to grow at the rate of long-term inflation,[10] i.e., we assume no real long-term growth in oil prices. We model incremental deviations from the trend price as being distributed as a Geometric Brownian Motion process with zero mean and a variance based on historical data. We use historical data to model the rate at which the market price returns to the trend price. Exhibit 3 shows an example of the simulated oil price distribution.

[10] We form our long-term view of inflation by taking our US Consumer Price Index (CPI) forecast for five years, assuming the growth rate in year five applies for the next five years and then averaging across all 10 years.

EXHIBIT 3

Sample Simulation of Oil Prices



Sources: Federal Reserve Economic Data: St. Louis Fed, Moody's Investors Service

Furthermore, some solar PPAs reference a wholesale rate rather than the utility rate. We typically simulate wholesale rates based on their historical relationship with energy price and/or with utility rate. In the case of Singapore, we model a spread between wholesale rate and utility rate. In Singapore, some solar contracts are linked to retail rates[11] and modeled by adding grid charges to the wholesale rate.

Solar Payments: Contract Modifications

Obligors who have the means to pay their electricity bills but are unwilling to pay because they are dissatisfied with the savings from their solar contracts relative to utility rates are likely to attempt to modify the economic terms of their contracts. At the same time, we believe that it is generally more economical for transaction managers, who typically are the solar developers, to allow obligors to renegotiate the economic terms of their contracts rather than remove the solar panels or sue the obligors for failure to pay. Contract modifications will reduce solar payments and therefore the cash flows to the ABS transactions. Contract modifications are more likely in cases where solar contracts are not anchored to utility rates than in cases where solar contracts are set at a fixed discount to utility rates.

We model solar contract savings as the difference between the simulated utility rate (as described above) and the projected solar contract price, which depends on the initial solar price and the periodic price escalator rate, if any.

Since electricity usage typically accounts for a relatively small share of an obligor's monthly expenses, we do not expect obligors to renegotiate contracts the moment savings become negative. Instead, we assume the level of negative savings is about as much as the initial savings first obtained from the solar contract before obligors decide to renegotiate. For example, if the solar contract initially provided savings of 10% relative to the prevailing utility rates, we generally model obligors as renegotiating only when the solar price is 10% above the utility rate, and then to a new solar contract price that is again 10% below the utility rate.

If the sponsor does not provide us contract-level or pool-level initial savings rates, we generally assume that obligors' initial savings rates are positively related to their periodic price escalators. A given level of solar savings can be achieved by pairing a high initial savings rate with a high annual price escalator or a low initial savings rate with a low annual price escalator. As such, we expect obligors' initial savings rates and periodic price escalators to be positively related.

[11] Retail rates are offered by electricity retailers to customers under a customized contract.

Our assumptions regarding the timing and degree of contract modification may differ by obligor type. We expect contract modification risk to be generally greater for CIMU obligors who, in comparison with residential obligors, are likely to have greater bargaining power and more resources to monitor the savings from their solar power contracts. To set contract modification threshold assumptions, we would look at a CIMU customer's type, size, industry, the willingness of the solar developer to renegotiate, and past renegotiation history of CIMU customers with respect to the solar developer where available.

Regulatory changes introduced after solar contracts have been struck may reduce the savings obligors may have initially expected from their solar contracts. Regulatory changes in a specific jurisdiction may also introduce differences in tariff structures and expected savings for solar customers in that jurisdiction depending on their contract start dates. We expect to receive contract-level information regarding the location and utility company of obligors, and date of origination of the solar contract. We would use this information to assess the impact of regulatory changes on solar savings and make adjustments to solar cash flows accordingly.

Our assumptions on the extent of contract modifications may be informed by the transaction sponsor's historical contract renegotiation data when available, any limitations on modifications in the securitization documents and/or any bondholder consent requirements.

Although contract modifications are likely to be less extensive in cases where solar contracts are set at a fixed discount to utility rates, some modifications may still occur in cases where contractual floors limit the drop in solar prices. In such circumstances, we expect obligors to renegotiate rates with the transaction manager to ensure that savings are not negative.

Solar Payments: Cash Flows from Performance-Based Incentives and Solar Renewable Energy Certificates

The securitized assets in a solar ABS transaction may include revenue from programs that encourage the installation of solar PV systems and the use of solar-generated electricity. For example, some US lease and/or PPA transactions include performance-based incentives (PBIs) or Solar Renewable Energy Certificates (SRECs).

PBI obligors,[12] usually utilities or state or local governmental authorities, make periodic PBI payments to the owners of solar PV systems based on how much electricity the solar power system produces for a certain period. Payment periods generally range from 5 to 20 years. Generally, PBI payments are based on a fixed fee per kWh of solar power produced, established either under state legislation or regulations or by state utility commissions.

SRECs exist in US states that have Renewable Portfolio Standard legislation with specific requirements for solar power. These states provide SRECs to an owner of a solar power system depending on the amount of electricity the system produces.[13] System owners can sell SRECs to utilities and other energy suppliers that are required to produce a certain portion of their electricity through renewable sources. Utilities and other energy suppliers sometimes enter into forward contracts with PV system owners to purchase SRECs from the system owners at a fixed price. Contract terms are generally two to four years in length. We assign value to SRECs that the issuer has contracted to sell based in part on the credit quality of the purchaser of the SRECs and the strength of the payment obligation stipulated by the forward contracts.

[12] PBI obligors maintain or administer renewable energy programs designed to incentivize the installation of PV systems and use of solar-generated electricity and have approved, and are obligated to make, PBI payments to the owner of the related PV system.

[13] System owners receive one SREC for one megawatt hour of electricity produced by their systems.

We assume little to no revenue from SRECs that the issuer has not contracted to sell as of transaction closing because the spot market price of SRECs is subject to supply and demand constraints and can be highly volatile.

Obligor Defaults

We assume that an obligor will default on its solar contract payment (as opposed to modify or renegotiate the payment) for reasons of financial distress only. Given the essential nature of electricity to businesses and households, we assume that there will be no selective or "strategic" default on the solar contract. We model residential and non-residential defaults separately.

Residential Obligor Defaults

We base our residential obligor default assumptions on historical data from residential defaults on utility bills, historical data from the default performance of the obligors of the originator's managed portfolio or existing securitizations, or both, if available, and the average credit quality of the pool of obligors, as available. We base our assessment of the recovery on defaulted contracts on historical utility bill recovery rates and recovery rates on solar contracts of borrowers in distressed scenarios, such as short sales and foreclosures.

Non-Residential Obligor Defaults

We simulate solar contract defaults by initial CIMU obligors, including PBI and SREC obligors, using a model that accounts for each entity's default probability and for correlations among entities, based on their industries and regions. We use a correlation approach that is consistent with the approach we use to evaluate other non-granular pools of corporate or sub-sovereign obligors.[14] We use the CIMU obligor's rating or credit estimate, or assume a rating based on the nature of the borrower and the applicable rating methodology to infer a probability of default for the obligor.[15] In the absence of any specific information about the obligor we may assume a low speculative-grade rating. For granular pools, we may base default assessments on the average credit quality of the pool, CIMU customer default rates on utility bills, and on the historical data from the default performance of the obligors of the originator's managed portfolio or existing securitizations, or both, if available, over a sufficiently long period, including a period of economic stress.

Upon a CIMU default, the manager may be able to generate recoveries on defaulted CIMU contracts by operating the solar PV system and selling the electricity wholesale until claims on the contract are settled or the contract is reassigned, if possible. If we determine that the manager has the experience and capability to sell the electricity wholesale and the contractual right to access the property, we generally assume that the manager will sell the electricity wholesale at a discount to the utility rate after an initial delay.[16] We assume the contract will generate no cash flow during the initial delay period.

The initial period of delay and the period of time for which electricity is sold wholesale would generally depend on factors including the contractual rights of the manager to access the solar assets, the original obligor type (e.g. corporate vs. municipal), the property type, quality, and geographic location, the ability of the manager to sell electricity wholesale, and the length of time it would take for claims to be settled or the contract to be reassigned if possible. We base our assessment of the discount at which electricity is sold wholesale, in part, on historical experience on the difference between utility rate and wholesale prices.

[14] More specifically, our approach is consistent with the CDOROM™ framework used to evaluate pools of corporate credit in corporate synthetic obligations (CSOs).

[15] For more information, see our cross-sector methodology on the use of credit estimates in structured finance. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[16] We would also need to assess the ability of a successor manager to sell electricity wholesale in the event of a manager default.

We would typically assume that upon an initial CIMU obligor default, the solar contract is renegotiated with the same obligor or a new obligor, if possible, at terms more favorable to the obligor. We assume that renegotiated terms are similar in both cases. For contracts where reassignment is not possible, we would assess the likelihood of the obligor liquidating instead of reorganizing. For contracts where liquidation is likely and that do not allow for reassignment, we may assume renegotiated terms that are consistent with recovery on an unsecured claim in bankruptcy. For all other contracts, we may assume the renegotiated initial savings rate and escalator rate are towards the more conservative end (i.e. terms that are more favorable to the obligor) of the observed ranges for these contract features. We would typically assume the contract is modified to its renegotiated initial savings rate applied to the lower of the prevailing utility rate and the solar price.

We model solar contract defaults by initial CIMU obligors only and would apply conservative contract modification assumptions to capture losses in revenue from future defaults. For example, after default, we may assume future contract modifications on the contract occur each time the solar price reaches the utility rate.

For PBI and SREC obligor recoveries we would apply a haircut to the PBI or SREC revenue stream, depending on contract details and obligor type.

In jurisdictions like Singapore, where a backstop agreement might exist with the local utility, we typically assume after initial default solar power is sold to the local utility (e.g. Singapore Power [SP]) at a haircut to the utility rate less grid charges.

Operations and Maintenance Risks[17]

The strength of an ABS transaction backed by solar power contracts depends on the effective ongoing performance of transaction parties, such as the transaction manager, the transition manager and the trustee. Solar ABS transaction managers are often responsible for the ongoing monitoring and O&M of the solar power systems owned by the issuer. Solar ABS transaction managers are often also responsible for servicing the solar contracts and collecting payments as well as submitting and processing payments. Our approach for assessing O&M risks and payment disruption are discussed below.

Manager Default Probability

The transaction manager is often responsible for ongoing maintenance, repair, and monitoring of the solar PV systems owned by the issuer. The default of the transaction manager could delay or reduce cash flows available to the transaction. Poor maintenance quality can also cause power production to fall and affect cash flows to the transactions.

In our assessment of the probability of a manager defaulting on its O&M obligations, we use its rating or credit estimate, if available. If no rating or credit estimate is available, we assume a default probability consistent with a low speculative-grade rating. We would also consider the likelihood of the manager reorganizing instead of liquidating in a bankruptcy scenario.[18]

Impact of Manager Default

We typically assume managers that reorganize can continue to perform their O&M responsibilities while those that liquidate cannot. Reorganization may, however, result in the manager being temporarily unable

17 For more information, see our methodology detailing additional rating considerations specific to operational and counterparty risks. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

18 Our assessment of an unrated manager's credit quality may also depend on legislative or regulatory changes that make solar power more or less profitable. Lower tax incentives and rebates for solar power would give companies and obligors less incentive to invest in solar power, affecting the financial performance of the solar developers that manage the transactions.

to meet its O&M obligations fully. Upon manager liquidation a weaker successor manager may also be less responsive to fix system problems and may lack sufficient resources to perform maintenance on the PV systems in a timely manner.

We may apply delays in revenue collection that could stem from a disruption in the O&M of the solar power systems or a haircut to solar power production levels (and, therefore, to contract payments) resulting from weaker performance of the reorganizing or successor manager or to account for the risk that systems may be offline for a certain period and unable to produce power. Upon liquidation, depending on the manager or the back-up manager arrangement, higher manager fees (including O&M fees) may be necessary to attract a successor manager. Higher manager fees may also be necessary if post reorganization the manager seeks to renegotiate its contract to bring it up to market assessed levels. In making these adjustments, we will assess, for example, the following elements: (1) historical O&M performance of the manager, (2) financial stability of the manager (credit quality, evidenced e.g. by rating or credit estimate), (3) monitoring processes in place to detect system outages, (4) downtime of the solar power system before the manager is able to make it operational again, (5) number of O&M staff compared with system growth, and (6) the presence and nature of any back-up manager arrangements.

We may also apply an additional haircut to contract payments for CIMU contracts that allow obligors to suspend or offset payments resulting from a material breach by the manager of its O&M performance obligations under the contracts.

In addition to impacting O&M services as described above, the default of the manager may result in disruptions to servicing and collection activities, leading to reduced transaction cash flows.[19]

Structural Analysis and Liability Modeling

Cash Flows and Credit Enhancement

For each simulated path of the underlying collateral cash flows, we calculate the cash flows available to investors to determine the extent of any investor loss. We calculate the average bond loss across all simulations and compare that average to our Idealized Expected Loss tables at each rating level to determine a model output.[20] The model outputs derived by our quantitative modeling are important considerations in our rating committee process. However, the ratings assigned by the rating committee incorporate a variety of qualitative factors, including operational and legal risks.

The bond losses in any scenario will depend on the transaction's credit enhancement. High levels of credit enhancement can compensate for uncertainty in cash flows over the life of the transaction. Credit enhancement can include overcollateralization, subordination of junior bonds, reserve accounts and excess spread.

Other structural features can mitigate some of the risks specific to solar ABS transactions. Inverter replacement reserves can fund timely replacement of inverters.[21] Replaceable inverter components may have a useful life shorter than the typical length of a solar contract. We base our assumptions for the useful life of inverters on information provided by the IE in connection with the transaction, the type of inverter, the manufacturer of the inverter, the length of the inverter's warranty when available, and historical data

19 For more information, see our cross-sector methodology for assessing counterparty risks in structured finance, including operational risks and commingling risk. A link to a list of our sector and cross-sector methodologies can found in the "Moody's Related Publications" section.

20 For more information, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions*, (a link can be found in the "Moody's Related Publications" section) and in the "Loss Benchmarks" section.

21 Inverters are essential components that convert the DC electrical power generated by the solar panels into AC power that can be consumed by the obligor or sent into the electric grid.

provided by the sponsor. We assess the size of the inverter replacement reserve in terms of its adequacy for replacing inverters as needed over the life of the transaction. We may review IE assessments of the inverter replacement plan of the manager including its adequacy for maintaining reliable operations given the inverter technology used. In some cases, reserve accounts may also be used to pay for replacement costs of other system components.

An interest reserve account can mitigate risks associated with timely payment of interest on the ABS in case of any disruption in payment collection. Cash flows can be interrupted, for example, if a replacement manager needs time to take over billing, collections and/or O&M of the systems. A decline in power production, contract modifications and obligor defaults can also disrupt transaction cash flows.

Typical transaction triggers can affect bond losses by accelerating bond amortization under stress scenarios. Where triggers exist, the transaction will hasten bond amortization by diverting excess cash flows to pay principal upon the occurrence of pre-set conditions. Triggers can be based, for example, on the occurrence of an indenture default, expected maturity date, pool performance metrics, overcollateralization levels or debt service coverage ratios.

We adopt a simulation approach to model solar power production and utility rates. Our simulation approach allows for increasing uncertainty around utility rates and solar power production with the passage of time. As time goes by, the increasing volatility in power production and utility rates is likely to create more extreme losses in the model which in turn require additional enhancement to achieve a given rating level. Depending on the transaction structure and the degree of reliance on late cash flows to repay the bonds, additional enhancement may be needed in the form of subordination, over-collateralization, cash reserves, excess spread or transactional features to provide greater protection to bondholders.

For transactions that include swaps, our approach to assessing the rating impact of linkage of the transaction to any swap counterparties would be based on our cross-sector approach for assessing swaps.[22]

Loss Benchmarks

In evaluating the model output for solar ABS transactions, we select loss benchmarks referencing the Idealized Expected Loss table[23] using the Standard Asymmetric Range, in which the lower-bound of loss consistent with a given rating category is computed as an 80/20 weighted average on a logarithmic scale of the Idealized Expected Loss of the next higher rating category and the Idealized Expected Loss of the given rating category, respectively. For initial ratings and upgrade rating actions, the upper-bound of loss consistent with a given rating category is computed as an 80/20 weighted average on a logarithmic scale of the Idealized Expected Loss of the given rating category and the Idealized Expected Loss of the next lower rating category, respectively. When monitoring a rating for downgrade, the upper-bound of loss is computed as a 50/50 weighted average on a logarithmic scale. That is, the benchmark boundaries of loss appropriate for evaluating rating category R are given by:

22 For more information on our cross-sector approach to assessing swaps, a link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

23 For more information, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions*. A link can be found in the "Moody's Related Publications" section.

FORMULA 3

$$[1]\ Rating\ Lower\ Bound_R = exp\{0.8 \cdot log(Idealized\ Expected\ Loss_{R-1}) + 0.2 \cdot log(Idealized\ Expected\ Loss_R)\}$$

$$[2]\ Initial\ Rating\ Upper\ Bound_R = exp\{0.8 \cdot log(Idealized\ Expected\ Loss_R) + 0.2 \cdot log(Idealized\ Expected\ Loss_{R+1})\}$$

$$[3]\ Current\ Rating\ Upper\ Bound_R = exp\{0.5 \cdot log(Idealized\ Expected\ Loss_R) + 0.5 \cdot log(Idealized\ Expected\ Loss_{R+1})\}$$

Where:

» ***Rating Lower Bound**$_R$* means the lowest Idealized Expected Loss associated with rating ***R*** and the expected loss range of rating ***R*** is inclusive of the ***Rating Lower Bound**$_R$*.

» ***Initial Rating Upper Bound**$_R$* means the highest Idealized Expected Loss associated with rating ***R*** that is either initially assigned or upgraded and the expected loss range of rating ***R*** is exclusive of the ***Rating Upper Bound**$_R$*.

» ***Current Rating Upper Bound**$_R$* means the highest Idealized Expected Loss associated with rating ***R*** that is currently outstanding and the expected loss range of rating ***R*** is exclusive of the ***Rating Upper Bound**$_R$*.

» ***R-1*** means the rating just above ***R***.

» ***R+1*** means the rating just below ***R***.

» The Rating Lower Bound for Aaa is 0% and the Rating Upper Bound for C is 100%. These are not derived using the formula.

Source: Moody's Investors Service

Other Considerations

Tax Equity Structures

In the US, the federal investment tax credit (ITC) allows the owners of PV systems to claim a percentage of the fair market value of the system at the time of installation as a tax credit against their taxable income.[24] US sponsors that are not producing sufficient taxable income typically transfer the benefits of the ITC to third-party financiers through tax equity investment structures. One of the risks in a solar ABS transaction with a tax equity structure is that the Internal Revenue Service (IRS) could determine that the fair market value of the PV systems backing the transaction was inflated; in this scenario, the ITC would drop commensurately. The IRS could then seek to "recapture" the unvested tax credits and the tax equity investors could seek to be reimbursed ahead of bondholders. A transaction can mitigate this risk, for example, by contractually prohibiting tax equity investors from seeking indemnification from the issuer until the bonds are repaid in full or by purchasing an insurance policy from a highly rated entity that will cover tax loss payments to the tax equity investors incurred by a recapture of the unvested tax credits.

[24] Most solar systems are financed in a way that allows the tax benefits to be calculated based on the fair market value of a PV system installation rather than its actual cost.

Legal Risks

Our analysis focuses on the legal risks posed by the potential bankruptcy of the transaction sponsor, securitization vehicle, manager, collections account bank and other relevant parties.[25] We also assess consumer protection laws and regulations applicable to residential solar contracts and the sponsor. We review legal opinions at closing to further inform our views on the key legal risks identified in a transaction.

Bankruptcy of the Sponsor

Our legal analysis of the potential bankruptcy of the sponsor is an assessment of three key questions:

» Have the receivables actually been sold?

» Would the owner of the assets (the securitization trust) be substantively consolidated with the sponsor in the event of the sponsor's bankruptcy?

» Can the securitization trustee enforce its ownership or security interest in the collateral once the sponsor has filed for bankruptcy protection?

We thus assess the likelihood that the bankruptcy proceeding of a sponsor – whether voluntary or involuntary – would delay or reduce the payments on the bonds. The degree to which the securitization has protection against these risks determines the extent to which its ratings can be higher than those of the sponsor's own rating.

Consumer Protection Laws

The application of consumer protection laws to residential solar contracts could expose the originator to legal liability. For example, if residential obligors claim that originators misled them over the size of their total energy savings from their solar contracts and such claims result in lawsuits, originators could incur damages resulting from monetary penalties or could enter into settlements that force changes to their practices, reducing revenues or increasing expenses of the originator. In cases in which such results weaken the financial position of the originator – and the originator is also the manager of the ABS transaction – the credit quality of the ABS could be negatively impacted. We capture the negative impact on ABS cash flows through the credit rating of the manager and also through the potential application of increased manager fees, revenue haircuts and revenue delays as explained in the Operations and Maintenance Risks section. We also consider whether damages claims could lead to a right of set-off against the obligors' securitized lease or PPA payments. We may apply haircuts to deal cash flows based on our assessment of the right to set-off.

Monitoring

To monitor solar ABS transactions, we generally apply the key components of the approach described in this report; however, we may deemphasize those elements that become less relevant as the transaction becomes seasoned, such as our review of the legal structure. We also use transaction-specific performance data that we receive on a periodic basis to monitor the transactions.

In monitoring ABS backed by solar contracts, we use updated contract information, where available, to track the characteristics and performance of the underlying collateral. We also take into account any material changes in the industry and developments regarding the originator and transaction manager and other participants in the transaction that could significantly impact future performance, including regulatory

[25] For more information, see our methodology on bankruptcy remoteness criteria for special purpose entities in structured finance transactions. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

changes, new technologies, and developments in the distributed solar generation or electric utility industries.

In reviewing the ongoing performance of the transactions, we consider the credit enhancement level and monitor the key variables that determine the transaction's cash flow performance. For example, where available, we would consider the transaction's delinquency and default rates, contract modifications, recovery rates, and actual production compared to originally estimated production for the solar PV systems. If we detect material changes in any of these factors, we may perform an in-depth analysis and/or request additional information to determine the impact, if any, on the rating(s). That analysis may include a simulation of the transaction, using updated inputs where warranted, and a review of the outstanding transaction ratings by a rating committee.[26]

[26] For example, in methodologies where models are used, modeling is not relevant when it is determined that (1) a transaction is still revolving and performance has not changed from expectations, or (2) all tranches are at the highest achievable ratings and performance is at or better than expected performance, or (3) key model inputs are viewed as not having materially changed to the extent it would change outputs since the previous time a model was run, or (4) no new relevant information is available such that a model cannot be run in order to inform the rating, or (5) our analysis is limited to asset coverage ratios for transactions with undercollateralized tranches, or (6) a transaction has few remaining performing assets.

Appendix A: Summary of Indicative Assumptions for Solar ABS Transactions

This section describes the indicative assumptions that we apply in modeling cash flows to solar ABS transactions. Our assumptions may differ from transaction to transaction based on a number of factors:

» The type and quality of data that the transaction sponsor provides, including contract-level data such as initial solar contract price and escalator and historical collateral performance data.

» The type and quality of data that the Independent Engineer (IE) provides on the solar PV systems in the pool, including solar power production estimates, system degradation rates and inverter replacement costs. When possible, we will look at production data from other comparable areas to assess whether production and degradation estimates provided by the IE are reasonable and make adjustments to these estimates where appropriate.

» The quality and track record of panel manufacturers and their equipment - we are likely to adjust production or degradation estimates to incorporate the use of panels and components from lower-quality manufacturers with little or no track record.

» The pool's collateral characteristics, including obligor types, credit quality and jurisdictions (such as US states) where the obligors and PV systems are located, and contract types and provisions.

» Transaction structural features, including the amortization profile and tenor of the bonds, credit enhancement, collateral performance triggers, the presence of a transition manager or a back-up manager, and the tax equity structure (if applicable).

» The experience, expertise, history, and credit quality of the sponsor, originator, manager and IE.

EXHIBIT 4

Solar Power Production

Parameter	Indicative Assumption
Solar power production level (including system degradation)	Stochastic distribution calibrated to IE's one-year P50 and P90 estimates. Distributions are perfectly correlated over time and across contracts. Subject to qualitative adjustments.

Source: Moody's Investors Service

EXHIBIT 5

Solar Payments: Utility Rates Driven Primarily by Regulation

Parameter	Indicative Assumption
Initial solar price	As stated in contract.
Initial escalator rate	As stated in contract.
Future solar contract price	Appreciates at the escalator rate subject to contract modifications.
Diffusion process	We simulate utility rates as a Geometric Brownian Motion process. We estimate the growth, volatility and correlation in utility rates based on historical data across jurisdictions.
Initial utility rate and savings rate	Initial savings rate assumed to be 10%-20% of the utility rate in the absence of any other information. Initial utility rate based on the initial solar contract price and the initial savings rate.
Frequency of shocks to utility rates	May vary by jurisdiction. For example, in the US, we typically assume a negative shock once every 5-10 years on average in each state.
Shock size (i.e., change in savings)	An amount that typically corresponds to a 5%-15% drop in the obligor's prevailing utility rate.
Correlation among shocks	Shocks are assumed to be 50% correlated among states in the US. May vary by jurisdiction depending on extent to which technological innovations are shared and degree of energy policy coordination.
Wholesale electricity rates	In the US, we assume wholesale rates are 20%-50% of the prevailing utility rate.

Source: Moody's Investors Service

EXHIBIT 6

Solar Payments: Utility Rates Driven Primarily by Energy Prices

Parameter	Indicative Assumption
Initial oil price	Set to average US dollar (USD) oil price in quarter preceding closing.
Long-term equilibrium oil price	As of the date of publication of this report, our current baseline view, which is underpinned by current costs of production, is $60. This may be updated over time based on our internal forecasts, when available, and/or on external forecasts from reliable third-party sources, such as the World Bank, the International Monetary Fund and the US Energy Information Administration.
Variation in payments due to energy price movements	Sensitivity to changes in energy prices may be modeled in jurisdictions where power production costs are largely dependent on a single source of energy e.g. Singapore.
Real growth rate in long-term equilibrium trend level of USD oil prices	0% real growth in long-term equilibrium US dollar oil prices.
Nominal growth rate of long-term equilibrium trend level of USD oil prices	Forecast long-term nominal changes based on our forecasts for US CPI inflation, by computing a 10-year average; typically around 2% but could be higher or lower.
Variance in oil price changes	Calibrated to historical data.
Relationship between energy prices and benchmark utility rates	Varies by jurisdiction and determined empirically. The relationship between the USD oil price and the oil price denominated in Singapore dollars is based on our estimate of the historical relationship between the two currencies.
Wholesale electricity rates	Varies by jurisdiction and determined empirically. We assume US wholesale rates are 20%-50% of the prevailing utility rates. In the case of Singapore, we model a spread between wholesale rate and utility rate. In Singapore, some solar contracts are linked to retail rates, and modeled by adding grid charges to the wholesale rate.

Source: Moody's Investors Service

EXHIBIT 7

Solar Payments: Contract Modifications

Parameter	Indicative Assumption
Revenue losses from contract modifications	For example, in the US, we model residential contract modifications when the solar price rises above the utility rate by the initial savings rate. Contracts are assumed to be reset to the initial savings rate. Less likely to be important in jurisdictions like Singapore where contract prices are set at a fixed discount to utility rates. Some modifications may still occur where contractual floors limit the drop in solar prices. In such circumstances, contracts are assumed to be reset to ensure that solar payments are never higher than utility rates and savings are not negative.
Initial savings rate over the utility rate	Depends on transaction collateral information. If no information is available for residential obligors in the US, we typically assume 10%-20%.
Obligor contract modification threshold	Passed when an obligor's then-current solar price exceeds the prevailing utility rate by a percentage equal to the obligor's initial savings rate. We may adjust our contract modification threshold for certain non-residential obligors based on a customer's type, size and industry, the willingness of the solar developer to renegotiate contract terms and historical contract modification data provided by the transaction sponsor.
Renegotiated savings rate	Equal to initial savings rate. Certain adjustments considered for non-residential obligors upon default.

Source: Moody's Investors Service

EXHIBIT 8

Solar Payments: Cash Flows from PBIs and SRECs

Parameter	Indicative Assumption
Revenue from incentive programs	
PBI revenue	Based on a fixed fee per kWh of solar energy produced.
SREC revenue	Value primarily from SRECs that the issuer has contracted to sell at closing.

Source: Moody's Investors Service

EXHIBIT 9

Obligor Defaults: Residential Obligor Defaults

Parameter	Indicative Assumption
Residential obligor default rate	Based on historical residential utility bill default rates and historical obligor default rates on solar contracts from the originator. For example, in the US, we generally assume 1% per year.
Recovered cash flows from defaulted residential obligors	Based on historical residential utility bill recovery rates and recovery rates on solar contracts of borrowers in distressed scenarios, such as short sales and foreclosures. For example, in the US, we typically assume 75% of defaulted obligor cash flows are recovered.

Source: Moody's Investors Service

EXHIBIT 10

Obligor Defaults: Non-Residential Obligor Defaults

Parameter	Indicative Assumption
Original CIMU obligor default rate	Based on obligor's rating/credit estimate or assume a default probability consistent with the obligor type and the applicable rating methodology. Defaults are assumed to be correlated according to obligor industry and region. For granular pools of non-residential obligors, we may base default assessments on our assessment of the average credit quality of the pool, default rates on utility bills and on the historical default performance of the originator's obligors. The correlation framework used is similar to the framework of CDOROM™.
Time from CIMU obligor default until new property owner assumes contract or contract is settled in bankruptcy	Typically 12 to 24 months.
Time from default to recoveries from wholesale electricity generation	1 to 6 months.
Recoveries from wholesale electricity generation	In the US, upon a CIMU default, if we determine that the manager has the experience and capability to sell the electricity wholesale and the contractual right to access the property, we generally assume that the manager will sell the electricity wholesale at a discount to the utility rate after an initial delay of 1-6 months. In Singapore, after an initial period of delay of about 1-6 months we generally assume that the transaction manager may be able to generate recoveries on defaulted CIMU contracts by operating the solar PV system and selling the electricity wholesale to a utility. In some circumstances, we may take into consideration pre-existing contractual arrangements between the transaction manager and the utility. In Singapore, we typically assume the recovery electricity rate is the least of (1) a discount to the utility rate less grid charges, (2) the wholesale rate (3) prevailing solar contract price.
Recovered cash flows from defaulted CIMU obligors	Renegotiated contracts assumed to have an initial savings rate of 30%-60% and a 0% escalator rate. Value within this range would depend on our assessment of the likelihood of reorganization and whether contracts can be reassigned in liquidation. In cases where reorganization is unlikely and the sponsor does not have reassignment rights, we may assume a recovery level consistent with an unsecured claim against the remaining net present value of contract cash flows. The renegotiated saving rate is applied to the lower of the prevailing utility rate and the solar price.
Multiple defaults	We model solar contract defaults by initial CIMU obligors only. To capture loss in revenue from future defaults we may assume the revised contract is modified to its initial savings rate each time the solar price reaches the utility rate.
PBI and SREC defaults and recoveries	PBI and SREC defaults are captured under the framework for CIMU defaults. For PBI and SREC obligor recoveries, we would apply a haircut to the PBI or SREC revenue stream depending on contract details and obligor type.

Source: Moody's Investors Service

EXHIBIT 11

Operations and Maintenance Risks

Parameter	Indicative Assumption
Manager default probability	Based on manager's credit rating/credit estimate, if available, or a low speculative-grade rating. We would also consider the likelihood of the manager reorganizing instead of liquidating in a bankruptcy scenario.
Cash flow disruption following manager default	For transactions with a transition manager, up to six months; for transactions without one, depends on transaction structure.
Manager fee (including O&M fees) following manager default	Generally 25% increase from initial fee, or assessed market-based fee.
Haircut to power production following manager default	We may apply a haircut to solar power production levels (and, therefore, to contract payments).

Source: Moody's Investors Service

Assumption Sensitivity

Sensitivity of solar ABS cash flows to our assumptions is likely to vary with the characteristics of the transaction and structural features. The summary below provides a high-level indication of the sensitivity of the model cash flows to the assumptions listed above.

Solar Power Production

Assumptions that impact the level of production across a pool of solar contracts can have a high impact on solar ABS cash flows. Examples of these input assumptions include the P50 and P90 estimates for solar power production and system degradation.

Solar Payments

SOLAR PAYMENTS: UTILITY RATES

Utility Rates Driven Primarily by Regulation

Assumptions that impact the level of solar savings across a pool of solar contracts can have a high impact on solar ABS cash flows. We model solar contract savings as the difference between the simulated utility rate and the projected solar contract price. In jurisdictions such as the US, where regulators set utility rates based on the utility's cost of service plus an authorized rate of equity return determined by the regulators, changes to the frequency and size of regulatory shocks can have a high impact on utility rates and consequently on solar savings.

Utility Rates Driven Primarily by Energy Prices

Changes in energy prices like oil can, in principle, be large drivers of contract cash flows as these changes could impact the overall level of solar prices. In practice, oil price levels in our model revert to a long-term trend level which is assumed to grow at a constant rate. As such, we do not find that changes in the initial level of the oil price are a key driver of cash flows for deals where contracts are long-dated. However, in such cases, the time required to pay down the liabilities may be significantly extended. Changes in the current trend oil price level, its growth rate, and changes in the volatility of the oil price diffusion process can have a moderate to large impact on cash flows.

SOLAR PAYMENTS: CONTRACT MODIFICATIONS

Changes in contract modification parameters can impact ABS cash flows to varying degrees. Some variables like the initial savings rate can have a material effect on cash flows. Other parameters such as the obligor contract modification threshold and the renegotiated savings rate act jointly to have a moderate impact on cash flows since they both are assumed to equal the initial savings rate. A high initial savings rate implies obligors wait longer to modify contracts but that when they do, they also seek the same high savings rate they had initially.

SOLAR PAYMENTS: CASH FLOWS FROM PBIS AND SRECS

Sensitivity depends on the concentration of such contracts in the pool and the volatility of production backing the contracts. We give little or no value to SRECs that the issuer has not contracted to sell at closing.

Obligor Defaults

RESIDENTIAL OBLIGOR DEFAULTS

Default rates on residential contracts, because of their relatively low absolute levels and high recovery rates, generally have small to moderate impact on ABS cash flows.

NON-RESIDENTIAL OBLIGOR DEFAULTS

Default rates on non-residential contracts may have a moderate to large impact on cash flows depending on the length of delay until contracts are renegotiated or reassigned if possible, and whether reorganization is likely. Defaults can result in a sharp reduction in cash flows until the contract is reassigned or renegotiated with the current obligor or a new buyer of the property. In the event that reorganization is unlikely and reassignment is not possible, recoveries on contracts may be close to recoveries on unsecured claims in bankruptcy.

Operations and Maintenance Risks

Manager default can result in a reduction in cash flows through increased manager fees and haircuts to production following default. Changes to the manager's default probability and likelihood of liquidation can have a moderate impact on cash flows. Impact on cash flows from an increase in manager fees or an increase in the haircut applied to production following manager default is likely to be moderate. In most cases, we would expect such decreases in net revenue to be a small fraction of the overall transaction cash flows.

Appendix B: Summary of Indicative Assumptions and Modeling Approaches Used for US Solar ABS

This section summarizes the factors we consider in our projection of the asset cash flows along with indicative assumptions for the US. It also summarizes some modeling assumptions and estimated parameter values for the utility price simulation model for the US.

EXHIBIT 12

Summary of Indicative Assumptions for US Solar ABS Transactions

Energy Production (Including System Degradation)
Normal distribution calibrated to IE's one-year P50 and P90 estimates; Distributions are 100% correlated over time and across contracts; subject to qualitative adjustments.

→ **1. Solar Power Production**

Projected Solar Price
- **Initial Solar Price**: As stated in contract.
- **Initial Escalator Rate**: As stated in contract.
- **Future Solar Price**: Appreciates at the escalator rate subject to contract modifications.

Utility Rates Approved by Regulators
- **Diffusion Process**: Utility rates simulated using Geometric Brownian Motion process.
- **Initial Utility Rate**: Based on initial solar price and initial savings rate.
- **Initial Savings Rate**: Typically assumed to be 10%-20% of utility rate if no information.
- **Negative Shock Frequency**: Every 5-10 years, on average, in each state.
- **Negative Shock Size**: 5%-15% of utility rate.
- **Correlation Among Shocks**: 50% correlation among states, subject to variation based on economic integration and energy policy coordination.
- **Wholesale Electricity Rates**: Typically 20%-50% of prevailing utility rate.

Contract Modifications
- **Modification Threshold**: Modifications occur when solar price exceeds utility rate by obligor's initial savings rate. Certain adjustments considered for CIMU obligors
- **Renegotiated Savings Rate**: Equal to initial savings rate. Certain adjustments considered for CIMU obligors upon default.

Solar Incentive Programs
- **PBI Revenue**: Based on fixed fee per kWh of solar energy.
- **SREC Revenue**: Value primarily from SRECs that issuer has contracted to sell at closing.

→ **2. Solar Payments**

Residential Obligor Defaults
- **Default Rate**: Typically 1% per year.
- **Recovery Rate**: Typically 75% of defaulted amount.

PBI and SREC Obligor Defaults
- **Default Rate**: Same as CIMU obligor defaults.
- **Payment Recovery & Timing**: Haircuts to revenue stream depending on contract details and obligor type.

CIMU Defaults
- **Obligor Default Rate**: Based on actual rating, credit estimate or assumed rating. For granular pools, we may use average credit quality of pool, default rates on utility bills and the historical performance of defaulted obligors over a sufficiently long period including a period of economic stress.
- **Correlation**: Similar to CDOROM[TM] framework.
- **Time from Default to Wholesale Electricity Generation**: 1-6 months.
- **Time from Default until Contract Reassignment or Settlement**: Typically 12-24 months.
- **Renegotiated Savings Rate**: Typically 30%-60% depending on likelihood of liquidation or reorganization; 0% escalator rate. Saving rate is applied to the lower of the prevailing utility rate and the solar contract price.
- **Multiple Defaults**: We model initial default only. Make conservative assumptions on contract modification to capture loss in revenue from future defaults.

→ **3. Obligor Defaults**

Operations and Maintenance Risks
- **Manager Default**: Based on actual rating, credit estimate or low speculative grade rating if unrated; likelihood of liquidation or reorganization upon bankruptcy.
- **Cash Flow Disruption**: Up to 6 months with transition manager; case-by-case otherwise.
- **Manager Replacement Fee**: Generally 25% increase, or assessed market-based fee.
- **Haircut to Power Production following Manager Default**: Haircut to production (and, therefore, to contract payments).

→ **4. Operations and Maintenance Risks**

Legal Risks →

↓ **Portfolio and Bond Cash Flows**

Source: Moody's Investors Service

Utility Price Simulation for the US States

For each state, the utility price is simulated as a correlated Geometric Brownian Motion (GBM) process with jumps:

FORMULA 4

$$\frac{dU_t}{U_t} = \mu dt + \sigma dW_t + \kappa dJ_t$$

Where:

- U_t = Utility rate in year t.
- μ and σ are the drift and volatility of the GBM process respectively. μ and σ for each state are calibrated from historical data
- W_t = Standard Brownian motion process. Processes are correlated across states. Correlations are calibrated to historical data.
- J_t is a standard Poisson process with shock frequency $\lambda\Delta t$ over the discrete time interval Δt. In the US, we typically assume a shock once every 5-10 years on average in each state. Jump processes across states are assumed to be correlated. We assume a 50% correlation across states.
- κ is the shock size. We typically assume a 5%-15% shock size in the US.

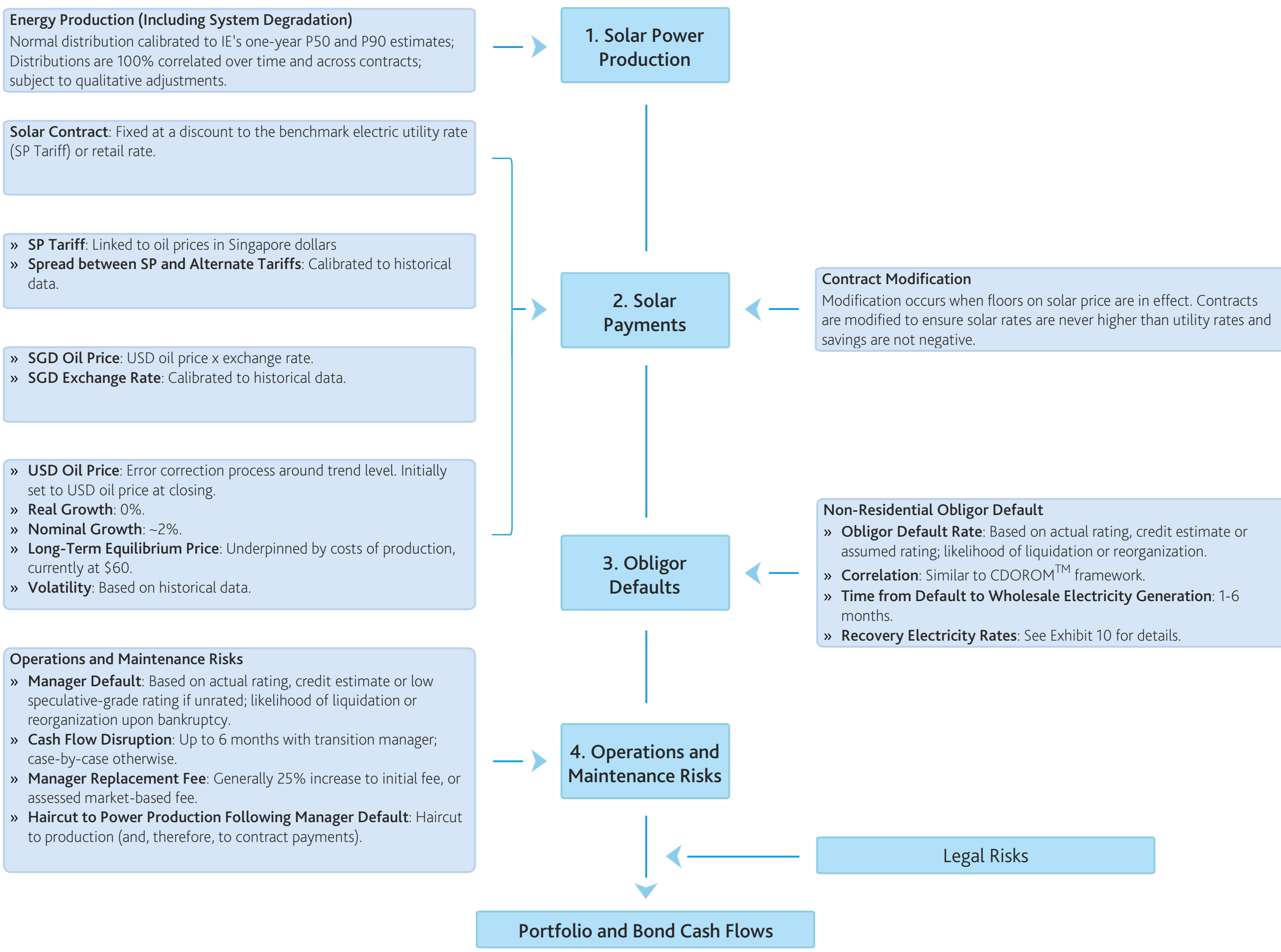
Source: Moody's Investors Service

Appendix C: Summary of Indicative Assumptions and Modeling Approaches Used for Singapore Solar ABS

This section summarizes the factors we consider in our projection of the asset cash flows, along with indicative assumptions for Singapore. It also summarizes some modeling assumptions and estimated parameter values for the oil price process and the Singapore framework for converting oil prices to solar tariff rates.

EXHIBIT 13

Summary of Indicative Assumptions for Singapore Solar ABS Transactions



Source: Moody's Investors Service

Oil Price Model

We model oil prices, $P_{Oil,t+1}$, as a stochastic error-correction process around a trend price level.

FORMULA 5

$$ln(P_{Oil,t+1}) = \alpha_{Oil,1} + \alpha_{Oil,2}T_{t+1} + \delta_{Oil,t+1}$$
$$\delta_{Oil,t+1} = \alpha_{Oil,3}\delta_{Oil,t} + \sigma_{Oil}u_{Oil,t+1}$$

Where:

» T is a time trend

» $\boldsymbol{\delta_{Oil,t+1}}$ is an AR-1 process. $\boldsymbol{\alpha_{Oil,1}}, \boldsymbol{\alpha_{Oil,2}}, \boldsymbol{\alpha_{Oil,3}}$ and $\boldsymbol{\sigma_{Oil}}$ are estimated from historical oil prices.

Source: Moody's Investors Service

Singapore Framework for Converting Oil Prices to SP Tariff Rates

SP Tariff refers to the Singapore electric utility rate set by Singapore Power Group. SP Tariff is regulated by Singapore Energy Market Authority (EMA) and is set each quarter to reflect the actual cost of electricity, including energy cost and grid charges. The energy cost component is linked to daily natural gas prices (in SGD) observed over the preceding quarter. We model SP Tariff Rates (P_{SP}) as a log-linear function of the average oil price in the preceding quarter expressed in Singapore dollars (P_{Oil}^{SGD}).

FORMULA 6

$$\ln(P_{SP,t+1}) = \alpha_0 + \alpha_1 \ln(P_{Oil,t}^{SGD}) + \alpha_2 \varepsilon_{SP,t+1}$$

Where:

» $P_{Oil,t}^{SGD} = E_t \times P_{Oil,t}$

» E_t is the USD to SGD exchange rate and is modeled as a log-linear process. See Formula 7 below:

Source: Moody's Investors Service

FORMULA 7

$$\ln(E_{t+1}) = \beta_0 + \beta_1 \ln(E_t) + \beta_2 \varepsilon_{E,t+1}$$

Source: Moody's Investors Service

EXHIBIT 14

Translating Oil Prices into Solar Tariffs

Source: Moody's Investors Service

Moody's Related Publications

Credit ratings are primarily determined through the application of sector credit rating methodologies. Certain broad methodological considerations (described in one or more cross-sector rating methodologies) may also be relevant to the determination of credit ratings of issuers and instruments. A list of sector and cross-sector credit rating methodologies can be found here.

For data summarizing the historical robustness and predictive power of credit ratings, please click here.

For further information, please refer to *Rating Symbols and Definitions*, which includes a discussion of Moody's Idealized Probabilities of Default and Expected Losses, and which is available here.

» contacts continued from page 1

Analyst Contacts:

NEW YORK	+1.212.553.1653
JingJing (Nicky) Dang *Associate Managing Director* jingjing.dang@moodys.com	+1.212.553.4801

HONG KONG	+852.3758.1300
Jerome Cheng *Associate Managing Director* jerome.cheng@moodys.com	+852.3758.1309

Contributor
Venkataraman Swami

Research consultant
Andrew Silver

Report Number: 1253672

ADDITIONAL CONTACTS:

Frankfurt:	+49.69.2222.7847
Madrid:	+34.91.414.3161
Milan:	+39.02.3600.6333
Paris:	+33.1.7070.2229