PROJECT FINANCE

SOLAR POWER PROJECTS

MARC RATING METHODOLOGY (EXPOSURE DRAFT)

INTRODUCTION

This methodology outlines MARC's approach to assessing utility-scale grid connected solar power plants which are financed on a non-recourse, project finance basis. This methodology is to be read together with the criteria reports for:

- Project Finance; and
- Independent Power Producer.

OVERVIEW OF THE SOLAR POWER SECTOR

The prevailing technology employed in solar power plants in Malaysia is photovoltaic (PV) technology. Grid connected solar PV power generation is a nascent sector in the country, having only commenced in 2012 with a subsidized feed-in-tariff (FiT) system. As of end-2016, the total installed capacity for solar power generation is 293.66 megawatts (MW) under the FiT system and comprises small solar power plants with capacities ranging between less than 1MW to 5MW each.

On an international scale, solar PV power generation is perceived to be relatively recent with a shorter operating history compared to conventional power projects. Aside from utility-scale solar power plants in the 1980s/1990s in the US using concentrating solar PV systems, the oldest utility-scale solar PV power plant which is in Germany was

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only commissioned in 2004. The plant is supported under a FiT system and uses monocrystalline silicon PV technology.

Solar power generation has since grown fairly rapidly worldwide. The drivers behind this growth are the shift towards long-term sustainable energy production and the falling installed costs for PV power plants. However, as the production cost of PV electricity is still higher than for electricity generated from fossil fuel power plants for the most part, energy price support by the relevant authorities continues to play an important role in the expansion of solar power generation capacity. Continuing technological progress in product development and manufacturing processes will enable future plants to be constructed at lower installation costs, an assumption that underpins the worldwide trend of decreasing feed-in-tariffs given by the authorities to plant operators. From a credit perspective, solar power plants (SPP) whose project economics depend significantly on energy price support are viewed as being more exposed to an unfavourable change in regulatory dynamics compared to newer and future SPPs that benefit from the dynamics of cost reductions. At the same time, MARC assesses SPP's post-completion offtake risk and stranded asset risk to be lower compared to conventional counterparts given their ability to supply electricity at low marginal costs (zero fuel costs and low production overheads).

ANALYTICAL FRAMEWORK

Utility-scale SPPs, defined as plants with 5MW capacity and above connected to the national energy grid, are at their infancy stage in Malaysia. There is limited documented data in respect of solar resource (irradiance) and panel performance in Malaysia. Compared to fossil fuel-fired power plants which have a considerably longer operating history, MARC is of the view that greenfield solar power projects are exposed to greater uncertainty in energy production, which could have a significant impact on their prospective credit profiles. These include the potential for over- or under-estimation of actual irradiance as well as uncertainties in other critical inputs such as the operational lifetime for solar panels and inverters, as well as their performance degradation over time.

Only after the plant is operational would the accuracy (or otherwise) of performance and energy output estimates become evident, which requires, in MARC's view, additional rigour and conservative expectations in certain areas

of the rating process. The initial credit ratings assigned by MARC to greenfield solar project financings will capture the additional degree of uncertainty. To the extent that the critical projected performance and energy output metrics are achieved as the plant comes online, the rating could migrate upwards. In our analytical framework, we assume that siting, permitting and licensing risks are satisfactorily mitigated with either outright purchase of the land or entry into a long-term lease beyond the term of the rated issue or the power purchase agreement, whichever is shorter.

MARC's assessment table assumes two ranges: secure and vulnerable. Solar power project financings rated in the secure range are expected to exhibit satisfactory risk mitigation through the use of high quality solar resource data in the development phase of the project to reduce the margin of error in predicted energy output. Accurate monitoring of production and plant performance should be in place once the plant is up and running to evaluate whether plant performance aligns with earlier estimates and to ascertain warranty fulfilment.

The rating considerations articulated in this methodology focuses on solar project risks. Key areas in our assessment are:

- Project Sponsor
- Regulatory Risk/Offtaker Risk/Power Purchase Agreement
- Construction Risk
- Site Resource Risk
- Operational Risk
- Financial Risk
- Financing Structure Risk

PROJECT SPONSOR

MARC considers the project sponsor's experience, perceived benefits to its existing core business, exit clauses and change in control covenants under the project financing documents, and any form of tangible credit support provided for the project as indicators of the sponsor's likely commitment to the project. MARC will also assess the project sponsor's background and track record, history of support for its investments as well as commitment to past projects of similar nature, if any.

A sponsor with a concentration of its activity in the industry such as a strong track record and experience in SPPs, or experience in the supply chain and has delivered solar projects on time and within budget is viewed more favorably than a sponsor that lacks the requisite experience. The former with a higher learning curve effect can respond to and solve potential problems during the construction and plant operation stages more quickly and minimize plant downtime. Where the sponsor is also the engineering, procurement and construction (EPC) contractor and/or operations and maintenance (O&M) operator, MARC will review the EPC and O&M contracts for potential conflicts and reasonableness of compensation.

A single sponsor or a consortium with a lead sponsor is viewed more favourably than a project with multiple sponsors who have limited or no time and reputation invested in the project.

MARC will also assess the sponsor's level of financial commitment to the project. A higher level of equity investment, provision of liquidity support and/or maintenance of material interest in the project throughout the tenure of the rated facility will be positive to the rating. A highly rated sponsor with a demonstrated track record of providing ongoing financial support for its projects is viewed as a credit strength. MARC does not incorporate any expectation of financial support from the sponsor beyond the contractually obligated amounts.

REGULATORY RISK

SPPs are typically supported by regulatory incentives to be economically competitive compared to conventional power generation facilities. Their viability is dependent on revenue stability through long-term power purchase agreements and incentives such as favourable tariffs (feed-in or through direct negotiation), green certificates, tax exemptions or other supporting regulatory frameworks. The primary regulatory risk is the withdrawal or reduction of such incentives such that the tariff is lower than the assumptions under the rating case scenario. MARC will assess the power purchase agreement (PPA) and evaluate the risk of tariff renegotiation, taking into account the regulator's history of shifting policies and the overall emphasis of renewable energy in electricity generation.

OFFTAKER

The credit strength of the offtaker will be assessed in terms of the ability and willingness of the offtaker to pay its obligations. In this respect, the credit quality of the offtaker serves as the ceiling for the project rating.

POWER PURCHASE AGREEMENT

The PPA provides the contractual foundation for the SPP's revenues and cash flows. The typical PPA will have an investment-grade offtaker with a contracted tariff rate throughout the term of the PPA. MARC will evaluate the performance requirements under the PPA in order for the SPP to receive projected payments, the terms under which termination may occur and events of non-acceptance of energy output by the offtaker.

MARC will rely on the assessment by the independent consulting engineer (ICE) on whether the SPP will be able to meet the minimum performance thresholds and the declared annual quantity of energy that the plant will generate and deliver to the grid under the terms of the PPA. Notwithstanding the ICE report, potential penalties for breaches to the terms will be incorporated in our sensitivity analysis.

MARC will also incorporate the extent of insurance coverage for any losses resulting from force majeure events or other events such as strikes. For brownfield projects, MARC will review the project's past performance for an indication of whether the project will breach these terms.

CONSTRUCTION RISK

The major construction risks are a delay in completion of the project, budget overruns and sub-optimal performance standards. Construction periods for solar projects are much shorter than conventional power projects at about six to 18 months, compared to the three- to five-year construction periods for the latter. While they generally involve low-complexity civil and foundation works, solar projects must ensure equipment manufacturers can deliver large volumes on time as equipment comprises the largest component of the plant.

In addition to the risk factors driving construction risk analysis in MARC's Project Finance methodology, our analysis will also cover the risk aspects pertinent to SPPs relating to contractor(s), construction contracts and equipment manufacturers.

MARC will also review the capacity for project completion in conjunction with the findings of the ICE on the project.

Contractors

MARC will review the strength and quality of the EPC contractor for the timely completion of the project and ability to meet performance requirements to achieve commercial operation. In this respect, MARC will assess the contractor's track record, technical and financial capability, and direct experience in projects with similar technology and scale in conjunction with the opinion of the ICE. A financially strong and reputable EPC contractor or enhancements such as letters of credit, performance guarantees or other forms of performance security are viewed positively.

Contract Terms

A fixed price, turnkey contract with liquidated damages (LD) for completion delays from a contractor with an established track record will reduce budget overruns and completion risks. MARC will review the terms in each phase of the construction through to commissioning and production start-up. Based on the ICE's report, MARC will assess the reasonableness of key construction milestones, including sufficient buffer for delays, and assess the contract terms for adequacy of LD.

Manufacturers

Solar projects are subject to equipment delivery delays. MARC will consider the manufacturers' level of experience with the technology as well as their creditworthiness and reliability for timely delivery. MARC will review the manufacturer's warranty claim experience as a reference for ascertaining the equipment quality and its future performance. If there is a risk of a manufacturer being replaced, an assessment will be made on how quickly and

cost effectively the equipment can be delivered and whether the project has the financial resources to support a change in the equipment manufacturers.

SITE RESOURCE RISK

An SPP's revenues are solely reliant on solar irradiance, which is an intermittent resource. The predictability of revenues and cash flows are therefore susceptible to site-specific solar resource risk with no compensating mitigating factors for irradiance levels below the rating case assumptions.

MARC will rely on the third-party solar resource consultant's assessment (refer to *Third-Party Reports* section) on the amount of solar irradiance at the specific site to quantify resource supply and provide estimates of the expected available irradiance at the plant. This will form the basis for the assumptions supporting the expected production and revenue forecast of the SPP. A report by a reputable consultant with an established track record and expertise will be viewed favourably. Without the solar resource assessment report, it is unlikely that MARC will be able to provide a rating.

Resource Data

MARC looks for historical satellite-derived data that cover a period of more than 10 years validated against site-specific ground data over at least a one-year period to reduce uncertainty in the solar resource estimation. MARC acknowledges that there could be potential weakness in the quality of ground-measured site-specific data at this stage of the industry in Malaysia. As such, MARC expects the consultant to validate data from the satellite with ground-based data in similar geographical regions. In incidents where data sets are deemed to be weaker, MARC expects the consultant to adjust the solar irradiance estimate with a more conservative level of uncertainty. The consultant will also opine on the quality of the data, instruments used and/or appropriateness of the methodology employed.

The definition of site-specific data can vary due to microclimate conditions with local differences in atmosphere, such as water vapour, clouds and pollution as well as surrounding topography, which affect the solar radiation received by the solar panels. Sunlight intensity, for example, increases with height above sea level.

MARC will rely on advice from the consultant regarding the acceptability of the data as site-specific. Data collected within 10 kilometers of the actual site may be considered as site-specific provided the surroundings are basically flat, but may not be site-specific if the surrounding topography is varied.

Probability of Exceedance

The consultant usually provides an estimation of the irradiance yield at probabilities of exceedances that are at 50% (P50), 90% (P90) and 99% (P99). A P90 estimate informs of a 90% probability that the actual irradiance will exceed the given estimate. A P50 probability of exceedance estimate will generally be used for the base case financial model. MARC will use the P90 probability of exceedance estimate for the rating case and P99 probability of exceedance estimate for our sensitivity analysis.

Energy Production Estimate

The independent consulting engineer (ICE) will combine the solar irradiance estimate with derating factors at the plant such as shading, panel degradation, wiring loss, inverter and transmission line losses, among other factors, to arrive at the estimated energy output that will be generated (energy yield) at the SPP. As the irradiance estimate is expressed at P50, P90 and P99 probability of exceedance levels, the energy production estimate which encapsulates the irradiance estimate and derating factors will also be expressed at P50, P90 and P99 exceedance probabilities.

MARC looks for a favourable opinion by the consultants for reliance on the energy production estimate. After the commencement of operations, MARC will compare the energy production estimate with the plant's actual energy yield to determine the reliability of the estimate made by the consultant.

Third-party Reports

MARC will rely on the solar resource assessment by an independent consultant for estimates of future solar energy (irradiance) available at the SPP. The assessment will provide the prospective annual average estimates of solar

irradiance available over the term of the rated facility and the probability of exceedance from these estimates.

The ICE's report will present findings on contractor capability, construction design, construction schedule and the ability of the construction plan to meet output specifications and commissioning tests. The report should also include an assessment of equipment warranties, technology, panel degradation, ease of supplier substitution and other factors affecting the project's economics.

The ICE will incorporate the irradiance estimate from the solar resource assessment and derating factors to derive the long-term energy yield from the SPP. This will form the basis for the rating case project economics which MARC will rely on.

OPERATIONAL RISK

Technology

In reviewing technology risk, MARC will consider the complexity and performance of solar panels; the largest component for electricity generation in an SPP. The main concern is panel underperformance which may impede the project's ability to achieve the level of performance under the rating case. A solar project that uses panels with proven technology and long utility-scale operating history commands a stronger rating than one with proven technology but limited utility-scale usage.

MARC will review panel performance datasets from the panel supplier in conjunction with the ICE's analysis and evaluate the technology based on its ability to provide the requisite output to meet the project's debt servicing. MARC will also compare the performance track record from the start-up period with the projected performance to appraise the initial estimation for panel degradation. Panel degradation that is higher than initially projected is considered to have higher performance uncertainty and will warrant a revision of the rating case scenario.

There are predominantly two types of PV technologies that are employed in utility-scale solar power plants: crystalline silicon and thin film. Another type of PV technology, concentrating PV (CPV) which uses mirrors and lenses to focus

sunlight on to semi-conductors, is prevalent in sun-rich regions with high direct normal irradiance. MARC believes that CPV is unlikely to be employed in Malaysia as it is not efficient given the high incidence of diffused irradiance.

Crystalline Silicon (c-Si) - c-Si is the technology that dominates the present market for utility-scale solar generation. There are two types of c-Si PV systems that are produced widely: monocrystalline silicon and polycrystalline silicon. Monocrystalline silicon (mono-cSi) solar cells are the oldest and most developed PV technology. Aside from market depth and track record, mono-cSi panels are currently more efficient than poly-cSi and thin film panels. Polycrystalline silicon (poly-cSi) solar panels which are a newer technology have slightly lower efficiency than their mono-cSi counterparts but are less expensive.

Thin Film - There are three types of thin film technologies: amorphous silicon (a-Si), cadmium telluride (CdTe) and copper indium gallium selenide (CIGS). With the exception of a-Si which is mature but the least efficient, thin film is a newer technology and currently has lower module efficiency than c-Si. MARC notes that the quality of thin film technology and manufacturing process varies between manufacturers. As such, in addition to the reputation and track record of the manufacturer, MARC will also consider the manufacturing process to be a major rating factor in ascertaining risk for this technology.

As c-Si PV technologies have market dominance as well as a longer operating history, both in utility-scale (since 2004) and residential (about 30 years) power generation, MARC regards c-Si panels as having lower performance uncertainty compared to thin film.

Manufacturer Profile, Warranty and Support

Panels

Solar projects will seek some panel performance risk transfer to the manufacturer in the form of product and performance warranties. Standard warranties are product guarantees for 10 years and performance warranties of up to 90% minimum peak power output during the initial 10 years and 80% minimum peak power output from years 11 to 20.

In view of the evolving technology and highly competitive landscape, solar panel manufacturers may not have lasting market presence. MARC will evaluate the historical warranty claim rates of the manufacturer along with the strength of the warranty counterparty and/or the performance guarantor. Where a panel manufacturer is not a major manufacturer with an established track record, a performance guarantee from an investment-grade third-party insurance provider can enhance the rating. Additionally, MARC considers maintenance reserves and/or panel degradation reserves as credit positive. These reserves may also cover the cost of replacing PV panels and inverters if the performance falls below a defined threshold mitigating financial stress during the term of the rated facility.

In view of the nascent stage of SPPs in Malaysia, MARC will also look for any technical support that equipment manufacturers may provide to the project. The degree of support beyond plant commissioning to ensure the successful operation of the plant as well as training of personnel is assessed to ascertain adequate technology transfer and the level of commitment by the manufacturer towards the project.

Inverters

Solar cells produce direct current (dc) which needs to be converted to alternating current (ac) which is supplied to the grid. Inverters are used to convert dc to ac. There are two types of inverters, central inverters and string inverters. Central inverters have higher capacity than string inverters, which translates to lower cost per watt and fewer component connections, but higher installation, dc wiring and system costs. String inverters have lower system and ongoing maintenance costs with simpler designs and modularity facilitating maintenance and replacement but have higher cost per watt with more inverter connections and require more space.

Operations and Maintenance - Operator

Although the operations of an SPP are relatively simple as it has no moving parts, many aspects of operations and maintenance (O&M) practices are interrelated and significantly affect the performance of all the components in the generation chain and project lifecycle. In particular, suitable planning, supervision and quality assurance activities are critical at all stages of the plant

in order to minimize the risk of damages and outages, optimize the use of warranties and maximize the overall performance of the plant.

The quality of the O&M arrangement is an integral part of the plant's operational efficiency which will ensure that the SPP meets the financial performance required under the rated facility. Positive rating drivers are operators experienced with the same technology in the same geographical area with adequate resources and qualified staff. The balance sheet strength and track record of the operator will be considered together with the ICE's evaluation of the operator's performance. Ongoing reviews will be carried out on the production variance in plant operations to assess the operator's ability; a positive variance is viewed favourably as opposed to one with a negative variance. Where the operator is an affiliate of the sponsor, panel manufacturer or EPC contractor, the O&M agreement is reviewed for potential conflicts and the reasonableness of compensation.

MARC will review the O&M contract for any performance guarantees, the operator's spending authority and terms for termination. Any measures to cover instances where the operator's performances are below the requisite performance standards, for example insurance against loss in revenues as a result of breakdowns and the availability of technical support from major equipment suppliers, will be viewed favourably.

Operations and Maintenance - Costs

While the O&M budget is generally a small component of the cost structure, a fixed price contract that transfers O&M risk will reduce operating cost volatility. MARC relies on the ICE report to assess the requirements for the project's operating costs and the adequacy of a plan covering periodic and overhaul maintenance. MARC will also rely on the ICE's evaluation of the adequacy of the O&M staffing levels, reasonableness of O&M management fees as well as the sufficiency of the budget to replace the operator should a replacement be required. Given that financing structures of solar plants are long-term, the ICE report should also inform the ability to substitute equipment in a commodity-like manner as solar is an evolving technology. Maintenance reserves which will cover the cost of replacement parts and relieve financial stress, including incidental higher costs of cleaning, monitoring and maintaining the plant, will add strength to the operating risk evaluation.

FINANCIAL RISK

The primary financial metric is the debt service coverage ratio (DSCR) which is a measure of the project's cash flow resiliency and debt repayment capacity under the rating case and stressed scenarios. MARC will stress the cash flows which will include changes in interest and exchange rates, operating costs, cost overruns and delays in completion and commencement.

MARC will also assess the project life cover ratio (PLCR). While DSCR provides a guidance on the project's ability to repay obligations according to the scheduled profile, the PLCR shows the liquidity cover of the project over the remaining full life of the project. The PLCR also illustrates the extra security to lenders afforded by the debt tail, i.e., the number of years after the scheduled final repayment date, and would typically be 10-20% higher than the minimum DSCR.

For a more thorough analytical framework on the project's financial risk analysis, please refer to MARC's Project Finance rating methodology.

FINANCING STRUCTURE RISK

A project's financing structure is of critical importance to MARC's analysis. MARC believes that the level and structure of project debt can increase or lower default risk; sponsors' incentive to manage a project through challenging conditions is typically affected by the size of the equity layer in a project's capital structure. Sponsors who have already recouped their original investment would have a lower vested interest in the outcome of the project. MARC will look at broader measures of capitalisation than the gearing levels alone; debt leverage is assessed in relation to project-level business, regulatory and financing risks.

Project sponsors very often prefer to finance the project through a combination of equity and subordinated debt mainly for two reasons: i) to avoid the "dividend trap" and ii) to enjoy tax deductibility on interest paid on subordinated debt. However, the use of subordinated debt may lead to the erosion of the project capital base in cases where prohibitive accrued interest costs on subordinated debt combine with higher project losses.

MARC's approach to financing structure risk analysis for project financing is outlined in its Project Finance rating methodology and Equity Credit and Notching Approach for Corporate Subordinated Debt and Hybrid Securities.

Exhibit 1: Illustrative Rating Factors Guiding Qualitative and Financial Assessments of Solar PV Power Projects

Rating Factors	RATING CATEGORY	
	Secure	**Vulnerable**
Project sponsors	• Some experience and track record in utility-scale solar power generation or is supportive of or involved in solar power supply chain with some reputation in the solar power industry. • Single sponsor or consortium with leading sponsor. Has time and reputation invested in the project. • Demonstrated commitment to project with sufficient level of equity contribution.	• Limited experience or no track record in solar power generation and where solar power generation is not a strategic thrust. • Multiple and factious sponsors with no lead sponsor. Investment has limited or no strategic thrust for each of the sponsors. • Reasonable commitment to adequate level of equity contribution.
Regulatory/ Offtaker/ PPA	• Transparent legal environment with a small degree of risk of change in law or regulatory framework leading to minor additional costs. • Solar power is important to the national framework but may be challenged in the intermediate term. • Investment grade offtaker. • Long-term PPA with achievable performance criteria and at reasonable tariff rates that exceed tenure of debt.	• Opaque legal jurisdiction with precedence to force re-negotiation of contracts. • RE is important to the national framework but may be challenged in the near term. • Non-investment grade offtaker. • PPA with onerous performance criteria and inferior tariff rates leading to weaker DSCRs. • PPA expires on or before maturity of debt.
Construction Risk	• EPC contract is fixed price, date certain, turnkey or multiple contractors with clearly assigned responsibilities and ownership of various risks. • Experienced EPC contractor and equipment suppliers with good track record. • Sufficient financial buffers and liquidity covers for liquidated damages and debt service. • Realistic schedule for completion and sufficient buffer for possible delays. • ICE report with unqualified opinion on project completion from consultants with an established track record.	• Multiple weak contractors with insufficient credit enhancements. Unclear delineation of responsibilities and ownership of the various risks. • EPC contractor with limited track record and equipment suppliers with limited capabilities to meet targeted shipment dates. • Insufficient financial cushion and liquidity covers for liquidated damages. • Optimistic completion schedule with thin buffer for possible delays. • Qualified ICE conclusions for design, schedule, budget and debt service coverage.
Operational Risk	• Proven panel technology with at least 10 years of utility-scale operating history. • Major manufacturers and acceptable warranties; if needed, supported by credit/insurance enhancements or reserves for foreseen and unforeseen replacement maintenance. • Experienced O&M operator. • Fixed priced long-term O&M contract. • ICE and solar resources reports with unqualified opinions for expected performance. • Actual plant operations and costs reveal minimal variability from performance warranties. • Independent technical advisor retained to review power warranties and degradation rates during initial years of operations.	• Unproven or demonstration-stage technology with minimal utility-scale operating history. • Small or mid-sized manufacturers and weak warranties. Inadequate credit enhancements or compensating reserves. • O&M operator has little experience with the technology. • Cost-plus or short-term O&M contract. • Actual historical plant operations and costs reveal high variability from performance warranties. • Qualified opinions on ICE and solar resource reports. • Limited third party monitoring of power warranties and degradation rates.
Site Resource Risk	• At least one-year of actual onsite ground-based data combined with the most relevant long-term satellite data to provide the lowest level of uncertainty. Where on-site ground data is not available, satellite data should be validated with ground-based data in similar geographical regions. • Long-term annual average energy production under P90 probability of exceedance scenarios. • Solar resource assessment by reputable consultant with good track record. • Actual energy production at plant reveals favourable variance from energy production yield estimated by the consultant.	• Solar assessment based on older satellite data or satellite images with inferior quality such as low resolution and not produced in time series. Data is not adjusted for data quality and technology. • Long-term annual average energy production under P50 probability of exceedance scenarios. • No independent verification of solar resource estimate or consultant has limited track record. • Qualified opinion from independent consultant. • Actual energy production reveals unfavourable variance from estimates made by consultant.

Rating Factors	RATING CATEGORY	
	Secure	**Vulnerable**
Financial Risk	• Minimum P90 DSCR at or above 1.3 times. • Debt-to-equity ratio at or below 4 times • Forward-looking DSCR	• Minimum P90 DSCR below 1.3 times. • Debt-to-equity ratio of > 4 times • Backward-looking DSCR
Financing Structure Risk	• Fully amortising debt with minimal refinancing risk • Debt service reserve equal to at least 6-12 months of debt service; fully funded at financial close • Covenants ensuring timely repayment, limit further indebtedness • Flat/increasing DSCR profile	• Significant refinancing risk • Debt service reserve less than six months and/or not fully funded at financial close • Weak liquidity and leverage provisions • Uneven/declining DSCR profile

Published and Printed by:

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