

**THE SOCIALIST REPUBLIC OF VIETNAM
NATIONAL TEXTILE COMPANY**

**THE SOCIALIST REPUBLIC OF VIETNAM
PREPARATORY SURVEY ON ROOFTOP
SOLAR PROJECT FOR NATIONAL
TEXTILE COMPANY
(PPP INFRASTRUCTURE PROJECT)
FINAL REPORT (Public Version)**

DECEMBER 2020

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

ITOCHU CORPORATION

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CONCLUSION AND RECOMENDATIONS

Conclusion

The Rooftop Solar Projects in Vietnam may be technically feasible and financially viable.

The capacity of one Rooftop Solar Project is a MW class with reasonable amount of energy production.

The likely financial indicators for one Rooftop Solar Project will show an acceptable rate of return that would be equal to or greater than a typical hurdle rate of foreign investors.

The CO2 emission reduction is estimated to be 60 thousand tCO2 per year class if enough portfolio is built out.

Recommendations

- (1) Detailed design for the Rooftop Solar Projects be reviewed by an internationally qualified professionals in the forthcoming development stage, as concept designs executed by a local engineering company in this JICA Study was not evaluated acceptable in view of the technical reliability. Or, each detailed design be assessed and/or improved by such internationally qualified professionals in advance.
- (2) The structural strength and safety of each roof (as a foundation of Rooftop Solar) be carefully checked by an internationally qualified professionals.
- (3) A SCADA system be considered to make remote monitoring possible.
- (4) A step-wise portfolio build-out is recommended. The first phase portfolio build-out is to be developed with 100% equity funds.
- (5) PPA expected is of Onsite Private PPA Model having a long term validity period.
- (6) The rooftop lease agreement is recommended with each factory owner.

Risk Evaluations

Impact	Description	Risk
SPC establishment	A single purpose company is to be established.	Low
Licensing	There is no specific licensing required for the Rooftop Solar Projects, because the power transaction is beyond EVN.	Low
Roof selection	Factories be carefully selected in terms of their financial capability and structure (roof) strength.	Medium
Business contracts	A power purchase agreement is to be concluded between SPC and a roof owner.	Low to Medium
Transmission Line (interconnection)	The Rooftop Solar Projects do not require electricity transmission.	N/A
Access	The access to each roof should be confirmed in its transportability.	Low
Generating Equipment	An RTS system is to be constructed by an EPC contractor.	Low
Construction Program and Management	Material supplies should be discussed. Safety measures should be discussed. Detailed construction program and time schedule should be prepared.	Low
Energy Generation	If PPA includes a penalty/low tariff clause, the energy sales should be optimized month-by-month.	Low to Medium
Operation & Maintenance	The detailed operation and maintenance plan should be prepared. SCADA system be considered for remote monitoring.	Medium
Cost estimations	Price quotations should be collected from qualified EPC contractors.	Medium to High
Comprehensive Risk Evaluation		Low

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Abbreviations

Economy & Finance

USD	United State Dollars
VND	Vietnamese Dong
JPY	Japanese Yen

Energy

kW	kilowatt
MW	megawatt
kWh	kilowatt-hour

Organization

GOV	Government of Vietnam
EVN	Vietnam Electricity
JICA	Japan International Cooperation Agency

Business & Administration

PPA	Power Purchase Agreement
COD	Commercial Operation Date
C&I	Commercial & industrial
CCS	Cross-currency swaps
CPI	Consumer Price Index
EBITDA	Earnings before interest, tax, depreciation & amortization
EPC	Engineering, Procurement and Construction
FX	Exchange Rate
IRS	Interest rate swap
PV	Photovoltaic (systems)
RTS	Rooftop Solar

CHAPTER 1 INTRODUCTION

1.1 Background

ITOCHU Corporation, as one of the potential Japanese investors, intends to undertake the development of the rooftop solar plants (RTS) in Vietnam. The expected capacity of RTS per roof is a MW class for direct sale of electricity and the total portfolio would become tens of MW across various locations in Vietnam.

In response to the study proposal, in August 2020 Japan International Cooperation Agency (JICA) entrusted ITOCHU Corporation with the Preparatory Survey on Rooftop Solar Project in Socialist Republic of Vietnam.

1.2 Basic Concept of the Study

Project Outline

In this project, solar power generation facilities will be installed on the roofs of factories. Itochu is to own them for a long period of 15 to 25 years and provides related services such as power supply and other maintenance to the companies.

It is assumed that the electricity generated from the solar power generation facilities installed by this project will be preferentially consumed at the factories that have installed all or most of them, assuming sufficient credit can be secured. However, surplus electricity may be generated during times when the factory is not operating, etc., and the electric power supply to the state-owned electric power company EVN will also be considered.

Study Scope

Sites that match this project will be selected from the over 200 factories, and the final installed target is set at approximately 30 to 50 sites of solar power facilities. The study team will be to provide services such as equipment design, procurement, installation, possession, power supply and maintenance and operation management at each factory based on the survey.

Objective of Study

- (1) For commercialization, the study team will investigate whether rooftop solar power generation can achieve independent profitability without relying on FiT (“Business Feasibility Study”).
- (2) The study team will check various legal systems (related to electricity sales, entry by foreign-affiliated companies, tax system, etc.) and investigate whether or not this project will be feasible in Vietnam (“Legal System Investigation”).
- (3) In order to improve the profitability of this project, the study team will investigate the conditions for bank lending, including the lending scheme to which the JICA Overseas Investment and Loan Scheme is applied (“Financial/Financial Relations Survey”).

1.3 Study Formation and Time Schedule

This study was executed with three advisors and one site survey contractor under supervision and coordination by Itochu. Each advisor and contractor was selected by international competitive bidding. The study is scheduled for a period from August 2020 to January 2021.

CHAPTER 2 LEGAL SYSTEMS AND BUSINESS MODELING

2.1 Rooftop Solar related Regulations in Vietnam

2.1.1 Overview

The National Power Development Plan for the period from 2011 to 2020 with the Vision to 2030 set out a strategy to ensure Vietnam's energy security, improve rural electrification and increase renewable energy capacity. In 2016, a Revised Power Development Master Plan VII was issued. It targeted that renewable energy should be increased to 10% of total generation by 2030. Solar has been seen as key to the proposed increase in renewable generation capacity.

In 2017, the government initiated a period of rapid development and the introduction of a renewable energy feed-in tariff. This initially prioritized the development of solar energy over other energy sources.

In December 2019, the Ministry of Industry and Trade (MOIT) released an update to the existing feed-in tariff ("FiT") for grid connected floating solar and grid-connected, land based solar. The first solar FiT suggested a price of approximately US cents 9.35/kWh.

In April 2020 Decision No. 13 was set out, with its key provisions including the extension of the Solar FiT.

2.1.2 Legal Framework for Rooftop Solar Power in Vietnam

As a guiding overview, an overview of the key regulations on solar power is set out below, including rooftop solar, focusing on Feed-in-Tariff ("FiT") mechanisms in Vietnam.

- Vietnam has two different stages of programs on FiT for solar power, which are:
- the first program on FiT for solar power projects and systems which achieve commercial operation date ("COD") by 30 June 2019 ("FiT 1 Program"); and
- the second program on FiT for solar power projects which achieve commercial operations between 1 July 2019 and the new FiT deadline by 31 December 2020 ("FiT 2 Program").

After the FiT programs, it is intended that a new competitive bidding mechanism (also known as solar auction or reverse auction for solar farms) would potentially be applied to determine the tariffs on other solar power systems / projects which are not eligible for the FiT programs. For rooftop solar, it remains unclear for the period after the end of 2020.

(a) The FiT 1 Program

On 11 April 2017, the Vietnamese Government issued Decision No. 11 on FiT 1 Program for grid-connected solar farms/projects and rooftop solar power systems. Details related to rooftop solar are set out below.

(i) The tariff under the FiT 1 Program

Under Decision No. 11, FiT 1 at the delivery point was approved at VND 2,086 per kWh (equivalent to US cents 9.35 per kWh, exclusive of VAT).

FiT 1 can be adjusted according to the fluctuations of VND-USD exchange rate based on the central rate of VND versus USD quoted by the State Bank of Vietnam ("SBV").

(ii) Conditions for FiT 1 eligibility

FiT 1 applies to solar power projects in Vietnam which achieve actual COD by 30 June 2019.

(b) The FiT 2 Program

Decision No. 13 updated the definition for the rooftop solar as a solar power system with photovoltaic panels installed on the roofs of civil works or industrial works and has a capacity of less than or equal to 1MW and directly or indirectly connected to the electricity purchaser with the line of 35kV or less. Also the most dramatic change is that the off-taker and generator now can be an organization and an individual person, which means that power transaction now allows no EVN the local power authority interfere, and be more specific, private PPA is legitimate now. Where, EVN stands for Vietnam Electricity, a government owned utility company in Vietnam.

The contents of the FiT 2 Program based on Decision No. 13 follow.

(i) Tariffs under the FiT 2 Program

Under Decision No. 13, the tariffs for rooftop solar for the FiT 2 Program are approved at VND 1,943 per kWh (equivalent to 8.38 US cent per kWh).

(ii) Conditions for eligibility for the tariff for rooftop solar systems

Eligible grid connected solar power systems must achieve their CODs by 31 December 2020.

2.1.3 Tariff Mechanism

(1) For energy output received from EVN's grid

The electricity seller must pay for any energy output received from EVN's power grid (i.e., import energy, if any) in accordance with the relevant existing regulations (i.e., retail tariff with EVN), as discussed below.

For retail electricity tariffs for power purchased and received from EVN's grid (in case power consumers or generators take any energy from EVN's grid), on 20 March 2019, the MOIT issued Decision No. 648 to specify the new average retail power tariff level of VND 1,864.44 per kWh (exclusive of VAT) as well as the new retail tariff rates to be applied from 20 March 2019.

Accordingly, the retail electricity tariff structures and allocations vary between different types of customers (industrial, commercial and household / residential), voltages and time-of-use (peak, normal and off-peak hours).

Vietnam has a roadmap to reform the electricity market with high-level policies on the development and transition to competitive electricity wholesale market and then competitive retail electricity market with a roadmap to gradually transition to a more market-based tariff mechanism. However, those policies will need to be detailed by specific legal regulations to be prepared and issued in the coming time.

(2) For energy output exported and sold to EVN's grid

The electricity buyer (i.e., EVN Group) shall pay for any energy output generated to EVN's power grid from rooftop solar power projects (i.e., export energy, if any) at the purchase tariff as regulated by the MOIT.

Under Decision No. 02, Circular No. 05 and EVN's Official Letter No. 1532, the tariff for power energy output exported to EVN's grid is as follows:

- Before 1 January 2018, the applicable tariff (excluding VAT) is VND 2,086/kWh (equivalent to 9.35 US cent/kWh, in accordance to the central exchange rate of VND 22,316/USD as announced by the SBV on 10 April 2017).

- From 1 January 2018 to 31 December 2018, the applicable tariff (excluding VAT) is VND 2,096/kWh (equivalent to 9.35 US cent/kWh in accordance to the exchange rate of VND 22,425/USD as announced by the SBV on 31 December 2017).
- From 1 January 2019 to 31 December 2019, the applicable tariff (excluding VAT) is VND 2,134/kWh (equivalent to 9.35 US cent/kWh in accordance with the exchange rate of VND 22,825/USD as announced by the SBV on 31 December 2018).
- From 2020 onwards, the tariff shall be determined on the basis of the official exchange rate of VND versus USD, quoted by the SBV on the date of release of the last exchange rate in the previous year.

The tariff of 9.35 US cent/kWh mentioned above would apply to rooftop solar power systems coming into commercial operation and finalizing meter readings by 30 June 2019, and, in such case, for eligible rooftop solar systems, this tariff would apply for the power purchase agreement ("PPA") term of 20 years from the actual COD. In other words, the tariff of 9.35 US cent/kWh is applicable beyond 30 June 2019 for a period of 20 years from the actual COD but only for projects already commissioned and achieved COD before 30 June 2019.

For rooftop solar power projects and systems achieving COD from 1 July 2019 to 31 December 2020, the new FiT for rooftop solar power (which is 8.38 UScent/kWh) will apply under new Decision No. 13, which replaces Decision No. 02 and Decision No. 11. In this case, for eligible rooftop solar systems, this tariff would apply for the PPA term of 20 years from the actual COD. As such, the tariff of 8.38 UScent/kWh is applicable for a period of 20 years from the actual COD for rooftop solar system actually achieving their COD during the period from 1 July 2019 to 31 December 2020.

Specifically, under Decision No. 3641 of MOIT and Official Letter No. 3725 of EVN, the tariff for power energy output exported to EVN's grid is as follows:

- From 1 July 2019 to 31 December 2019, the applicable tariff (excluding VAT) is VND 1,913/kWh (equivalent to 9.35 UScent/kWh in accordance with the central exchange rate of VND 22,825/USD as announced by the SBV on 31 December 2018).
- From 1 January 2020 to 31 December 2020, the applicable tariff (excluding VAT) is VND 1,940/kWh (equivalent to 8.38 UScent/kWh in accordance with the central exchange rate of VND 21.155/USD as announced by the SBV on 31 December 2019).

For rooftop projects achieving their CODs after 2020, at the moment, tariff mechanism remains unclear (particularly, whether there will be a new FiT or a competitive auction mechanism or otherwise).

If a third party developer wishes to sell output rooftop solar power to an EVN Power Corporations ("EVN Group"), the developer should have prepared for the rooftop system COD soon to be entitled for FiT 2 with their COD achieved by the end of 2020. If a rooftop system's COD is after the FiT 2 deadline, the developer has to wait for a new tariff mechanism or an auction mechanism to be determined for an applicable tariff to sell to EVN Group.

2.1.4 Tax System in Relation to Rooftop Solar Business

(1) Corporate income tax

As a company established and operating in Vietnam, an investor incorporated in Vietnam is subject to corporate income tax ("CIT") on income from the sale of electricity.

The assessable income is equal to the taxable income minus tax-exempt income if any and loss carried forward if any. The taxable income is equal to turnover minus deductible expenses, plus other income.

The current standard CIT rate is 20%. However, the investor may be entitled to CIT incentives based on the category of manufacturing renewable energy or clean energy (see our discussion on tax incentive section below).

Losses can be carried forward for five consecutive years.

Expenses are generally tax deductible if they are incurred for business purposes and supported by appropriate documents and invoices, except for certain expenses subject to limitations on deduction (e.g. depreciation expense subject to the statutory depreciation rates). In addition, expenses incurred for purchases of VND 20 million or more (including VAT) are tax deductible if these expenses are supported by non-cash payment evidence (e.g. bank transfer or offset).

Current regulations do not provide debt-to-equity ratio requirements except for certain specific industries such as banking, insurance, real estate, etc. However, interest expenses incurred for the purpose of equity contribution (charter capital contribution) are not deductible for tax purposes.

Besides, interest expenses incurred with respect to loan capital (i.e. the difference between the investment capital and the charter capital) are fully deductible if the following conditions are satisfied:

- i. The investors have contributed the registered charter capital in compliance with the registered schedule;
- ii. The company has proper supporting documents (e.g. loan agreements); and
- iii. The company properly registers its offshore medium or long-term loans with the State Bank of Vietnam.

In addition, interest expenses exceeding 30% of Earnings Before Interest, Taxes, Depreciation and Amortization ("EBITDA") are non-deductible under Decree 20 on transfer pricing if the company has any related party transaction (which is not necessary related party loan transaction). Interest expenses incurred in a tax period that is not deducted in the same tax period due to this cap may be carried forward to subsequent 5 tax years.

(2) Value added tax

Assuming that the investor will apply the credit method¹ for VAT filing which is likely the case, the sale of electricity is subject to 10% VAT which is output VAT for the same.

Under the credit method, a Vietnam based subsidiary of the investor can deduct credit of input VAT incurred against output VAT to arrive at the VAT payable. In addition, payment for purchases of VND 20 million (approximately USD 850) or more must be made on a non-cash basis to be qualified for claiming input VAT credit.

¹ A credit method, or credit-invoice method: A method of calculating VAT. Using the credit method, sales transactions are taxed, with the customer informed of the VAT on the transaction, and businesses may receive a credit for VAT paid on input materials and services. It is the most widely employed method, used by all national VATs except for Japan. Another method is the subtraction method currently only used by Japan. It is to apply at the end of a reporting period, a business calculates the value of all taxable sales then subtracts the sum of all taxable purchases and the VAT rate is applied to the difference.

(3) CIT incentives

Under current CIT regulations, income from a new investment project engaged in manufacturing renewable energy or clean energy is entitled to CIT incentives including 10% preferential CIT rate for 15 years, 4-year CIT exemption and subsequent 9-year 50% CIT reduction.

Solar energy is considered a type of renewable energy and is encouraged for development. As such, a project manufacturing solar energy is entitled to the CIT incentive package of 10% preferential CIT rate for 15 years, 4-year CIT exemption and subsequent 9-year 50% CIT reduction.

Under Electricity Sale model, we understand that the substance of this business is solar energy production, generation and sale whereby the Vietnam based subsidiary of the investor installs the rooftop solar photovoltaic systems on the rooftops of the private power consumers' facilities/buildings to generate electricity, then sells the generated electricity to these consumers. As the generation and sale of solar power is considered production of renewable energy, the Vietnam based investor's project under Electricity Sale model may be entitled to the CIT incentive package of 10% preferential CIT rate for 15 years, 4-year CIT exemption and subsequent 9-year 50% CIT reduction.

(4) Import duty incentive

A renewable energy, clean energy generating project such as rooftop solar power project is considered a special preferential project, which is entitled to import duty exemption with respect to imported fixed assets.

In addition, imported materials, supplies and spare parts of special preferential projects that cannot be domestically manufactured are exempt from import duty for five years from the manufacturing commencement date.

As such, a rooftop solar investor who has a going concern registered in Vietnam may be entitled to the above import duty incentives with respect to its business under Electricity Sale model.

2.2 Business Models of Rooftop Solar Power Systems

To develop rooftop solar systems in Vietnam, there are three common business models of rooftop solar contracts:

- (a) Power purchase agreement with EVN on rooftop solar power between power sellers and EVN as power purchaser.
- (b) Private on-site rooftop solar direct PPA between power developer and private power consumers.
- (c) Rooftop solar lease agreement between power developer (as lessor) and private power consumers (as lessee).

In addition to the above common business models, there are two other models to develop a solar rooftop system:

- (d) Rooftop solar service contract revenue sharing (BCC).
- (e) Rooftop solar system deferred payment sale contract.

Each of the above business models have different legal risks and consideration to assess the legal and commercial feasibility and select a business model suitable to investor's plan.

2.3 Key Permits and Approvals for Rooftop Solar Power Systems

2.3.1 Basic Requirements

Summary of key permits and approvals for developing rooftop solar power systems is set out below with professional comments and notes on relevant key factors.

The key process of developing rooftop solar power systems for a foreign investor includes:

- (a) obtaining investment and planning approvals (e.g., power development master, investment registration certificate and investment policy decision (if necessary)).
- (b) obtaining enterprise registration certificate and setting up the single purpose company (i.e., the SPC). This requirement varies if the investor does not want to set up a new company in Vietnam and intends to acquire shares, capital contribution or contribute capital in an existing enterprise. Please see further comparison in section 5 below.
- (c) obtaining construction, environmental protection, fire-fighting approvals for developing the project and then, grid connection, power generation license for project operation.

The specific approvals for rooftop solar power will be assessed and decided on a project-by-project basis and on a case-by-case basis. The specific list approval of a rooftop solar power project depends on the business models, the investment structures of corporate vehicle deploying rooftop solar power as well as certain technical deciding factors.

For example, there is a key technical threshold of the installed capacity of the solar PV system (i.e., whether it is less than 1 MW or 1MW or larger). Different installed solar system capacity leads to different legal implications in relation to the project's power generation license and power development master plan registration. Environmental permits will be based on the used land area and connection information. In addition, for investment approvals, different thresholds are considered based project's scale, capacity and location.

2.3.2 Specific Requirements for Rooftop Solar

The specific approvals for rooftop solar power will depend on the business models, the investments structures of corporate vehicles deploying rooftop solar power as well as the capacity of the solar PV system for each project (i.e., whether it is equal or less than 1MW (AC capacity); or larger than 1MW (AC capacity)).

Key permits and licenses follow, including power generation and grid connection agreement with EVN for the PPA model.

(a) If the capacity is equal or less than 1MW

- (i) Rooftop projects with capacity of equal or less than 1MW (AC capacity) and 1.25 MWp (DC capacity) must be registered for interconnection with EVN's provincial-level power company if the rooftop solar power systems are "directly" or "indirectly" connected with the national or EVN's grids.
- (ii) The information to be provided for registration include: the installation location, capacity scale, proposed electrical lines and interconnection information.
- (iii) A Power Generation License is not required for rooftop projects with capacity of less than 1 MW.
- (iv) Circular No. 18/2020 provides an exemption of a Power Generation License for solar power system that has capacity less than and equal to 1 MW to sell electricity to other organization, individual.

(v) This threshold of 1 MW appears to apply on a system-by-system in term of the exemption from Power Generation License requirement. Under Official Letter No. 7088, MOIT clarifies that a project can be exempted from the Power Generation License requirement if the project with total installed capacity larger than 1MW contains multiple rooftop systems per one location that each system's capacity does not exceed 1 MW.

(b) If the capacity is larger than 1MW

Under the current regulations, for a single rooftop solar power project/system with capacity of larger than 1MW, strictly speaking, the developers are required to apply for, among other things:

- An approval for inclusion of the project in the relevant power development master plan ("PDP"), and
- A Power Generation License.

In relation to the Approval for inclusion of the project in the relevant Power Development Plan, under the Law on Master Planning, this approval is required to be obtained from the MOIT and/or the Prime Minister, and this approval must be obtained before applying for investment and construction of the project.

Under Circular No. 18/2020, for rooftop solar power projects with capacity larger than 1 MW (AC capacity) and 1.25 MWp (DC capacity), the developers are required to apply for a Power Generation License. For the PDP inclusion approval, Circular No. 18/2020 does not mention this requirement and then, regulations of the Law on Master Planning and its associated guidelines will apply (unless developers can apply for special approval/clearance for investments on a case-by-case basis).

2.4 Options of Rooftop Solar Electricity Sale

Generally speaking, other than the typical requirements, there is no major supplements with regard to the key investment and corporate licenses for foreign investors on the rooftop solar sector. The rooftop solar investor must ensure two (2) key investment and corporate licenses to set up a new foreign invested rooftop solar company in Vietnam, including:

- an Investment Registration Certificate ("IRC") for the project; and
- an Enterprise Registration Certificate ("ERC") for the establishment of the Single Purpose Company.

However, for selling power to EVN, strictly speaking, the investor's SPC will need register in the IRC and ERC the business lines "Electricity power generation" or "production and sale of solar electricity" (Sector code under VSIC is 3511) to avoid challenges from EVN Group (unless the investor can manage to seek acceptance and flexibility from EVN's relevant PC for other alternative business lines on a case-by-case basis).

It is because that, unlike in a private PPA model, EVN Group before entering an utility PPA with the investor's SPC will typically check and review the IRC and ERC of the established SPC to ensure necessary business lines are registered by the SPC. ANNEX-4 of APPENDIX 4a sets out further details of business lines and the application documents required for setting rooftop solar SPC.

(a) If the investor wishes to apply for the business lines for power generation and sale of solar electricity in the initial application for IRC, then the DPI as the licensing authority may issue a request for opinions for an in-principle acceptance from MOIT and MPI as the relevant ministries and will only issue the initial IRC after that. If so, the combined timelines for receiving the initial IRC will be prolonged. This will subsequently prolong/delay ERC application for setting up SPC. In case DPI can

waive such kind of consultation (subject to their discretion after application is submitted) and this business line is approved in the initial IRC, then the 2nd application for IRC supplement will no longer be required.

(b) If the investor wishes to exclude, in the initial IRC application, the business lines for power generation and sale of solar electricity, and will do it later after the initial IRC is issued, then the timeline for initial IRC can be shorter, and as a result, ERC (SPC set up) application timeline can be shorter. Overall, the SPC can be established sooner. Accordingly, the investor can save time to carrying out other procedures (bank account opening, tax and employment, using SPC to sign contracts, term sheets, and other matters) in parallel with applying for IRC amendment to supplement power generation and sale of solar electricity.

In both options, the registration of business lines for power generation and sale of solar electricity will take some additional time (sooner or later). Under Option (b), the additional time will take after initial IRC and initial ERC so that the SPC can in parallel proceed with other procedures. After the company has been established, to make its licenses perfect, the company will register for supplements of "Electricity power generation" or "production and sale of solar electricity" to fully satisfy EVN Group requirements.

2.5 Power Sale-Purchase Agreements

An assumption is made that a foreign investor will use a new local company (whether by way of setting up a 100% foreign owned company or acquiring 100% shares in a local company) to conduct its rooftop solar business in Vietnam (in either case, referred to as "the Vietnam based subsidiary"). The Vietnam based subsidiary, as a developer/power seller, is interested in two key models:

- (1) Private Direct Power Purchase Agreement (Private PPA) model: Vietnam based subsidiary installs rooftop solar photovoltaic systems and sells power to private power consumers. Under this model, Vietnam based subsidiary have two sub-models as below:
 - a. Vietnam based subsidiary owns the rooftop solar photovoltaic systems and installs these systems on roofs of private power consumers. Electricity generated from the rooftop solar photovoltaic systems is sold directly to private power consumers. Private power consumers pay electricity price for the consumed electricity to Vietnam based subsidiary. ("Electricity Sale model"); and
 - b. Vietnam based subsidiary owns the rooftop solar photovoltaic systems. Vietnam based subsidiary will lease the rooftop solar photovoltaic systems to private power consumers, install these systems to their rooftops and private power consumers can consume electricity generated from these systems. Private power consumers pay the lease of the rooftop solar photovoltaic systems to Vietnam based subsidiary. ("Equipment Lease model").
- (2) EVN Power Purchase Agreement (EVN PPA) model: Vietnam based subsidiary rents roofs of roof owners and installs the rooftop solar photovoltaic systems on such roofs. Generated electricity will be sold to EVN under a power purchase agreement between Vietnam based subsidiary as power seller and EVN as power buyer. Vietnam based subsidiary as roof lessee pays rental to roof owners as roof lessor under a separate roof-rent contract. Under this structure, Vietnam based subsidiary collects revenue for the sale of power to EVN.
- (3) Combination of Private PPA and Roof-rent Agreement with Roof owner and private power consumer: In case power purchasers are private power consumers (not EVN) and Vietnam based subsidiary enters into (i) a roof rent agreement with the roof owner/lessor; and (ii) a private direct

PPA with power consumers, as two separate contracts (regardless of whether the roof owner and the power consumer are same or different entities), then such private direct PPA is same as the Private PPA under the Electricity Sale model at Section 1(a) above.

2.6 Roof-rent Agreements for Solar Power Systems

To ensure tax deduction for lease payment to rooftop owners, lease payment must be supported by roof rent/lease agreements between the Vietnam based subsidiary of the investor as roof lessee and rooftop owners as roof lessors, proper invoices issued by rooftop owners and lease payment must be paid via bank transfer if the amount is from 20 million VND or more.

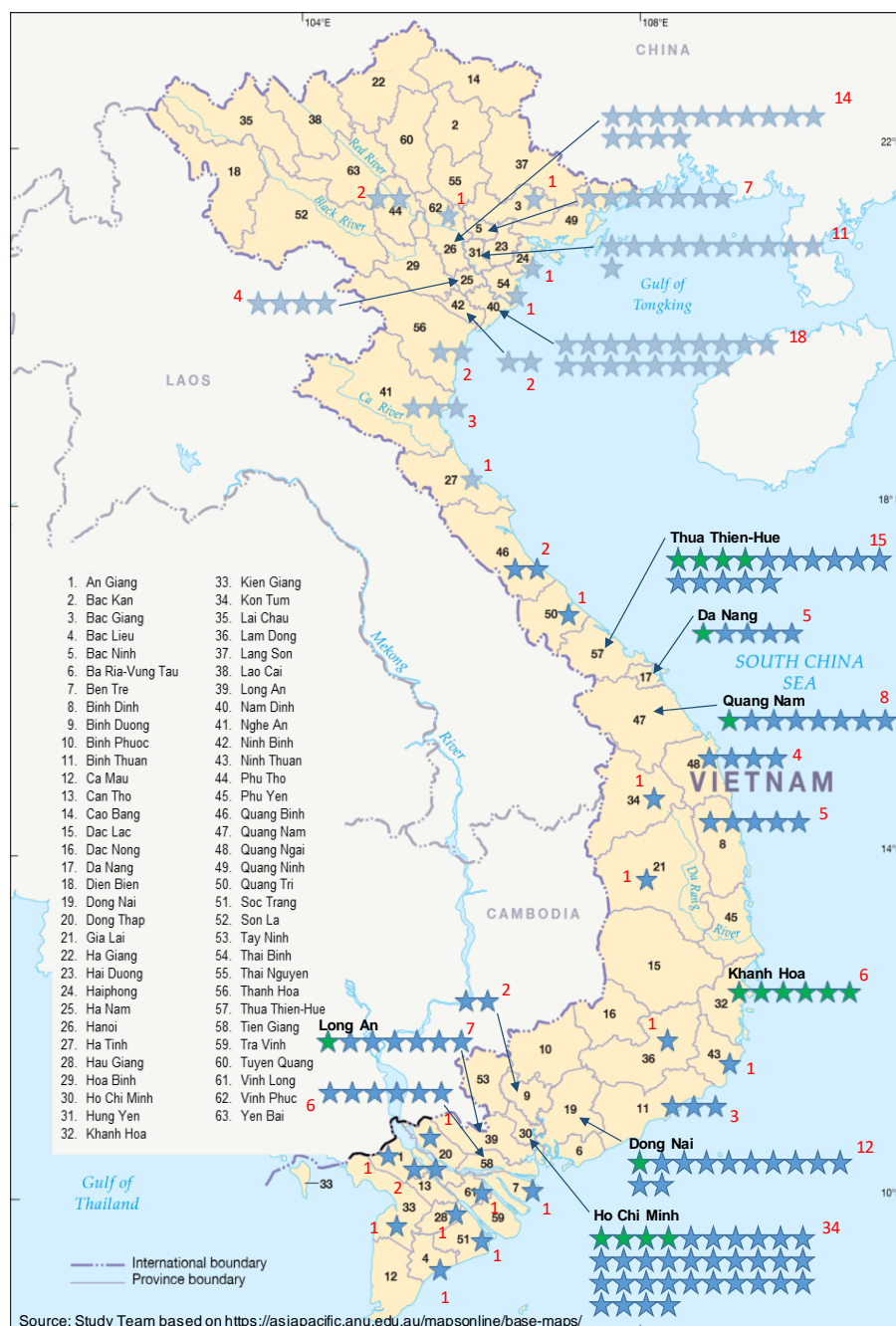
However, if rooftop owners are individuals, tax deduction for the lease payment can be supported by lease contracts and payment vouchers of the lease. Roof rent/lease agreements with individuals should specifically state that the lease includes all applicable taxes payable by individual lessors.

In case power purchasers are private power consumers (not EVN) and the Vietnam based investor's subsidiary enters into (i) a roof rent agreement with the roof owner/lessor; and (ii) a private direct PPA with power consumers, as two separate contracts (regardless of whether the roof owner and the power consumer are same or different entities), then such private direct PPA is same as the Private PPA under the Electricity Sale model.

CHAPTER 3 ROOF SELECTION AND CONCEPT DESIGN

This chapter discusses the potential rooftop sites, screening of the roofs, and the preliminary engineering design for the two priority roofs.

3.1 Location of Potential Project Sites



- ★ 68 factories that have been excluded from the assessment list due to low irradiance
 - ★ 106 factories where the field investigation were not executed out of 124 due to lack of business information
 - ★ 18 factories where the field investigation was executed
- Numbers in red stand for facto

Figure 3.1 Location of Potential Roofs

There exist 192 factories identified as potential RTS sites throughout Vietnam, excluding offices and small buildings of which electricity demand at peak is very small.

These 192 factories may potentially enjoy the electricity benefits from rooftop solar plants. The factories are locations are plotted in Figure 3.1.

It should be noted that there is a large difference in the amount of solar radiance depending on the region, as compared in Figure 3.2. Therefore, priority was given to the factories located in the middle and southern regions where the amount of solar radiance is higher than the north.

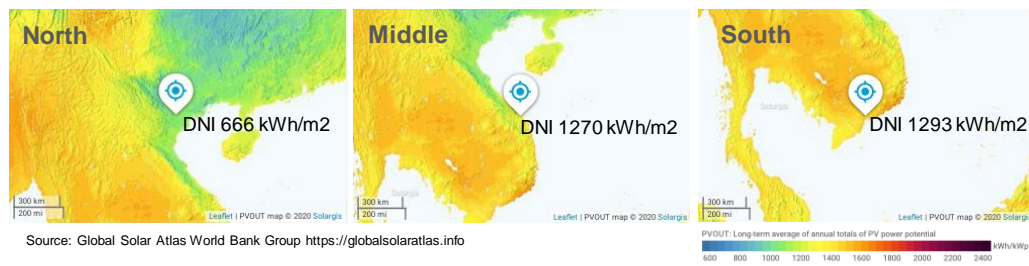


Figure 3.2 Direct Normal Irradiance at North, Middle & South

From the view point of speedy field investigations for the site screening, the Study Team gave priority to factories that showed their positive interest in RTS. The 57 factories fall under this category. Out of these 57, 37 factories are located in the central or southern regions where irradiance is greater. Out of these 37 factories, the field surveys were finally conducted on the 18 factories that were proactive in installing the rooftop solar plant and provided sufficient data in advance. The 18 factories are listed in Table 3.1.

Table 3.1 18 Factories for Field Investigations

Factory Code	Type of Business	Province
8-1	Secondary industry	Long An
8-2	Secondary industry	Long An
8-3	Secondary industry	Long An
10-9	Secondary industry	Quang Nam
10-1	Secondary industry	Quang Nam
11-2	Secondary industry	Hue
11-3	Secondary industry	Hue
11-4	Secondary industry	Hue
11-5	Secondary industry	Hue
14-1	Secondary industry	Hue
16-1	Secondary industry	Hue
18-1	Secondary industry	HCM
19-3	Secondary industry	Khanh Hoa
19-6	Secondary industry	Khanh Hoa
19-a	Secondary industry	Khanh Hoa
19-b	Secondary industry	Khanh Hoa
19-1	Secondary industry	Khanh Hoa
19-2	Secondary industry	Khanh Hoa

The 192 factories are distributed broadly; 68 at North region and 124 at Middle or South regions. In a long-term view for RTS investments, there is a good probability to realize tens of MW class RTS.

3.2 Roof Screening for RTS Development

Field investigations were conducted to the 18 factories and technical assessment were made to each of the factories in terms of:

- Factory type (main manufacturing business),
- Roof area (if it is over 1 ha to accommodate 1MW solar panels), Roof orientation (azimuth) and slope (tilt angle),
- Factory building year (if it does not require reinforcement),
- Operating hours per year (if 100% energy can be sold),
- Electricity source & consumption (if 1MW electricity can be consumed),
- Site conditions & access (construction and maintenance easiness),
- Single line diagram (for engineering design),
- Structural design drawings (for roof strength and safety), and
- Structural calculations (for engineering design).

The technical assessments concluded that 2 factories are good potential for immediate development.

Table 3.2 Results of Field Investigations

ID	Location	Roof (m2)	Likely P (kWac)	Consump. (kWh/day)	Likely Sell (kWh/day)	Notes	Rank
16-1	Đa Nang	10,600	848	42,489	3,507	Dust on roof.	B
11-5	Hue	11,840	947	3,200	3,890	Will not reach 1MW.	B
14-1	Hue	21,000	1,000	110,381	4,134	Dust on roof.	A
10-9	Quang Nam	11,400	1,000	37,100	4,145	Excellent.	A1
10-1		5,000	400	34,200	1,808	Narrow roof.	B
19-3	Khanh Hoa	13,860	1,000	50,000	4,984	Excellent.	A1
19-6		4,515	361		1,805	Narrow roof.	C
19-a		3,612	289		1,444	Narrow roof.	C
19-b		1,970	158		788	Narrow roof.	C
18-1	HCM	12,500	1,000	41,543	4,679	Old building.	B
8-1	Long An	12,000	960	48,000	4,474	3 separated buildings.	A
8-2		6,000	480		2,238	Narrow roof.	C

Note: The following six factories were judged disqualified for RTS screening during the field survey, due to either (a) electricity demand not enough, (b) roof size not enough, or (c) roof strength not enough.

3.3 Preliminary Engineering Design for Priority Roofs

3.3.1 Concept Design

The preliminary engineering design was carried out for the two priority roofs selected in Section 3.2.

Table 3.3 Typical Bill of Quantities Estimated for 1MW class RTS

No	Items	Description	Unit	Quantity	Suppliers
A	SOLAR POWER SYSTEM				
1.	Main Devices				
(1)	PV panel model: JAM72S10; 400Wp mono	capacity range 390-410 Wp	Pcs	3,114	JA solar
(2)	Inverter cabinet 100kW	SUN2000-100KTL-M1	Pcs	10	Huawei – China
(3)	AC String Box (10 MCCB 4P-200A-ICU: 36kA + 1 MCCB 4P-2000A-ICU:65kA)	AC String box 10 input	Pcs	1	Switchgear brand LS, Mitsubishi.

No	Items	Description	Unit	Quantity	Suppliers
(4)	Logger set, controller	logger	Pcs	1	Huawei – China
2.	Connecting materials		Set	1	Domestic Supply
(1)	Low-Pressure Metering Equipment	VietNam			
(2)	Connect to busbar	VietNam			
3.	DC SYSTEM				
(1)	Cable connects PV to the inverter string, PV1-F-1x4mm2	Cu/XLPO/XLPO-1x4mm2	m	35,000	Sun.King Power – China
(2)	HDPE tube	HDPE-32/25	m	1,000	Tan Phat/An Phat HDPE
(3)	Control cable modbus 485 (AWG 18)	AWG 18		240	Alantek – USA
(4)	Connecting material for above cable	MC4 connector (F & M)	pcs	350	Sun.King Power – China
(5)	Racking material for PV module		lot	1	
	Mini rail L=300mm,H=50mm	galvanized iron			Systech
	Fitting for above				Systech
	Support for above				Systech
	Miscellaneous material				Systech
(6)	Midlamp	Anod Aluminium/ AL/6005-T5	Pcs	2,500	Empery – China
(7)	Endclamp	Anod Aluminium/ AL/6005-T6	Pcs	4,500	Empery – China
4.	AC SYSTEM				
(1)	Cable for connecting Inverter to AC combiner Box	0,6/1kV-PVC/XLPE/Cu-(3x70)mm2	m	340	LSvina, Cadivi, Cadisun Thuong Dinh
(2)	HDPE tube connecting cable	HDPE 85/65	m	500	Tan Phat/An Phat HDPE
(3)	Cable for connecting AC combiner	0,6/1kV-PVC/XLPE/Cu-(1x300)mm2	m	120	LSvina, Cadivi, Cadisun Thuong Dinh
(4)	Cose part for connecting cable to equipment		lot	1	
(5)	Ladder		lot	1	Systech
	Cable Ladder	W500H100			Systech
	Cable Ladder	W300H100			Systech
	Accessories for above cable ladder				Systech
	Support material for above cable ladder				Systech
(6)	Walkways & SUS Life line	Hotdip GI	lot	1	
5.	Factory Earthing		All in	1	Domestic Supply
(1)	Earthing Cable	CU/PVC 25sqmm-1C	m	200	LSvina, Cadivi, Cadisun Thuong Dinh
		CU/PVC 10sqmm-1C	m	550	LSvina, Cadivi, Cadisun Thuong Dinh
		CU/PVC 4sqmm-1C	m	10,000	LSvina, Cadivi, Cadisun Thuong Dinh
(2)	Grounding box		Pcs	1	
(3)	Connection Materials for LV Cable		lot	1	
(4)	PVC flexible conduit		lot	1	
(5)	Flexible steel conduit		lot	1	
6.	WATER SUPPLY SYSTEM		All in	1	
(1)	PP-R pipe - DN25 x 2.3t		m	40	Domestic Supply
(2)	PP-R pipe - DN32 x 2.9t		m	240	Domestic Supply
(3)	Bronze ball valve - 10K, screwed - 20A		pcs	10	Domestic Supply
(4)	Bronze ball valve - 10K, screwed - 32A		pcs	2	Domestic Supply
(5)	CV (Screw End) 32A		pcs	1	Domestic Supply
(6)	Y-Strainer (Screw End) 32A		pcs	1	Domestic Supply
(7)	Fitting for above		lot	1	Domestic Supply
(8)	Support for above		lot	1	Domestic Supply
(9)	Miscellaneous material		lot	1	Domestic Supply

No	Items	Description	Unit	Quantity	Suppliers
7.	Surveillance security system				
(1)	Camera IP with 8 chanel.		system	1	
	Camera IP Infrared	2.0 Megapixel	pcs	4	Hikvision
	Camera IP Speed Dome	2.0 Megapixel, 25x	pcs	1	Hikvision
	8-Port 100M PoE Switch		pcs	1	Hikvision
	CAT5 outdoor		lot		Hikvision
	8-channel IP camera recorder		pcs	1	Hikvision
	hard drive	1TB	Pcs	1	Hikvision
(2)	Internet, Internet hub, power supply		lot	1	
B	Labor costs and construction equipment				
1.	Labor				
	Project Manager		staff	1	
	Senior Engineer		staff	1	
	Junior Engineer		staff	3	
	Onsite worker		staff	25	
2.	Construction Equipment				
	Lease of crane		shift	60	
	Lease of forklift truck		shift	60	
3.	Utilities for construction				
	Electricity		kWh	25,000	
	Water		m3	1,000	
	Housing for onsite staff		1/day	1,170	2 people/room
C	Shipping Fee		MWp		
(1)	Container for PV Module	DaNang port - site	Route	5	Container 40feet
(2)	Container for Inverter	DaNang port - site	Route	1	2000kg
(3)	Racking material for PV module	DaNang port - site	Route	1	
(4)	Cable	HaiPhong - site	lot	1	
(5)	AC box	HaNoi - site	lot	1	1500kg
(6)	HDPE tube	DaNang - site	lot	1	
(7)	Ladder	HaNoi - site	lot	1	
D	Survey fee, design fee				
	Construction drawing		DWG	1	Systech
E	Project Management cost		MWp	1	
F	Testing and inspection fees				
(1)	Electricity system quality inspection		MwP	1	Systech and EVN
(2)	Roof structure inspection		root	1	CCB or orther
(3)	Cable quality inspection		lot	1	Quatest1, 2
(4)	AC String Box inspection		Pcs	1	Quatest1, 2
(5)	Inverter inspection		Pcs	10	Quatest1, 2
(6)	String PV testing		string	174	Quatest1, 2
G	Project development				
	PPA with EVN	Optional	MwP	1	Systech
	Roof leasing contract	Optional	MwP	1	Systech

Notes: This BoQ corresponds to 10-9. Its quantities may slightly vary depending on the physical particulars of the roof and factory building structures.

3.3.2 Time Scheduling for RTS Construction

The construction time for one 1MW class RTS was estimated 3.5 months excluding the administrations.

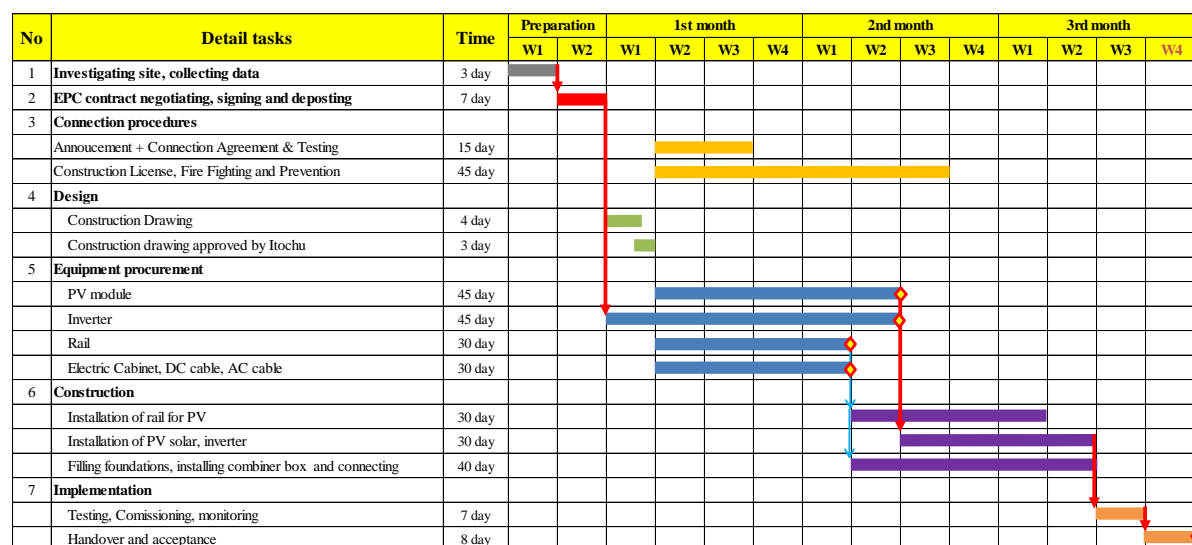


Figure 3.3 Time Schedule for Construction of 1MW Class RTS

3.3.3 Maintenance Planning

The following maintenance rules are expected.

Table 3.4 Recommended Maintenance Rule for 1MW class RTS

No.	Description
1	Monitor operative status and check equipment parameters in the system.
2	Industrial cleaning for equipment: AC box, DC box, inverters, information sets. Inspect status of transformers, system of wires and attached devices. If there is abnormality, it is required to report the owner and recommend timely measures to overcome.
3	Inspect the whole panels in the plant according to contents such as panel temperature, transformer temperature and electric cabinets inside temperature, fuse (inspected by gauging machine), dust on panel surface.
4	Clean all panels. Check all MC4 jacks and system of connection wires to panels. Tighten bolts at the frame and middle, side clamps of cells, maintain panel's grounding system.
5	Implement specific work contents for all equipment according to maintenance procedures: equipment system attached to panels, transformers, low voltage electric cabinet.
6	Implement periodical test on transformer stations in the plant.
7	Unexpected treating tasks during operation

The organization in charge of operation and maintenance should make reporting to the RTS owner regarding:

- Summarizing operative situation of the plant.
- Summarizing implemented tasks. Reporting output and capacity of inverters.
- Errors of solar energy system.
- DZ and TBA systematic errors.

- In-short list of maintenance enumerating all maintenance activities occurring in the month together used supplies and result. Summarizing supplies includes used items, remaining items, comparing inventory with recommended one and replacing planning for used items.
- Technical problems.
- Environmental, safety and health issues.
- Maintenance planning for the next month.
- Evaluating impacts affecting operative capability of solar energy system.

3.3.4 Cost Estimation for RTS Construction

The costs required for one 1MW class RTS are estimated the Vietnamese engineering company to be around USD 1 million. It depends on the physical particulars of the roof geometry and the original factory building structures.

CHAPTER 4 TECHNICAL FEASIBILITY STUDY

4.1 Technical Assessments to Concept Design

4.1.1 Introduction to Technical Assessments

The technical assessment was performed in two parts. The first is an indicative energy yield assessment for the two prospective solar PV rooftop sites in Vietnam, and the second is a technical assessment of the latest design documentation for both sites from the local EPC contractor candidate.

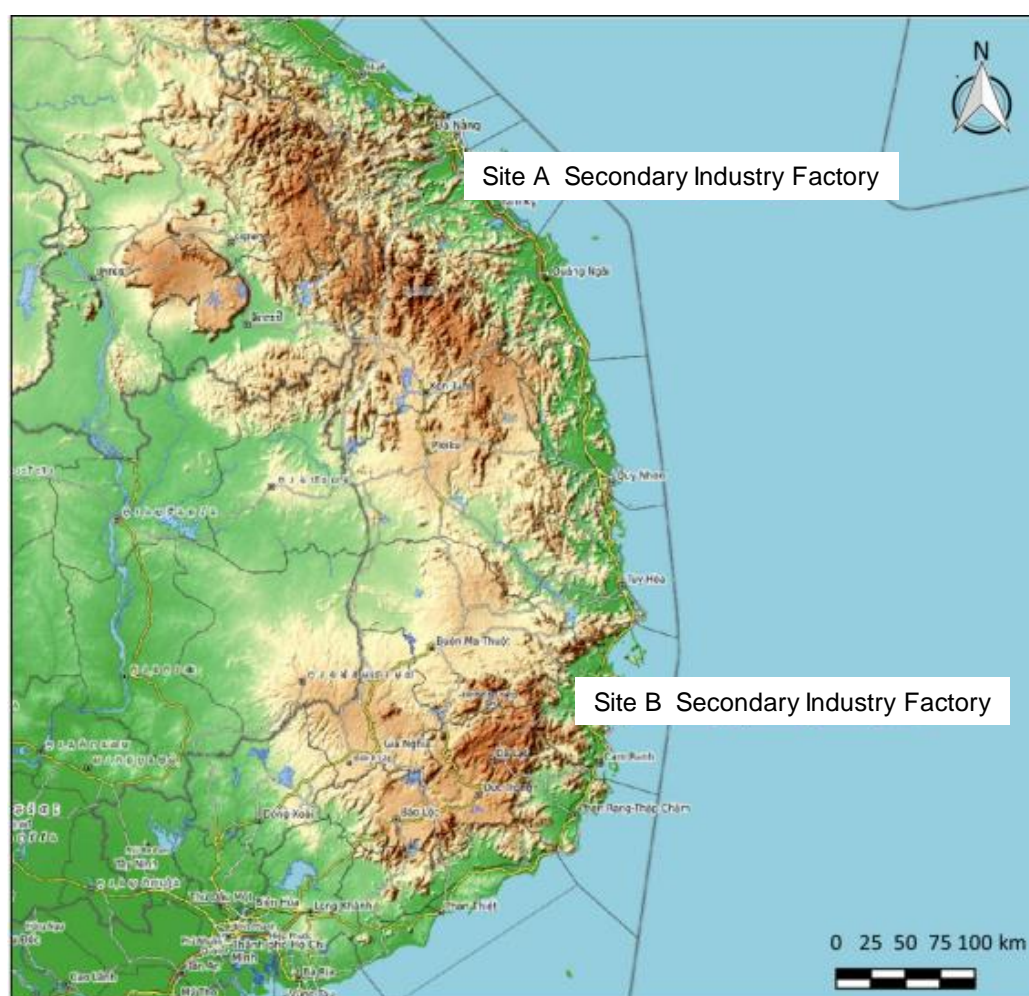


Figure 4.1 Rooftop Solar Portfolio locations

The Portfolio sites are located on the eastern coast of Vietnam, as shown in Figure 4.1. The **Site B** is situated in the Khanh Hoa province in Southern Vietnam, approximately 8km north of Nha Trang city. The site is located in an industrial area and is situated on flat terrain surrounded by hills and mountain ranges. The site is within 5km of the coast. The **Site A** is situated in the Quang Nam province of Central Vietnam, approximately 36km south of Da Nang. The site is located in a rural region and the terrain comprises flat agricultural land. The site lies approximately 6km from the coast.

4.1.2 Concept Design and Proposed Specifications

The study team has conducted a conceptual design and technology review on the two rooftop solar projects in Vietnam (the Projects) being designed by the local EPC contractor candidate.

Both sites had design documentation which detailed the module layout on the roof, cable runs to the inverters, and electrical single line diagrams. Both designs specify the same components, however it is understood that some components such as inverters and PV modules are not yet final for commercial reasons. The designs are very detailed for preliminary design, and only need final component selections and for-construction notes to be made into construction documents. Structural calculations were made available, as well as local EPC contractor's quote which is well itemized in line with scopes of work and materials being provided, indicating full scope coverage. The local EPC Contractor designs for both sites are detailed and well thought-out for a preliminary design, and equal in level of detail, and therefore the following applies to both designs. The design specifies the materials to be used and the location on the structures, as well as cabling sizing. Some site pictures, component documents, and early site visit notes were also provided. Key issues noted in our review are as follows:

- Details on the local EPC contractor's experience as a designer or EPC contractor is limited: even the technical advisor is not in a position to precisely evaluate their capability because of no experience with them. Details on previous rooftop PV projects constructed, CVs of their construction team, as well as their ability to meet project timings should be reviewed prior to financial close.
- The local EPC contractor candidate is to be providing the support structure components per the quote (except for PV module brackets): no warranty or product information are available at this stage other than the structural design. Specification should be made for these to be suitable for corrosion for the anticipated lifetime of the Project.
- Structural calculations are preliminary in nature, and although they generally cover the key considerations for checking the roof structure, the technical advisor raised issues with (i) missing documentation for Site B, (ii) live load estimates being very low, (iii) construction logistics on such a roof, and (iv) wind loading not having been fully considered. The study team takes these matters serious, and must be remedied in order for the design to be acceptable.
- The electrical designs pose no particular issues, however final PV module and inverter selection need to be confirmed to ensure all designs are within specification and the electrical design calculations should be included in the design documentation package.

4.1.3 Grid connection consideration

It is understood that the investor wishes to not be involved with any grid connection agreement and wants the Projects to be able to operate independently of the grid. The Project's electrical diagrams show the combined AC output from the inverters terminating on the 400V side of the factory site transformers, and as currently designed and specified, both designs will allow grid export. The study team has made recommendations on what needs to be considered to ensure generation is not exported but used only by the factories. The main points of consideration are as follows:

- The current meter which the solar PV inverters control based on needs to measure the factory load in order to shut down when factory load is not available.
- A study on load profile needs to be considered for inverter operation strategy, as well as the inverter specifications and manufacturer operating recommendations aligning with this sort of arrangement. Some suppliers may not recommend this.

It may be that there is ample factory daytime load to never allow the solar facility to need to curtail output, but this needs to be confirmed with a loading study and ensure the inverters are operated accordingly and within specification.

4.1.4 Cost Estimation

Cost estimations have been reviewed from the local EPC Contractor candidate's quote for each site. The pricing in USD (\$) for the modules, inverters, and overall construction can be evaluated reasonable, because it is in line with the qualified engineer's expectations and typical industry pricing..

4.1.5 Estimated Time Schedule for Engineering, Procurement, and Construction

The local EPC Contractor candidate has provided an indicative construction schedule dated 10 April 2020, shown in Figure 4.2. The timeline gives a construction period of 12 weeks which is in line with the qualified engineer's expectations for construction of a rooftop solar PV installation of the sizes being considered for Sites A and B. The potential concerns in technical matters, most notably structural loading, finalization of design, and establishing an appropriate non grid exporting arrangement might be critical to being fully remedied or mitigated in order to support the proposed construction schedule timing, and should be completed in advance of the EPC contract signing.

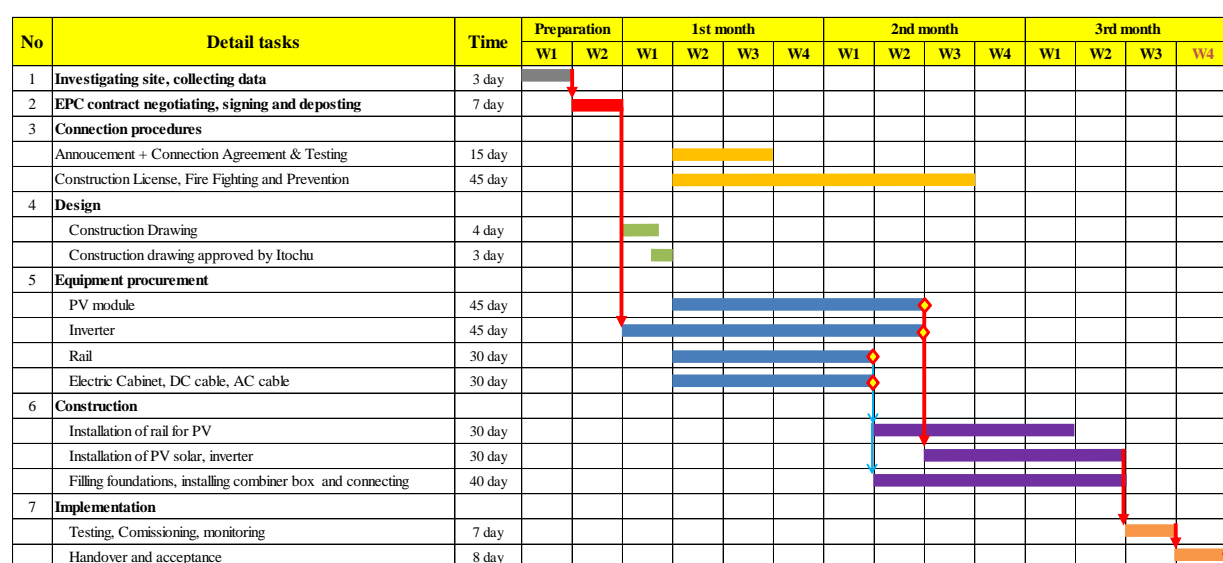


Figure 4.2 Preliminary Construction Time Schedule

4.2 Energy Yield

4.2.1 Energy Yield Estimation

Upon starting the roof priority selection, prior to the detailed energy assessments by the study team, executed its own energy yield estimation. The average energy yield was estimated at 1,625 MWh/year. The energy yields of P75 and P90 have been estimated to be 1,454 MWh/year and 1,346 MWh/year, respectively.

Table 4.1 Preliminary Estimation of Energy Yield

Preliminary assessment of the photovoltaic electricity production

Project Site B

Report generated 09 Sep 2020

Generated by Global Solar Atlas

Estimated Yearly Energy Yields (MWh)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
88	113	147	165	183	167	165	161	144	121	93	77	1625

4.2.2 Energy Yield Assessments

For the indicative energy yield assessment, on behalf of the study team, the technical advisor has sourced Solargis long-term reference solar resource data for the analysis at both sites. The sites are located approximately 390km apart, hence a separate Solargis dataset is required for each site location. The purchased datasets provide historical time series data for the period of July 2006 to September 2020, a total of 14.2 years.

For both sites in the Rooftop Solar Portfolio, the modules are to be installed on the rooftops of factory buildings connected through 10 string inverters. Design information provided for both sites has indicated that the inverters will be connected directly to a 400V switchboard and it is assumed that all available solar generation will be used exclusively by the factory load with no grid export.

The study team has prepared a list of preferred module manufacturers based on lenders' information that can be considered for the proposed developments. Based on this list and the technical advisor's experience with recent projects and market projections, the Longi Solar, LR4-72HPH-425M G2 425Wp module has been selected by the study team for the purpose of this assessment. The module is of monocrystalline PERC technology. The 425Wp module was selected to meet the criteria of a minimum 400Wp.

Table 4.2 Rooftop Solar Portfolio Energy Production Estimated

Parameter	Site B	Site A	Unit
Solar PV capacity	1,224	1,224	kWp
Effective AC capacity	1,000	1,000	kW
Average annual irradiation (GHI)	1,942	1,768	kWh/m ²
In-plane average annual irradiation (GTI)	1,940	1,762	kWh/m ²
P50 net energy yield ¹	1,875	1,695	MWh
Performance Ratio ¹	79	78.6	%
Specific yield ¹	1,532	1,385	kWh/kWp

Note: 1. All values reported here are representative of Year 0, excluding annual degradation.

Table 4.3 Key equipment details

Key equipment	Site B	Site A
PV Module tilt	5.7° / 10%	7.4 ° / 13%
PV Module	LR4-72HPH-425M G2	LR4-72HPH-425M G2
PV module rated capacity	425 Wp	425 Wp
Module quantity	2880	2880
Inverter	Huawei Technologies SUN2000-100KTL-M1	Huawei Technologies SUN2000-100KTL-M1
Inverter quantity	10	10
Transformer (MV)	No transformer required	No transformer required
Installation system	Rooftop	Rooftop

4.3 Conclusion and Recommendations for Development Stage

The study team has undertaken an indicative analysis of the expected long-term energy yield of the two proposed sites. The following conclusions are drawn:

1. Long-term Solargis reference data has been used in the assessment of long-term resource at the sites and generation of the TMY (Typical Monthly Yield).
2. The two installations were modelled using PVsyst software based on the data obtained. The installations consist of rooftop mounted modules combined with string inverters.
3. The predicted long-term TMY was used in conjunction with PVsyst software and the technical advisor in-house tools to calculate the energy yield of the Projects. Energy losses have been calculated or assumed.

The following recommendations are made by the technical advisor in order to improve the accuracy of energy yield results obtained:

1. Should refinements to the design be made as the developments progress, it is recommended that the energy production assessments are updated accordingly, including revision of the loss assumptions applied.
2. It is recommended that additional commercial and technical due diligence is undertaken prior to selection of module manufacturer and type.
3. It is recommended that a site visit is undertaken to confirm the presence and dimensions of shading objects.
4. It is recommended that a soiling study is completed in order to more accurately quantify the soiling loss at each site, given the likely presence of industrial airborne particulate.
5. It is recommended that electrical loss studies are completed to quantify the energy loss for both the DC and AC cabling at each site.
6. It is recommended that independent verification of the .pan and .ond equipment files in order to confirm their level of performance.
7. It is assumed that the Spinning Factories do not have back-up power supplies and therefore that the solar installations will be reliant on power from the grid in order to operate. It is therefore recommended that the grid operator is contacted to discuss the likelihood of any grid events throughout the life of the plant that may impact the energy yield. Extended outages or constraint scenarios should be applied separately to the yield results presented the technical advisor recommends that a site-specific independent grid study is conducted, in order to provide a robust assumption of the grid availability during the operational life of the plant.
8. It is recommended that the annual degradation assumption applied in the analyses is validated against module testing records and updated as soon as they become available.

Regarding the technical assessment, the following conclusions are drawn:

1. Design documentation is good for a preliminary stage, however further analysis and detail is needed to be ready for construction.
2. The local EPC Contractor candidate quote and construction schedule are generally in line with the international qualified engineer's expectations for projects of this scale for an experienced solar PV rooftop EPC contractor.

The following be considered in order for the investor to have the design be acceptable for construction:

1. Evidence of the local EPC Contractor candidate's ability to deliver the Project in a timely and competent manner needs to be reviewed. The study team was not provided with any portfolio of experience or evidence of the local EPC contractor's abilities.
2. Details of the structural components and warranties need to be reviewed, as well as the PV modules and inverters when finally selected.

3. Structural calculations appear to have low live loads and no wind loading included: these need to be reviewed by a certified in-country structural engineer to validate building code compliance. Further complicating this, no original factory design documentation was available for Site B: this needs to be obtained or reverse engineered in order to validate the structural calculations for Site B.
4. In order for the Projects to not export electricity to the grid, the electrical design will need to be modified and validated as appropriate for the inverter supplier selected. It is important to verify that inverter warranties are not voided, and that operation of the facilities and solar PV installations are not adversely impacted. Additional investigations may include facility load profile studies and other power quality verifications for the electrical design.

4.4 Potential Environmental and Social Impacts and Mitigating Measures

(1) Construction Phase

The construction phase will have site-specific impacts.

There will be a small, temporary increase in traffic in the local vicinity to complete the construction works which is considered to have localized impact. Fences will be erected around the parameter for security and occupational health and safety purposes.

Electrical works do not have any negative environmental impact and only trained, qualified professionals install electricity equipment. All equipment safety checks and sign off was completed by a qualified electrician.

(2) Operations Phase

The operation of the solar power project does not have adverse environmental impacts or emissions, but rather will reduce consumption of large quantities of diesel fuel.

In order to maximize solar efficiency, the panels must be free of dirt particles and cleaned regularly. Panels required more cleaning in the dry season than the wet season to remove dust and suspended non-toxic particles. Approximately 200 liters of water per row, is typically consumed for cleaning purposes. Rainwater tanks will be installed to reduce the burden of water consumption for cleaning from the local area during the dry season.

The operations phase is unlikely to generate significant solid waste.

(3) Decommissioning Phase

The project has a lifespan of 20 years based on the timeframe of the roof lease agreement and durability of solar panels and equipment installed. Although there is potential for the life of the project to be extended, it is anticipated that solar panels and associated equipment will need to be disposed of either on decommissioning of the project or when damaged equipment cannot be repaired.

A Decommissioning and Recycling Plan need be prepared to outline the procedures for handling and disposing of all materials and equipment at the conclusion of the Power Purchase Agreement. The importation of foreign products was minimized to reduce risk, and upon decommissioning, products will either be recycled locally or returned to the manufacturer for disposal. The Plan will comply with the Vietnamese regulations including development consent conditions. It is the company's intention to restore the site to pre-project state upon decommissioning of the project.

4.5 Estimated CO₂ Emission Reduction

The roof that can be finally installed is expected to be about 50 MW. Under this assumption, CO₂ emission reduction is computed to be 60 to 65 thousand tCO₂ per year.

Table 4.4 CO₂ Emission Reduction

Parameter	Description	Value 1	Value 2	Unit
-	The project is a development of geothermal power plant	No	No	
-	The project is a development of hydro power plant and CH ₄ emission from reservoirs of hydro power plants is significant	No	No	
EG _y	Power generation by the renewable energy system in year y	80,325	80,325	MWh/year
EF _{elec}	CO ₂ emission factor of the electricity	0.8154	0.75	tCO ₂ /MWh
EF _{Res}	Default emission factor for emissions from reservoirs of hydro power plants	0	0	kgCO ₂ -eq/MWh
W _{Main,CO2}	Average mass fraction of carbon dioxide in the produced steam			tCO ₂ /t
W _{Main,CH4}	Average mass fraction of methane in the produced steam			tCH ₄ /t
GWP _{CH4}	Global warming potential of methane	0	0	tCO ₂ /tCH ₄
M _{S,y}	Quantity of steam produced in year y			t/year
FC _{i,y}	Consumption of fossil fuel i at the power plant in year y			t/year
NCV _i	Net calorific value of the fossil fuel i			TJ/t
EF _{fuel,i}	CO ₂ emission factor of the fossil fuel i			tCO ₂ /TJ
	CO₂ Emission Reduction	65,497	60,244	tCO₂/year

Emission factor 0.8154 tCO₂/MWh for Value 1 comes from the Vietnamese Government (IGES's List of Grid Emission Factors updated in August 2017).

Emission factor 0.75 tCO₂/MWh for Value 2 is based on GHG Inventory of Ho Chi Minh City, JICA.
https://www.jica.go.jp/project/vietnam/036/activities/achievement02/ku57pq0000225lin-att/GHG_Inventory_of_Ho_Chi_Minh_City.pdf

CHAPTER 5 FINANCIAL STUDY

5.1 Introduction to Financial Study

The intent of this chapter is to provide the in-depth financial study being composed of the financial advisor's review and advice on the commercial and financial aspects of the Project. The financing feasibility of the Project and the different financing structures available to the Project will be also presented in this financial study.

5.2 Overview of Vietnam's Electricity Market

In this section we discuss a general overview of Vietnam's electricity market structure and regulatory framework, as well as the demand and supply dynamics of the country's electricity market. Based on the information that we have obtained, there is a need for a continued addition in renewable generation capacity to meet growing electricity demand. This is due to the following factors:

- Positive economic growth fundamentals in Vietnam will continue to stimulate an ongoing increase in power demand and consumption over the coming decade. As of Mar 2020, Fitch Solutions forecasts power consumption in Vietnam to grow by an annual average of 6.5% between 2020 and 2029, which remains one of the fastest growth rates in Asiaⁱ.
- The Vietnamese government's projections are more bullish than Fitch Solution's, with the Deputy Minister of Industry and Trade Hoang Quoc Vuong mentioning that electricity demand will increase on average about 7.5 – 8.0% per year from now till 2030 at a seminar on 18 September 2020ⁱⁱ.
- To meet Vietnam's growing electricity demand, the Vietnamese government forecasts that generation capacity has to increase by more than double (from 55 GW in 2020) to 131 GW by 2030 – an additional 7,500 MW of generation capacity per year.
- Renewables capacity is expected to grow significantly to account for 15 – 20% of installed capacity in 2030, which translates to about 20GW of new renewables capacity to be installed in the following 10 years.

Rooftop Solar Developments

In order to meet the nation's growing demand for electricity, on 6 April 2020, Vietnam's Prime Minister issued Decision 13 which became effective on 22 May 2020. This introduced regulations to encourage the development of solar power in Vietnam, including measures to encourage the development of rooftop solar projects. This Decision encompasses the sale of electricity from rooftop solar systems to private (i.e. non-EVN) off-takers under a direct corporate PPA which is open to negotiation (subject to applicable laws and regulations), thus paving the way for a non-Vietnamese investor to consider pursuing this Project.

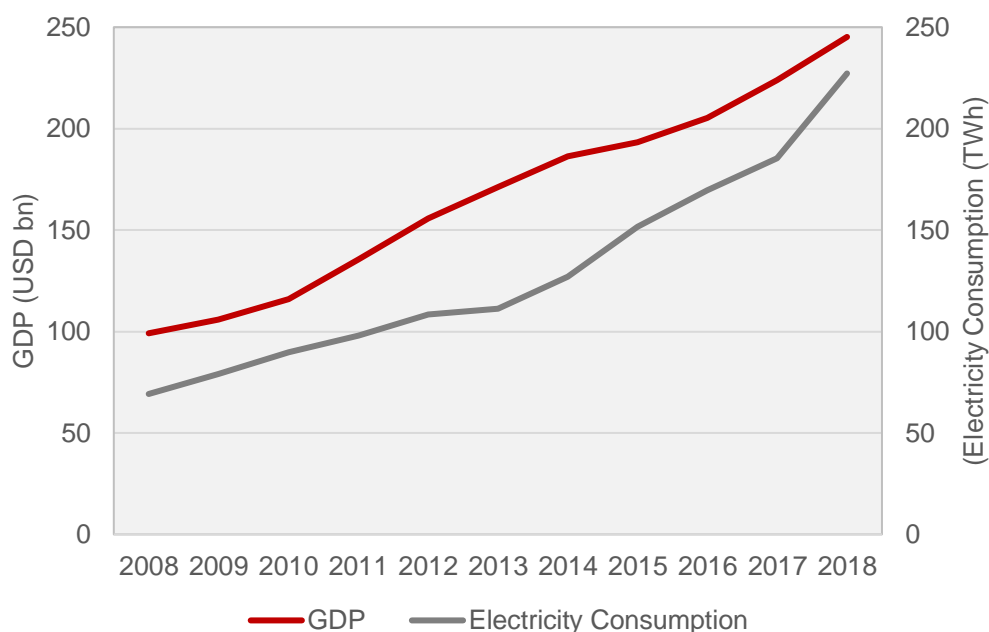


Figure 5.1 Vietnam GDP & Electricity Consumption (2008–2018)

5.3 Project Structure and Key Parties

It is envisaged that the Project Company holds the entire portfolio of 50MW of rooftop solar PV assets and enter into power purchase agreements (“PPAs”) with up to 50 different off-takers.

In general, third-party EPC Contractor(s) will be engaged for the design, construction and delivery of the rooftops solar systems (“RTS”) on a lump-sum, turnkey and date-certain basis. Key equipment will be procured from top tier OEMs with industry standard defect and performance warranties. After the installation and delivery of the RTS, the Project Company will be responsible for operation and maintenance of RTS system. The Project Company is assumed to be adequately resourced to undertake this task.

Targeted off-takers are subsidiaries and/or affiliates of Vietnam’s state-owned companies, as well as local subsidiaries of well-established Japanese companies, under long-term PPAs. After expiry of the PPA, the RTS system will be transferred to the off-taker at zero or nominal value.

The contractual structure and commercial arrangements planned for the Project are similar and in line with other commercial & industrial solar transactions that we have seen in the region.

The targeted off-takers are expected to be of good parentage and to be important manufacturing entities within their respective groups, and would therefore benefit from additional management, resources and technical support available to them as part of a larger group, compared to standalone small medium businesses.

Nevertheless, it is important to choose an appropriate methodology to assess off-takers so as to ensure better quality off-takers (as discussed in the following pages), because parent companies will not be providing any corporate guarantee or credit enhancement for the off-takers.

5.4 Methodology to Assess Off-Takers

A point-based scoring approach often applied for large companies does not fit well with the off-taker portfolio for this RTS projects.

Nevertheless, it should be noted that in the market sounding most international / regional lenders have expressed concerns on local Vietnamese counterparties as off-takers without corporate guarantee/credit enhancement as their institutions are not able (or would be difficult) to consider/evaluate long-term off-take risk on SME profile type entities. As such the RTS investor might want to consider further mitigants to enhance the bankability of the off-takers; some measures observed include asking for higher deposits or even SBLCs* and also having implicit support from the parent of the multi-national corporations' subsidiary.

* SBLC: Standby letter of credit. It is a legal document that guarantees a bank's commitment of payment to a seller in the event that the buyer—or the bank's client—defaults on the agreement.

5.5 Review of Power Purchase Agreement Template

The study team has engaged a global law firm with significant projects experience in the region to advise on and structure the draft PPA, in order to ensure that the draft PPA contains key terms and provisions customary and expected of project financing.

In the PPA, the Project Company is called “Developer”, the off-taker is the “Client” and the rooftop solar system is the “Generating Facility”. Key commercial arrangements are:

- The Client is obligated to purchase all Energy Output of the Generating Facility, regardless of actual electricity consumed which eliminates the risk of curtailment.
- The PPA tariff is expected to be slightly lower than the applicable EVN retail tariff¹. There are costs and benefits to this approach. We note that some international/regional lenders have also expressed reservations on the inability to have a direct USD-VND indexation included in the PPA tariff formulation. However some lenders may be persuaded to accept this PPA tariff subject to further due diligence.
- The Client is responsible for granting access to the Site and Premises. In the event that the Client no longer owns or leases the Site / Premises, it has to procure novation of the PPA to the new owner or lessor (subject to counterparty and terms being satisfactory to the Developer) or otherwise provide an alternative site satisfactory to the Developer; failing which, the Developer can terminate the PPA with termination payment due from the Client.
- Force majeure provisions consistent with similar utility scale power projects which excuse the affected party from performance of its obligations and allows either party to terminate the PPA for prolonged force majeure.
- The governing law and seat of arbitration being considered are Vietnamese law with arbitration to be resolved by the International Arbitration Centre which is in line with international financings in Vietnam that we have seen in the renewables and energy sectors.

The study team has sought market feedback on some of the key terms listed above. Most international/regional lenders have reverted that arbitration needs to be resolved in an international arbitration center. As mentioned earlier, Therefore, the investor should consider requesting for credit enhancement such as higher deposits as well as implicit support from the parent company for the PPA.

¹ EVN retail tariff is categorized by manufacturing industries, administrative offices, business or household – manufacturing industries should apply given profile of targeted off-takers.

The other key terms are broadly in line with those for similar commercial and industrial (“C&I”) solar projects being executed in the region.

Use of EVN Retail Tariff in the Corporate PPA

The study team has reviewed and analyzed the EVN retail tariff’s historical escalation, regulation for tariff adjustments as well as its correlation with Vietnam CPI and VND-USD FX rate changes respectively, and conclude that EVN’s adjustment of the retail tariff has historically provided a reasonable correlation with inflation and exchange rate movements of VND-USD and hence could provide a natural hedge against these parameters in the PPA, should the preferred route for most lenders (who responded on the market sounding exercise) of having VND-USD indexation not be possible, due to structure/regulations.

5.6 Financing: Liquidity & Options

Based on precedent and ongoing project financing transactions of renewables in the region, it is believed that there are several potential sources of financing for the Project, such as loans from international / regional commercial banks and local Vietnamese commercial banks.

The borrowing currency can be denominated in US dollars or Vietnamese dong, but both need to ensure be sufficient liquidity for both currencies subject to satisfactory downside mitigation.

5.6.1 Financing: Bank Sounding & Recommendation

Market sounding was conducted over Oct and Nov 2020 to obtain indicative high-level feedback and response in order to find out which option would provide the better liquidity and financing terms.

Based on our key findings, the optimal financing structure is via a USD term loan on mini-perm basis with legal tenor and notional tenor which some international/regional banks have indicated they can consider; a legal advisor is to be further consulted on refinancing structure/approvals in view of Vietnam laws and regulations.

This financing structure is recommended as it (1) provides lower costs of financing for the Project, (2) FX and interest rate risks can be hedged by USD-VND cross currency swaps and (3) multi-year mini-perm dovetails which should be more acceptable to lenders as at refinancing lenders can reassess debt size taking into account USD-VND FX and CCS rates then.

JICA Private-Sector Investment Finance (PSIF) is one of the potential lenders to form the financing structure.



Figure 5.2 Criteria for PSIF

Table 5.1 PSIF Major Terms for Debt

Amount	\$10M - \$150M as typical ticket size. Maximum amount of JICA loan should be equal to the lead co-financier (or, sometimes 70% of total project cost)
Currency	JPY, USD, EUR, and Local Currencies (through cross-currency swap operation)
Interest Rate	JPY: FILP Rate* + Margin (Fixed) USD: 6 month LIBOR + Margin (Floating) Country risk premium is not included in the Margin LCY: Swap rate equivalent to JPY Interest Rate (Fixed/Floating)
Tenor	Up to 20 years (door to door: with grace period of up to 5 years depending on project cash flow) Generally longer than commercial loan especially for Corporate and FI Loan
Repayment	Semi-annual repayments
Fees	Same rate of front end fee and any other fees applicable with co-financiers.
Safeguards	Standard and customary security package including financial covenants
Security	Compliance with JICA's Environmental and Social Guidelines

* FILP (Fiscal Investment and Loan Program) Rate is long term low interest funding by the Japanese government to achieve policy objectives and utilized by Japanese official agencies such as JICA. Currently FILP rate for 10 years is 0.01% p.a.

Table 5.2 PSIF Major Terms for Equity

Amount	Max. 25% of total capital (PE) / fund size as a Minority Investor \$5M - \$20M as typical size for private equity investment \$10M - \$50M as typical size for fund LP investment
Currency	No currency limitation in principle
EIRR	To be determined by evaluating the level of risk.
Exit Strategy	Exit Strategy is MUST and agreed among shareholders 5-7 years as typical investment period with various Exit Strategy e.g. strategic sale (put option), trade sale (M&A), market sale (IPO), etc.
Necessity	Strong reason for JICA participation in case of private equity investment e.g. sovereign hook, business model that requires patient capital, etc.
Safeguards	Compliance with JICA's Environmental and Social Guidelines

Source: Pre-TICAD Seminar, JICA, Feb. 2019

5.6.2 Financial Model: Indicative Project Financials

The Project financial model and indicative financials have been prepared and reviewed by the potential RTS investor.

Total investment costs are currently estimated to be less than US\$1.0 million / MW. The total investment costs encompass the typical categories: EPC costs (inclusive of insurance costs), other pre-COD cost and financing costs.

The financing program is envisaged to be rolled out in two phases.

- Phase 1: The investor will fund the total investment costs by equity during the construction period for the first phase.
- Phase 2: Financial close with the first debt drawdown to refinance a comfortable proportion of the total investment costs. Subsequent drawdowns will occur following the completion of each batch of the subprojects.

The key assumptions have been introduced, such as investment costs, solar yield, degradation and O&M costs. Debt assumptions are based on feedback from prospective lenders, while tax assumptions were based on advice from a legal advisor. VND depreciation was based on historical trends.

These assumptions introduced have been confirmed generally in line with the other transactions that we have seen in the ASEAN region and is evaluated adequate at this stage for analysis and evaluation.

5.6.3 Results of Financial Analysis

Based on the market feedback from the bank sounding exercise, the Financial Advisor examined the financial analyses. The key indicators are:

Project IRR is around 10% in the base case.

Sensitivity analysis on project was conducted to assess the impacts if energy yield is 10% less, and/or if O&M cost is more expensive than the base case estimation. In conclusion, the return on investment will not diminish the willingness of typical foreign investors to invest.

5.7 Key Risks and Mitigations

Based on market feedback the key risks to consider are the off-taker risk as well as the FX / interest rate exposure. As mentioned earlier, some international/regional lenders have raised concerns around off-take risk of local Vietnamese counterparties with SME profile and/or no parent corporate guarantee/credit enhancement, as well as the potential FX exposure, citing these as reasons for not responding to the market sounding. This could limit the liquidity of USD financing available, as well

as amount of leverage and tenor that the project can undertake as commercial lenders (and even ADB) might not want to be exposed to this possibility of a mismatch.

The investor should consider requesting for higher deposits or even SBLCs as well as implicit support from the parent companies as mitigants for the off-taker risk. As for the FX exposure, one should think of procuring full short-year FX hedges for the USD financing and enter into new FX hedges when the original FX hedges expire; subject to further discussions and agreement with shortlisted lenders.

Local currency funding has the issue of high interest rates and inability to hedge beyond a couple of years. This exposes the project comp

Given the relatively small financing amount required, we believe that there should be sufficient international/local lenders who can support the financing on the basis stated above, subject to further due diligence and structuring (e.g. further assessments/credit enhancement on the off-takers). The table below summarizes the most critical risks that need to be considered for financing this proposed Project.

Table 5.3 Summary of Key Risks and Mitigants

Risk	Key issue & Mitigants
Tariff Risk	The PPA tariff may be subject to EVN retail tariff. Further study should be added before the project goes into its development.
FX Risk	Project revenue is assumed 100% VND, while the foreign investor puts its foreign currency as equity. This may result FX risks, especially when the VND depreciates more than expected. Further study should be added before the project goes into its development.
Offtake Risk	The financial profile of off-takers might not be providing a corporate guarantee or the like. Further study should be added before the project goes into its development.

ⁱ Asian Power. (04 March 2020). COVID-19 to weigh on Vietnam's power consumption in 2020. Extracted from: <https://asian-power.com/power-utility/news/covid-19-weigh-vietnams-power-consumption-in-2020>.

ⁱⁱ Hanoi Times. (20 September 2020). Vietnam encourages private investment in power industry with new master plan. Extracted from: <http://hanoitimes.vn/vietnam-encourages-private-investment-in-power-industry-with-new-master-plan-314256.html>