

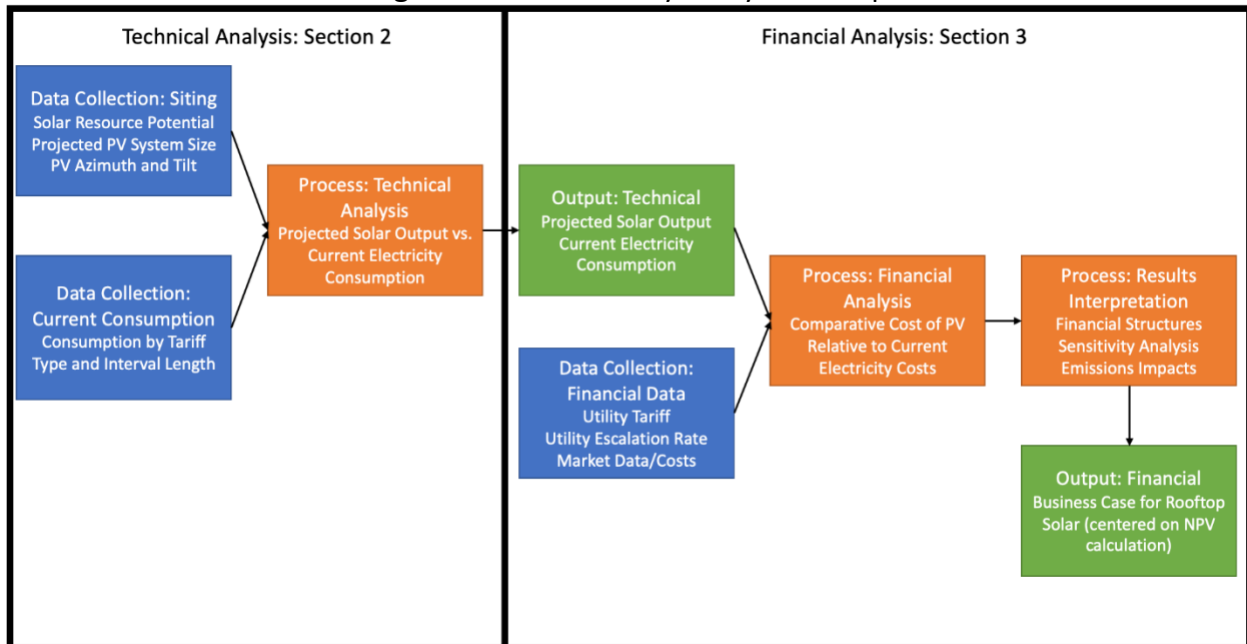
Toolkit 2: CEIA Vietnam Pre-Feasibility User Guide

SECTION 1: OVERVIEW

This Pre-Feasibility User Guide will enable users to evaluate the business case for procuring rooftop solar photovoltaic (“PV”). This toolkit will do so by providing quantitative financial and technical estimates to help determine a project’s viability for a company’s given facility. This Guide will walk users through the steps of the Pre-Feasibility Study, to include: 1) outlining data collection requirements and procedures, 2) describing the technical and financial analyses users should execute, and 3) linking to templates and tools that can help the user through this process.

The Guide is broken into three sections, including this Section 1 introductory overview. Section 2 (technical analysis) and Section 3 (financial analysis) are outlined in the Pre-Feasibility Study Process Roadmap in Figure 1. Appendix A lists and summarizes all the tools and templates referenced in the three sections.

Figure 1: Pre-Feasibility Study Roadmap



The analysis process begins with Section 2’s technical analysis. First, technical data on a PV installation’s potential location and current consumption is collected. This data is then analyzed to project how much PV energy a system might generate and compare it to the facility’s current electricity consumption. These outputs then serve as key inputs for Section 3’s financial analysis.

Section 3 explains how financial data on utility tariffs/rates and market data/costs are collected and combined with technical outputs. The financial analysis then produces a cost of PV in comparison to current electricity costs, usually through a net present value (“NPV”) calculation. This financial analysis is then supplemented with additional results-interpretation steps, such as conducting sensitivity analyses on key inputs, analyzing alternative procurement models, and calculating emissions impacts. The combined outputs of these two analyses (technical and financial) can generate a clearer cost-benefit picture of the business case for rooftop PV for a particular site.

SECTION 2: TECHNICAL ANALYSIS

The technical analysis of the Pre-Feasibility Study requires collecting data about the site where PV might be installed, and the site’s current electricity consumption. These data are input into a technical analysis model, which then calculates projected PV electricity output and compares it to current site electricity consumption. This comparison output is a critical input for the financial analysis process described in Section 3.

Subsections 2.1 and 2.2 detail the step-by-step processes for how to collect this “site” data and current electricity consumption data, respectively. These subsections will also include brief descriptions of each type of technical data, why they matter, and where to source the data (if necessary).

Subsection 2.3 describes the process for calculating projected PV electricity output and a site’s current electricity consumption. This subsection will introduce, and link to, some tools which can be used to conduct the technical analysis. It will also provide a template for comparing projected PV electricity output and current site electricity consumption.

Subsection 2.1: Data for collection—project site

The items below are sets of data on the physical site where the PV is to be installed, that the user should initially collect.

Item 1: Site-specific solar resource data

What is it? *Site-specific solar resource data* shows how much energy from the sun hits a specific location on the Earth, over a set period of time. This is easily translated into how much electricity a PV panel can generate in that location. Users can estimate how much PV output is possible per kilowatt peak (“kWp”) at their location by inputting their site’s coordinates, or address, into the Global Solar Atlas website linked below. Additionally, the tools described in Subsection 2.3 (technical analysis process) will have embedded solar resource data, so users can simply input their site’s geographic coordinates.

Why it matters? Given the variance of solar resource endowments across Vietnam, site-specific solar resource data is critical to ensuring the accuracy of PV output projections.

Where to source it? [Global Solar Atlas](#)

Item 2: Facility infrastructure size and condition

What is it? There are limits to how many PV panels may sit on a rooftop or be fed into a building's electricity network. Thus, the maximum size of a facility's rooftop PV system may be constrained by the dimensions of a facility's rooftop or consideration of the safety aspects of installing a PV system (e.g., roof structural soundness, wind load considerations, roof reinforcements, soiling risk).

Why it matters? A PV system's size correlates directly to its output. The more panels, the larger the PV system, and therefore the more power it can generate. Assuming installing sufficient panels to generate one kilowatt at its peak (kWp) requires 8-10 m², users can calculate the projected maximum PV system size that will fit on their roof.

Where to source it? Users should consult their facility's roof and building diagrams to determine how much roof space in square meters is available for installation of the PV system.

Item 3: Azimuth and tilt of PV system

What is it? Users should use the roof and building diagrams of the site to determine the azimuth and tilt of roof areas which will hold the PV system. Azimuth refers to the direction the PV faces (north, south, west, east), and tilt refers to the angle of the PV panels relative to the rooftop. Both are calculated in degrees.

Why it matters? Azimuth and tilt can affect PV system output due to their angles relative to the sun, so they are important to include as a component of the PV array.

Where to source it? Users should consult their roof and building diagrams to determine the angle of the roof (tilt) and the compass direction the roof faces (azimuth).

Subsection 2.2: Data for collection--current electricity consumption

The items below are sets of data on the current electricity consumption of the facility where the PV is to be installed, that the user should initially collect.

Item 1: Site's current consumption data by tariff type and interval length

What is it? Users should collect **site's current electricity consumption data** by tariff type (standard, peak, off-peak) over the past 12 months, both in annual and monthly terms. If possible, users should also collect monthly and annual data on the past 36 months and future projections.

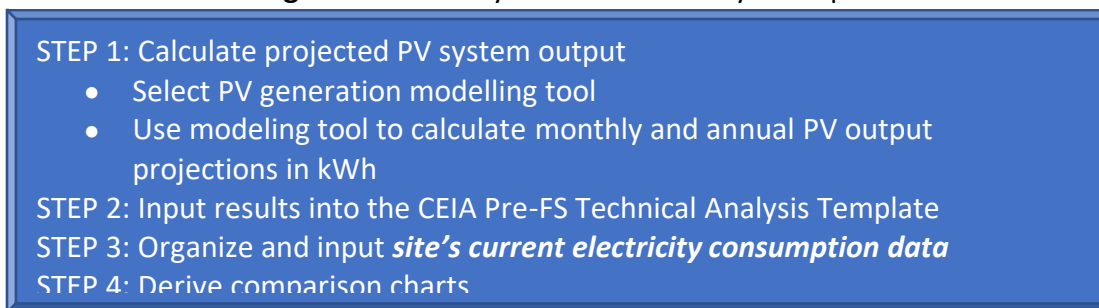
Why it matters? Annual electricity data is critical for comparing PV output over the life of the project (15-25 years) as well as for calculating savings in Section 3. Monthly data can provide context for how a PV system can meet site demand given that PV output varies seasonally. Obtaining data for the past 36 months, as well as any future projections, can support projecting future electricity demand over the life of the PV system. However, this projection can be done even if the user only has access to 12 months of data (described in Subsection 2.3).

Where to source it? Users can find monthly and annual previous site consumption by looking at past EVN electricity bills for the site.

Subsection 2.3: Process--calculate PV energy output and compare to *site's current electricity consumption data*

The technical analysis component of the Pre-Feasibility Study calculates the PV system's projected monthly and annual electricity output and compares it to the facility's monthly and annual electricity consumption, respectively. The steps of the technical analysis, summarized in Figure 2, are explained in greater detail below.

Figure 2: Summary of Technical Analysis Steps



Walkthrough of Technical Analysis Steps

STEP 1: Calculate projected PV system output

- Select PV generation modelling tool
- Use modeling tool to calculate monthly PV output projections in kWh

Users should first select a PV generation modelling tool for calculating the PV output projection. The two recommended options include the [Global Solar Atlas](#) project tool and [PVWatts](#). These are geared for non-technical users and are generally user-friendly. Below are links to download visual walkthrough guides for both options for users to quickly understand how to use them.

- [Click HERE for the Global Solar Atlas Walkthrough](#)
- [Click HERE for the PVWatts Walkthrough](#)

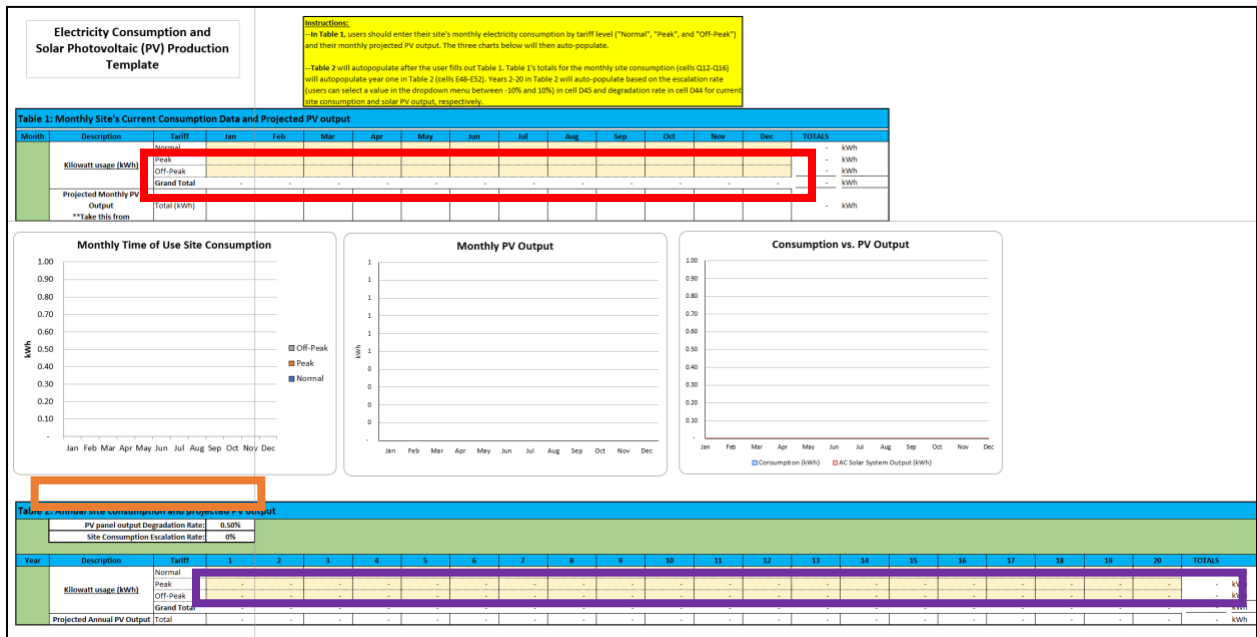
Alternatively, NREL’s “[System Advisor Model](#)” (SAM) tool could be used as it is more detailed, but it is significantly more complex and technical. All three tools’ functionalities are described in greater detail in Appendix A, but all involve inputting the projected size,ⁱ azimuth, and tilt of a prospective PV system as key inputs. All of these tools also already incorporate solar resource data (see Subsection 2.1) that users can harness simply by providing the site’s geographic coordinates.

These tools will calculate a prospective PV system’s estimated **projected monthly PV output** in kWh for year 1, on a monthly basis. The monthly format will account for PV generation’s seasonal variability, enabling a more robust comparison to the facility’s current energy consumption.

STEP 2: Input Global Solar Atlas/PV Watts results into [CEIA Pre-FS Technical Analysis Template](#)

The user should take both Step 1’s **projected monthly PV output** and input them into Table A, in the row labeled “Projected Monthly PV Output” on the [CEIA Pre-FS Technical Analysis Template](#), as shown in the red box in Figure 3 below.

Figure 3: Projected PV outputs cells in Technical Analysis Template



ⁱ As of April 2022, Vietnam does not currently have a feed-in-tariff program. Thus, any excess PV generation beyond what the facility is using at one time, is lost, with no compensation. Therefore, it is not cost-effective to build a PV system that will produce as much (let alone more) power than the facility can use at any one time.

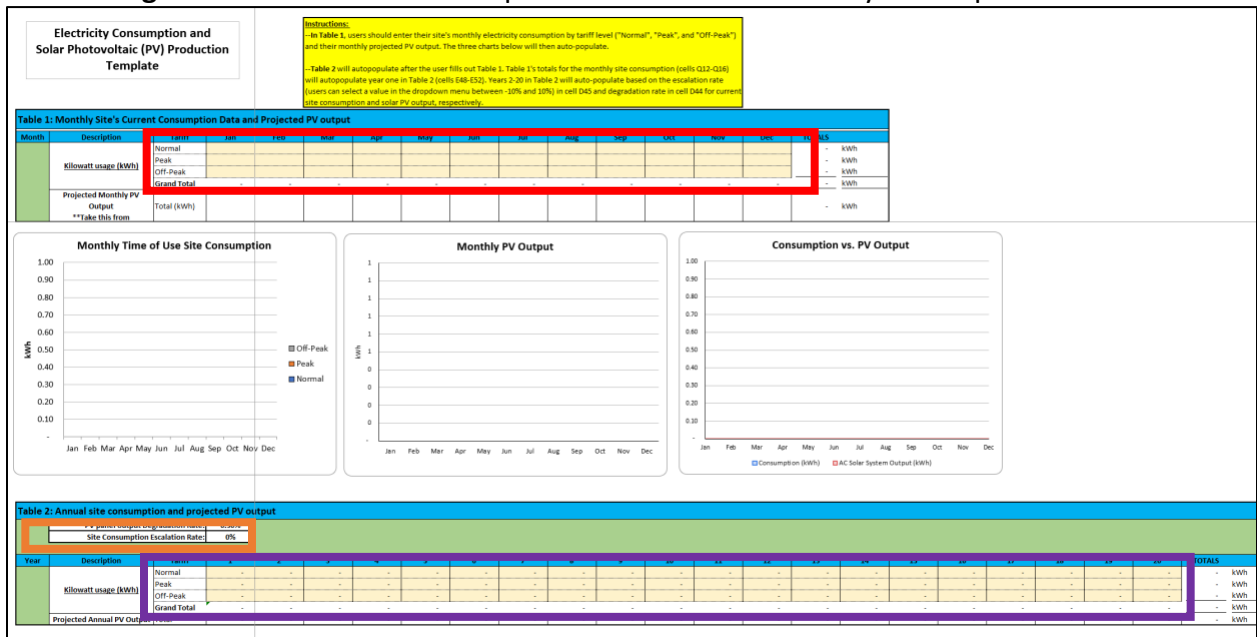
Filling-in the “Projected Monthly Solar Output” row in Table A, will also auto-populate the “Projected Annual Solar Output” row in Table B (as shown in the purple box in Figure 3).

All PV panels degrade over time, and so convert less sunlight to electricity each year. The degree to which they do so, is called “output degradation”. In Table B, you can change the expected output degradation of your solar panels next to the label “PV panel output Degradation Rate” (See the orange box in Figure 3). Originally it is set at 0.5%, as that is the standard for most commercially available PV panels today. In other words, every year, the PV panes will generate 0.5% less electricity from the same amount of sun, than the year before. Changing this number will change how steeply the numbers decline in the “Projected Annual Solar Output” row in Table B.

STEP 3: Organize and input *site’s current electricity consumption data*

The user should input the monthly *site’s current electricity consumption data* (collected in Subsection 2.2) into Table A of the CEIA Pre-FS Technical Analysis Template, in the rows labeled “Kilowatt hour usage” (as shown in the red box in Figure 4 below). This monthly data will serve as the point of comparison for seasonal variability of the PV system’s generation. Filling-in the “Kilowatt hour usage” rows in Table A, will also auto-populate the “Kilowatt hour usage” rows in Table B (as shown in the purple box in Figure 4).

Figure 4: Current site consumption cells in Technical Analysis Template



The annual *site’s current electricity consumption data* in Table B initially assumes the facility will consume the same amount of energy every year. However, you do have the ability to tweak your facility’s energy consumption growth to see how that may impact the cost-benefit analysis of rooftop solar over time. Next to the Table B label “Site Consumption Escalation Rate”, which is initially set at “0%” (as seen in the orange box in Figure 4), you can use the drop-down menu to change the rate to any integer between -10% and 10%.

STEP 4: Read comparison charts

Once you complete Steps 1-3, the template will automatically generate three charts which provide context on how well the PV system should meet the facility's needs

- CHART 1: Consumption vs. PV output--This chart shows how seasonality impacts the ability of the PV system to meet consumption needs of the site.
- CHART 2: Monthly PV output -- This chart shows how much output the PV system is projected to produce over the course of a year.
- CHART 3: Monthly time of use site consumption -- This chart shows current site consumption over a year broken down by the time of use ("TOU") tariff the consumption falls under.

The annual data generate no charts but are key inputs for Section 3's financial analysis.

SECTION 3: FINANCIAL ANALYSIS

The Pre-Feasibility Study Financial Analysis results (Section 2) can be combined with financial data (described in Subsection 3.1) to determine how much money a PV system would save the customer, compared to their current electricity bills.

Determining this comparative cost (Subsection 3.2) by testing alternate financial structures, along with conducting sensitivity analyses and determining emissions impacts, will enable the user to better understand the business case for rooftop PV at their site. As such, comparing financial structures is a key step for determining the comparative cost of PV. [Table 1](#) (next page) shows the three financial structures and their key characteristics, which will be further elaborated in Subsections 3.1 and 3.2.

Subsection 3.1 will walk through how to collect each piece of financial data, which include utility tariffs/rates, market data (taxes, inflation), and market costs (CAPEX, O&M costs). For each piece of financial data, this section will include a brief description of what they are, why they matter, and the source or range of values that could be used in Vietnam.

Subsection 3.2 will describe the process for combining the technical analysis and collected financial data to perform the financial analysis, which calculates the comparative cost of PV relative to current electricity costs. This subsection will include a description of this process and list a few tools which can execute this financial analysis.

Table 1. Comparison of different financial structures

Financial Structures	CAPEX Self-purchase	CAPEX with loan	OPEX
Description	Site purchases PV system with own capital	Site purchases PV system with loan from a third-party	Site buys discounted electricity from a third-party who finances the PV system
Ownership	Full ownership of PV system	Full ownership of PV system (after debt payoff)	No ownership during PV lifetime
Upfront Cost	Highest, requires excess capital	High, requires incurring debt	Zero
Lifetime Savings	High, but high upfront costs	Highest, lower upfront cost than CAPEX self-purchase	Lowest
O&M Responsibility	Yes	Yes	No, third-party is responsible

Subsection 3.1: Financial data collection

Item 1: Utility tariffs/rates

What is it? Vietnam businesses pay EVN a different set of electricity tariffs/rates depending on the voltage of the facility's connection to the grid. As [Table 2](#) shows for manufacturing power consumer, EVN then charges each customer under a "time of use" (TOU) system, a different price per kWh depending on the time of day and day of the week a kWh is consumed.

Table 2. Electricity tariff rates for EVN manufacturing customers

Voltage Size of Grid Connection	TOU Hourly Rate (VND/kWh)		
	Peak	Standard	Off-Peak
≥110kV	2,759	1,536	970
22kV to < 110 kV	2,871	1,555	1,007
6kV to < 22 kV	2964	1611	1044
< 6kV	3,076	1,685	1,100

Why it matters?: The facility's electricity tariffs/rates allow the user to calculate how much money the facility will save, by displacing power purchased from EVN's grid with kWhs generated by the new PV system.

Where to source it?: Users can find the exact rates for their specific facility on the [EVN Website](#).

Item 2: EVN escalation rate

What is it? The is the rate at which electricity prices are likely to increase in future years.

Why it matters? Current electricity rates allows the user to calculate the comparative cost of PV in year 1. However, an EVN escalation rate is required to accurately project utility electricity costs in future years.

Where to source it? The United States-based non-profit [Institute for Energy Economics and Financial Analysis](#) (IEEFA) can often be a good source for these numbers. [IEEFA](#) recently projected EVN rates in Vietnam will escalate at **3.6%** per year for 2021-23.

Item 3: Market data (taxes, inflation, discount rates)

What is it? Market data set the financial context in Vietnam and includes the following items:

- Corporate Tax Rate: Tax applied to corporate business in Vietnam, assumed to be **20%**
- Inflation Rate: Annual inflation rate for VND, assumed to be **4.5%**
- Cost of Equity: The discount rate for equity investments, assumed to be **14%**
- Cost of Debt: Equal to the interest rate on a loan, assumed to be **10.5%**
- Weighted Average cost of capital (WACC): The discount rate on the PV project after accounting for the debt ratio of the capital expenditures. The equation is:

$$\text{WACC} = \text{Cost of Debt} * (1 - \text{Corporate Tax Rate}) * \text{Project Debt \%} + \text{Cost of Equity} * \text{Project Equity \%}.$$

Why it matters? The corporate tax is important for creating a realistic projection of costs and revenues in Vietnam, and the inflation rate enables projection of costs (and savings) into future years. The discount rates (cost of equity, cost of debt, WACC) enable the user to value future costs and savings in the present, which is key for measuring the comparative cost of PV.

Where to source it? The user can use the assumed values above to represent the market context.

Item 4: CAPEX costs

What is it? This section describes data collection requirements related to the CAPEX financing structure, where the site self-purchases (either with or without a loan) the PV system upfront. It includes the following items:

Unit PV cost (per kWp): upfront investment cost per 1kWp PV system. The upfront cost as a whole usually falls between **600-650 USD/kWp (13.5-14.5M VND/kWp)**. The subcomponents of this cost are broken down in **Table 2**.

Table 3. Electricity tariff rates for EVN manufacturing customers

Unit Cost Breakdown (per kWp)	Percentage
Total CAPEX	100%
PV Panel	56.5%
Inverter	10%
Civil Balance of Plant	18%
Electrical Balance of Plant	7%
Grid Interconnection	2.5%
Development Costs	5%
Other	1%

- O&M cost (per kWp): Cost of operations and maintenance of PV system, usually around **4-10 USD/kWp (92,000-230,000 VND/kWp) per year.**
- Insurance cost (per kWp): cost to insure PV system, usually ranges from **0.2-0.25%** of Unit PV Cost.
- Inverter replacement cost (per kWp): cost to replace inverter during life of PV, usually averages around **45 USD/kWp (100,000 VND/kWp)** per replacement and is done once every 10 years.
- Debt/equity ratio and terms: If the user is using a loan to pay the upfront PV cost in the CAPEX financing structure, a debt/equity ratio and loan term (in years) are two key data points needed to perform the financial analysis.

Why it matters? CAPEX costs are important to collect for the financial analysis because they will be weighed against current electricity costs and potential savings from the PV system to build the business case for rooftop PV.

Where to source it? The user can use the assumed values above to represent the CAPEX costs.

Item 5: OPEX costs

What is it? This section describes data requirements related to the OPEX financing structure, where the third party purchases the PV system upfront and sells the electricity to the site through a power purchase agreement (“PPA”). It includes the following items:

- PPA contract length: Usually between **15-25 years** for commercial and industrial users
- Price discount from EVN tariff: Most PPAs charge the user at a per kWh rate discount compared to the EVN tariff (for all tariff types), usually between **3-20%.**

Why it matters? OPEX costs are important to collect for the financial analysis because they allow the user to calculate the expected savings the site could see from using an OPEX financing structure.

Where to source it? The user can use assumed values above to represent the OPEX costs.

Subsection 3.2: Process- input technical outputs and financial data into a tool which calculates comparative cost of PV relative to current electricity costs

The financial analysis component of the Pre-Feasibility Study inputs technical analysis outputs and financial data collected above into a tool to calculate the comparative cost of the projected PV system relative to current electricity costs. The steps of the financial analysis are outlined in Figure 3, and each step is described in further detail later in this subsection.

Figure 5: Summary of Financial Analysis Steps

STEP 1: Selecting a tool for financial analysis
STEP 2: Calculate current electricity costs
STEP 3: Calculate expected savings from PV system for each financial structure and calculate NPV

- **Structure 1 and 2:** CAPEX self-purchase and CAPEX with loan
- **Structure 3:** OPEX

STEP 4: Perform additional results interpretation- sensitivity analyses, emissions impacts

Walkthrough of Financial Analysis Steps

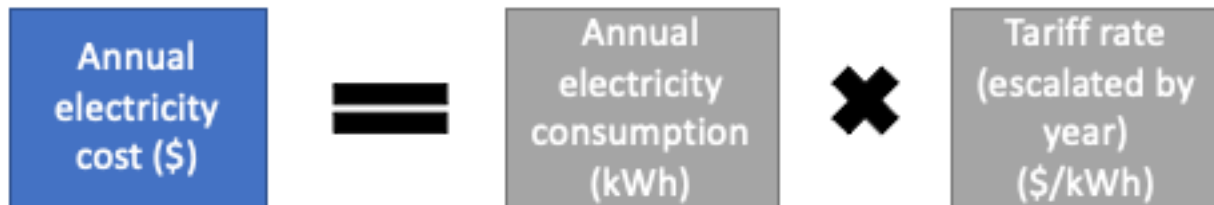
STEP 1: Selecting a tool for financial analysis

Users should select a tool to execute the financial analysis. Although each tool has differing levels of analysis complexity, all of them can ably execute steps 2-4 of the financial analysis described below provided the user can provide the technical outputs and financial data. This guide will describe in greater detail two financial analysis tools: SAM and the CEIA Vietnam Financial Model Tool, in Appendix A.

We recommend the CEIA Vietnam Financial Model Tool because it is most user-friendly and tailored to the Vietnam context. Along with being one of the tools the user could use to perform the financial analysis, the CEIA Vietnam Financial Model Tool is the third toolkit of this series. Therefore, there are similarities between this financial analysis walkthrough and the tool.

STEP 2: Calculate current electricity costs

Users should calculate current electricity costs by tariff type (standard, peak, off-peak) for each year:



Discounting the annual electricity consumption costs for each year back to the present using WACC will yield the NPV calculation for the base scenario (no PV), which will be negative because only electricity costs are being accounted for.

STEP 3: Calculate expected savings from PV system for each financial structure and calculate NPV

This step calculates the NPV of three different financial structures (CAPEX self-purchase, CAPEX with loan, OPEX) by calculating expected net savings (**savings – costs**) from the PV system for each year and discounting them back to the present using WACC. **If this NPV value is positive, then that means the financial structure in question leads to net savings for the site, and the financial structure with the highest positive NPV is the best option for the site. The NPV values of the three structures can also be compared to the base scenario to see how much savings a PV system would generate relative to having no PV.**

- **Structures 1 and 2:** CAPEX self-purchase and CAPEX with loan

The CAPEX self-purchase financial structure is when the site purchases the entire PV system upfront and thus requires large amounts of capital. Calculating the net savings for a PV system under this financial structure means subtracting the costs of the PV system from the savings derived from the portion of site consumed EVN electricity that the PV system displaces each year and discounting these back to present using WACC to obtain an NPV calculation.

The CAPEX with loan financial structure is when the site purchases the PV system by taking out a loan to access the necessary capital. As such, it requires less capital upfront but more appetite for debt. Calculating the net savings for a PV system under this structure is similar to CAPEX self-purchase described above. However, there are a few adjustments to the cost and savings side. On the cost side, the user should multiply the upfront cost by the percentage of the cost funded from equity. This will decrease the cost in year 0 (thus increasing the NPV). On the savings side, users should subtract the annual amount used to pay off the loan (which can be calculated with a standard financial analysis considering the interest rate (cost of debt) and the length of loan). This will decrease the savings across the life of the project (thus decreasing the NPV).

The PV Cost equations from financial structures 1 and 2 are shown below:

- CAPEX Self-purchase:

$$\text{PV Cost for each year (\$)} = \text{Upfront cost (only year 0) (\$)} + \text{O\&M cost (\$)} + \text{Insurance cost (\$)} + \text{Inverter replacement cost (only year 10) (\$)}$$

- CAPEX with loan (same equation as above, the only difference is in red):

$$\text{PV Cost for each year (\$)} = \text{Upfront cost (only year 0) (\$)} \times \text{\% of project funded from equity (year 0)} + \text{O\&M cost (\$)} + \text{Insurance cost (\$)} + \text{Inverter replacement cost (only year 10) (\$)}$$

To calculate the savings derived from the portion of EVN electricity that the PV system displaces each year, the user should first divide the projected PV electricity for site consumption into the different tariff types. A good rule of thumb is to set **75%** of production for the standard period and **25%** for the peak period (and 0% for off-peak since PV doesn't operate at night).

The PV Savings equations from financial structures 1 and 2 are shown below:

- CAPEX Self-purchase:

$$\text{PV Savings for each year (\$)} = \left(\text{Projected PV electricity for site usage (kWh)} \times \text{75\% (for standard period)} \times \text{Standard period EVN rate (\$/kWh)} \right) + \left(\text{Projected PV electricity for site usage (kWh)} \times \text{25\% (for peak period)} \times \text{Peak period EVN rate (\$/kWh)} \right)$$

- CAPEX with loan (same equation as above, the only difference is in red):

$$\begin{aligned}
 \text{PV Savings for each year (\$)} &= \left[\text{Projected PV electricity for site usage (kWh)} \times 75\% \text{ (for standard period)} \times \text{Standard period EVN rate (\$/kWh)} \right] \\
 &+ \left[\text{Projected PV electricity for site usage (kWh)} \times 25\% \text{ (for peak period)} \times \text{Peak period EVN rate (\$/kWh)} \right] \\
 &- \text{Debt service payment (\$)}
 \end{aligned}$$

Users can now calculate the NPV of both the CAPEX self-purchase and the CAPEX with loan options by subtracting PV Costs from PV Savings for each year and discounting all values back to the present using WACC.

- For both financial structures:

$$\begin{aligned}
 \text{NPV of CAPEX Structure (\$)} &= \left[\text{Present Value of Savings (Year 0) (\$)} - \text{Present Value of Costs (Year 0) (\$)} \right] + \left[\text{Present Value of Savings (Year 1) (\$)} - \text{Present Value of Costs (Year 1) (\$)} \right] \\
 &+ \left[\text{Present Value of Savings (Year 2) (\$)} - \text{Present Value of Costs (Year 2) (\$)} \right] + \dots
 \end{aligned}$$

- **Structure 3: OPEX**

OPEX is when a third party finances the PV system and sells electricity to the site at a discounted rate. Calculating net savings for the OPEX financial structure is easier than for CAPEX because there are no costs, so the net savings is simply the savings each year relative to paying full price for EVN electricity (shown below).

$$\begin{aligned}
 \text{PV Savings for each year (\$)} &= \left(\text{Projected PV electricity for site usage (kWh)} \times 75\% \text{ (for standard period)} \times \left(\text{Standard period EVN rate (\$/kWh)} - \text{Discounted standard rate (\$/kWh)} \right) \right) \\
 &+ \left(\text{Projected PV electricity for site usage (kWh)} \times 25\% \text{ (for peak period)} \times \left(\text{Peak period EVN rate (\$/kWh)} - \text{Discounted peak rate (\$/kWh)} \right) \right)
 \end{aligned}$$

Users can now calculate the NPV of the OPEX option by discounting PV Savings for each year back to the present using WACC.

$$\text{NPV of OPEX Structure (\$)} = \text{Present Value of Savings (Year 0) (\$)} + \text{Present Value of Savings (Year 1) (\$)} + \text{Present Value of Savings (Year 2) (\$)} + \dots$$

STEP 4: Perform additional results interpretation- sensitivity analyses, emissions impacts

Although the NPV calculations in Step 4 provide the most important results interpretation, sensitivity analyses and calculating emissions impacts can further support the robustness of a Pre-Feasibility Study.

A sensitivity analysis essentially shows the user the percentage change in key outputs when these inputs are adjusted up or down, and they allow the user to see which input assumptions affect the results of the Pre-Feasibility Study the most. Many financial analysis tools have some form of sensitivity analysis capabilities.

Calculating emissions impacts allows the users to see the emissions reductions a projected PV system would enable at their site. It requires an emission factor, which for EVN electricity is assumed to be **0.0008458 tCO₂/kWh**. The equation for site emissions reductions is below:

$$\text{Site emissions reductions} = \text{EVN Electricity Emissions Factor (tCO}_2\text{/kWh)} \times \left(\text{EVN Electricity consumed in No PV Case (kWh)} - \text{EVN Electricity consumed in PV Case (kWh)} \right)$$

Appendix A: Tools and Templates

This section is a repository for all tools and templates referenced in this guide. “Tools” refers to technical and financial analysis tools. “Templates” refers to data collection templates.

Each tool/template entry in this section will have a description of it’s the tool or template’s purpose and how it differentiates from similar tools/templates, as well as a short explanation of its strengths, limitations, and online location for the user to access.

CEIA Vietnam Financial Model Tool

- Template or Tool: Tool
- Description: The CEIA Vietnam Financial Model Tool enables users to conduct a quick financial analysis of all three financial structures (CAPEX self-purchase, CAPEX with loan, OPEX) over a 20-year PV system life by inputting projected PV size, location, and current electricity usage
- Strengths: This tool is user friendly and relatively simple. Vietnam-specific inputs are already given, such as current utility rates, market data, and CAPEX inputs. NPV and savings results are easy to interpret from the tool, allowing for quick conclusions
- Limitations: This tool does not include location granularity for the PV system, so sites can only assume the region instead of the exact site location for projecting PV production. It also does not include more nuanced projections of seasonal electricity consumption, only focusing on annual consumption.
- Access Location/method: [Here](#)

System Advisor Model (SAM)



- Template or Tool: Tool
- Description: The SAM tools enables users to conduct detailed technical and financial analyses for a projected PV system.
- Strengths: This tool is robust and enables users to generate detailed projection of technical and financial performance. SAM can account for seasonal electricity consumption, specific arrangements of the PV system on the rooftop, and even specific module and inverter models. SAM can also project PV performance by specific location, so the user only has to input the geographic coordinates of their site, and SAM can calculate the exact PV output. SAM also supports robust sensitivity analyses.
- Limitations: SAM requires users to input many data points manually, from specific layout of the PV panels to system costs to individual current electricity rates (and many others). Furthermore, results interpretation in SAM can be more difficult because SAM provides many outputs the user will have to sift through, and the tool has a more complex methodology which is not made immediately clear from using it (although there is a lengthy user manual).
- Access Location/method: [SAM website](#)

Global Solar Atlas Project Design

- Template or Tool: Tool
- Description: The Global Solar Atlas Project Design tool enables users to project a year's output from a PV system (by month). Users should select "medium size commercial" on the right and input the location of the site, projected PV size, and the tilt. The user should then click "open detail" at the bottom, and the tool will calculate results. Users can then view the results and download an excel sheet with more details.
- Strengths: This tool is user friendly and relatively simple.
- Limitations: This tool only projects PV output for one year (12 months), and it does not allow the user to account for different PV modules and array arrangements.
- Access Location/method: [Global Solar Atlas](#)

PVWatts



- Template or Tool: Tool
- Description: The PVWatts tool enables users to project a year's output from a PV system (by month). Users should enter the address of their site followed by the following information for the projected PV system: DC System Size, Module Type, Array Type, System Losses, Tilt, Azimuth, DC to AC Size Ratio, Inverter Efficiency, and Ground Coverage Ratio. PVWatts will then output monthly and annual projected output for the system
- Strengths: This tool is user friendly and relatively simple.
- Limitations: This tool only projects PV output for one year (12 months), and it does not allow the user to account for different PV modules and array arrangements.
- Access Location/method: [PVWatts](#)

CEIA Pre-Feasibility Study Technical Analysis Template

- Template or Tool: Template
- Description: The CEIA Pre-Feasibility Study Technical Analysis Template allows users to input the results of a technical analysis into a ready-made spreadsheet. The spreadsheet includes current site consumption and projected PV output at both annual and monthly levels.
- Limitations:
- Access Location/method: [Here](#)