FARFAN & MENDES LTD.

Alternative Energy Department Profile

Company Introduction

At Farfan and Mendes Group we have a reputation for providing quality products and services and going to the extreme to ensure products provide value to our customers. We are always aware that many of our customers rely on our products for their livelihood and operate in difficult to reach, far flung areas in our hinterland or are service providers themselves and therefore should only expect reliable and consistent performance of all the products and services we sell.
To ensure this –

- We work in cooperation with all suppliers to ensure that the products can reliably perform within our markets and the uses our customers put them to.

- Farfan and Mendes Group invests significantly in training and spare parts to be able to address any issues quickly and support the warranties on our products.

- Product testing is a critical part of our business operation. At FML we installed the first private grid connected solar system in Guyana in 2016 to understand better the value the system could provide and to be sure of the value proposition we would be offering to our customers. The system uses three different systems within our 36 kW array – standard panels with string inverters, DC optimized panels with string inverters and panels with micro inverters. This allows us to build our knowledge resource and have confidence in what system we should recommend to customers.

- We only stock or sell solar panels from tier 1 manufacturers and balance of system (BoS) components from industry leading companies. This includes but are not limited to:

Trina Solar Modules	Longi Solar Modules
East Penn Manufacturing Co. (Deka Batteries)	
Sunlight Battery Co.	Northstar Battery
Samsung Battery	Rolls Surette
Schneider Electric	Victron Energy BV
Fronius	SMA
Schletter	K2

SUCCESSFUL PROJECTS COMPLETED

Solar PV Carport Installed at our Head Office

Solar Array Installation @ Iwokrama River Lodge

Small Solar PV Array and Solar Water Heater Installed @ Iwokrama

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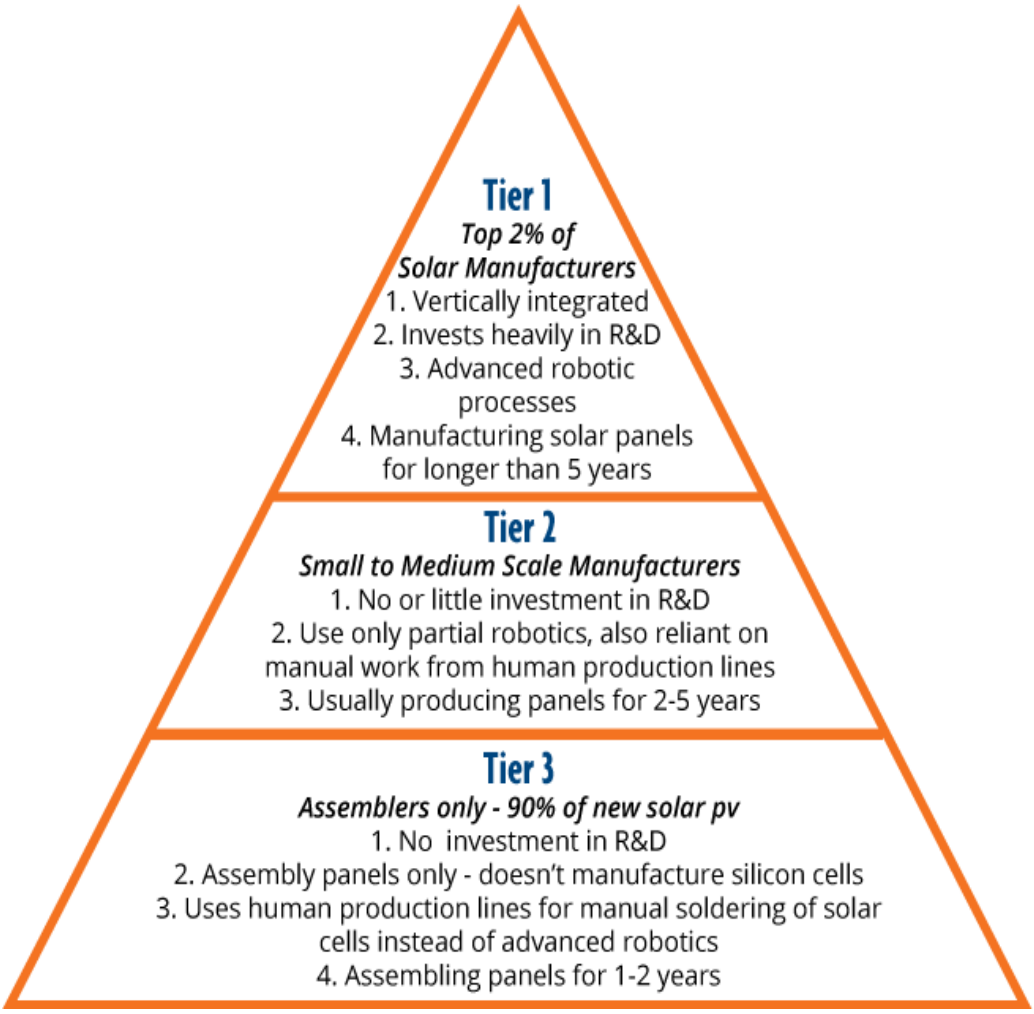
Tier 1 Solar Modules Selection Guideline



This is of high importance and is to ensure we can continuously offer support for products to our customers. Tier 1 companies are fully integrated companies, and are most likely be in business well into the future to be able to support their products and warranties offered. The same approach is taken when considering other components for use on the solar systems we offer, particularly batteries and inverters. With solar systems expected to last at least 25 years, choosing high quality equipment from the reputable manufacturers is the safest guarantee for the longevity of any system couple with high quality installation practices.

SUCCESSFUL PROJECTS COMPLETED

Solar PV Array Installed in the Hinterland

Typical PV Inverter Installation

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Why Solar Power?

There are few investments that can reduce energy demand, hedge against potential utility rate increases, provide an attractive return on investment and project and provide an environmentally friendly corporate image for decades to come, all at the same time.

Why Farfan & Mendes Ltd.?

- Local presence and solar pioneer in Guyana. Farfan & Mendes Ltd. established an operating presence in Guyana in 1960 and has been servicing the needs of the local customer base since. Our Solar Dept has been in operation since 2003, installing solar system throughout Guyana in all ten regions with a total installed capacity of over 6 MW to date.

- Experience with a wide range of PV system designs and installations, namely:
    - Small 1 Module Solar Home Systems
    - Small PV Household Systems and Mining Camp Systems
    - Solar PV & Storage Systems for Businesses in the Hinterland
    - Solar Grid Connected Systems for Homes & Businesses
    - Solar Micro Grid Systems with BESS for Hinterland Village

- Provision of full turnkey solutions for solar projects throughout Guyana. Our offers/proposals include system designs, procurement, requisite approvals from AHJ, management of high-quality installations by professionals, systems commissioning, testing and hand over.

- Reputation and high standard/quality of work and customer service. All our installations follow NEC codes which ensures the sustainability of your system and protects your investment.

- Unparalleled after sales service with access to immediate support after the installation to maximize system performance and secure investment, every hour of downtime equates to lost revenue and will affect your internal rate of return. If not the official representative here in Guyana, we are in direct communication with all manufacturers for products sold and installed.

- O&M contract can be provided on request as an option and can serve as an integral part of the project guaranteeing system performance and returns on investment.

SUCCESSFUL PROJECTS COMPLETED

34 kW Solar Array Installed on Flat Concrete Roof @ MoPI

AC Coupled System with Frequency Shifting Capability Installed @ MoPI

Large Battery Energy Storage System Installed @ MoPI

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Our Approach to Solar PV Recommendations

Analysis & Design

Depending on the scale and application of the customer's needs, either of the two are done:

1. Determine the customer's estimated energy demand using our custom spreadsheet calculations as seen below.

Qty.	Description of AC loads powered by Inverter	Watts	Hours/day	kWH/day
	Lighting			
8	LED	7	6	0.34
	Tungsten	175		0.00
7	Tungsten	60	4	1.68
1	Fluorescent (CFL)	20	4	0.08
	Fluorescent (CFL)	15		0.00
6	Fluorescent Strip Lights (tube)	20	4	0.48
6	Fluorescent Strip Lights (tube)	40	4	0.96
	Kitchen & General Household			
	Dishwasher	600		0.00
	Electric kettle	500	1	0.00
	Washing Machine	800	2	0.00
	Freezer	400		0.00
1	Refrigerator / Freezer	200	12	2.40
1	Iron	1000	0.5	0.50
1	Microwave Oven	1500	0.1	0.15
	Refrigerator	200		0.00
	Toaster	1500		0.00
	Electric Tumble Drier	3000		0.00
	Vaccum Cleaner	700	1	0.00
	Electric Clock	20		0.00
1	Coffee Maker	1000	0.25	0.25
	Clock Radio	20		0.00
1	Blender	800	0.1	0.08
	Alarm/Security System			0.00
	Personal Care			
1	Hair Dryer	1200	0.1	0.12
1	Hair Curler	1200	0.1	0.12
	Electric Shaver	15		0.00
	Other			0.00
1	Water Pump	400	2	0.80
2	AC Unit	1200	8	19.20
2	Fans	60	8	0.96
	Chargers			0.00
	Entertainment			
1	Smart/Colour TV	90	8	0.72
1	Surround Sound System	200	4	0.80
	Video Recorder	55		0.00
	DVD Player	45		0.00
	Hi-Fi System	200		0.00
	Gaming System	50		0.00
	Office			
1	Computers	150	8	1.20
1	Lap Top Computers	75	8	0.60
1	Printers	60	1	0.06
	Telephone System	30		0.00
1	Fax Machine	20	0.5	0.01
	Photocopier	1500	2	0.00
	Water Cooler	500	6	0.00
	Calculators	15		0.00
	Misc. Loads			0.00
	Max. Continous Power (W):	10415		
Total AC kWh per day				31.51
Provision for Inverter losses (10%)				34.66
	Inverter/DC voltage:			24.00

Qty.	Description of DC loads	Watts	Hours per day	WH per day
0	Lights	9	8	0.00
0	DC Refrigerator	70	12	0.00
0	DC Freezer	120	12	0.00
Total DC kWh per day:				0.00

System Components			Est. Price
Select Solar Module (W)	330		$ 36,300
Est. Daily Energy from Solar Module (kWh)	1.485		
Array Capacity Required (W)	7701		
Number of Solar Modules/Panels Suggested:	23		$ 847,161
Select Deep Cycle Battery (Ah)	565		$ 395,500
DC System Voltage (V)	24		
Usable Battery Energy (kWh)	9.492		
Number of Batteries Suggested:	4		$ 1,444,025
Select Charge Controller (A)	100		
DC System Voltage (V)	24		
Usable Capacity (kWh)	2.4		
Charging Capacity Required (A)	401		
Number of Selected Charge Controllers Required:	4.01		

Once the energy needs or demand is established, recommendations are made for appropriate number of solar panels and balance of system equipment to meet the specified needs. We do a careful analysis of the loads and calculate a system that will meet your expectations. It's easy to make an off grid solar system cheaper by sizing it without any redundancy (i.e. Not providing for enough battery storage for rainy days) which will reduce the number of batteries and panels needed, thereby lowering the purchase price, but leaving you in darkness and potentially shortening the life of the batteries significantly.

INSTALLATION EXAMPLES

PV Array @ Banks DIH. On Grid System with Load Management Capability. PV System powers load during a grid failure.

On Grid Inverters for 100 kW System @ University of Guyana

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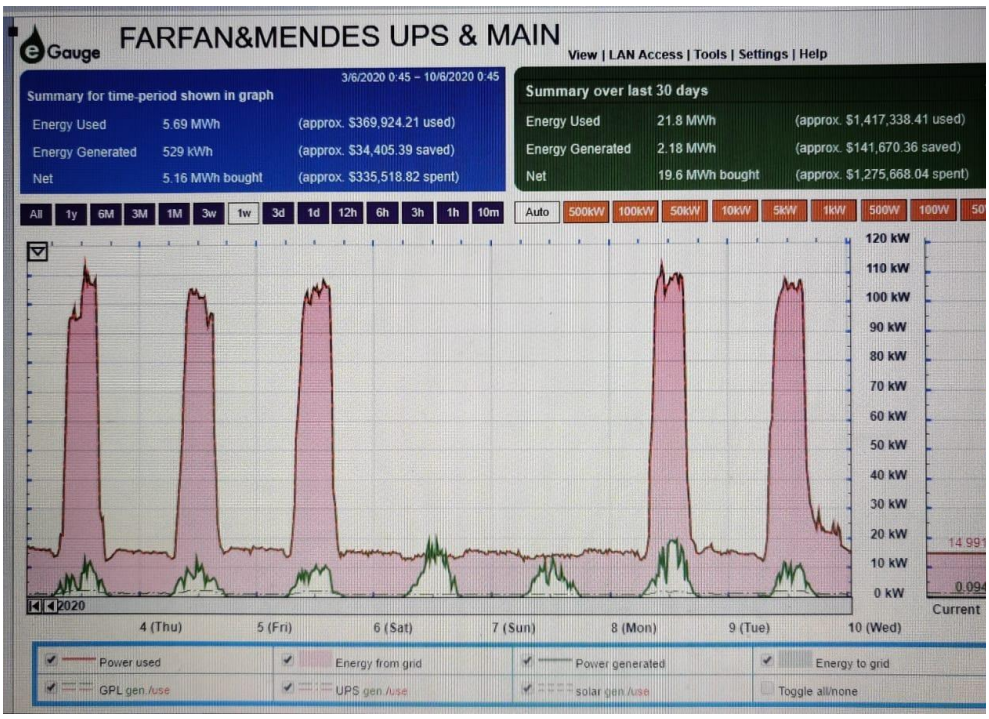
An AGM battery has estimated 800 cycles (a cycle is a draw down and then recharge) at 50% depth of discharge – approximately just over 2 years of life. At 80% depth of discharge that battery lasts only 500 cycles or 1.4 years. For heavy, deep discharges we also carry nano carbon batteries that have over 2000 cycles at 60% depth of discharge that may be more suited to your application and which will allow higher charging rates and therefore faster recharge than traditional deep cycle batteries – this allows you to add panels which are a cheaper way of adding capacity than adding batteries. Another important component of solar system design is "balance of system components" – i.e. The panel capacity should be able to recharge the battery bank within the 5 hour window of available sunlight per day – with insufficient recharge capacity the batteries will not be fully recharged on any given day and will discharge to zero percent capacity eventually, damaging the batteries. As a result, our technicians assess your loads and calculate the right sized system based on meeting your expectations of performance and ensure you have a sustainable, long term solution for your power requirements.

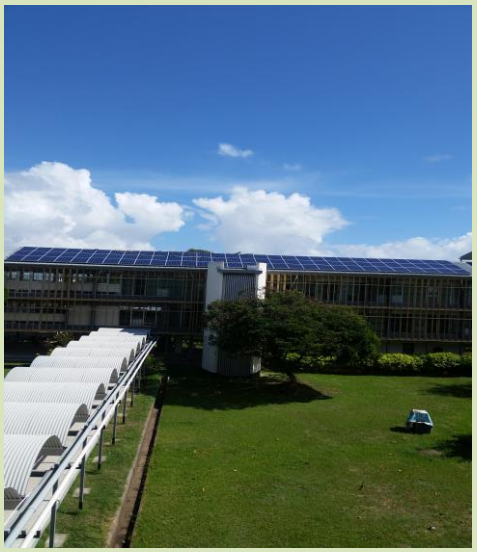
2. An energy meter/monitor is installed at the premises intended for consideration. Depending on the application, the duration for monitoring is determined, this can last from one week up to one year of data collection. Detail monitoring proves invaluable to the customer as a load profile eliminates the guesswork and provides more accurate analysis for extended system performance and financial considerations.



Example of energy profile generated from our eGuage monitor

INSTALLATION EXAMPLES

130kW PV Array Installed @ Ministry of the Presidency



100kW PV Array Installed @ University of Guyana

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Once monitoring is complete, careful analysis of the load profile begins to determine the best suited application to maximize returns on investment. Small amounts of data can also be extrapolated to yearly data for more realistic analysis. A range of applications are modelled on to the load profile to ensure that the energy generated from the PV system is fully utilized. E.g. a load profile with a low daytime load consumption and high nighttime consumption will not be best modelled with a solar grid connected system where most the energy gets fed back to the utility grid and not consumed directly by the loads. In this scenario, a solar system with some form of battery storage will be better suited. On the other hand, a place of business will be better suited with a grid connected system where most of the energy generated will be consumed by the loads.

With modelling of this nature, historical climate data is also incorporated to estimate the daily sun energy throughout the year and calculate performance data of the PV system for comparative analysis with the load consumption profile.

Electrical Demand

Total gen/grid demand	*kWh/year*	217,709
Peak demand	*kW*	103
Avg daily demand	*kWh/day*	596
Avg daytime demand	*kWh/day*	459
Avg night-time demand	*kWh/day*	137

PV system sizing

PV size	*kWp*	**120**
PV Generation	***kWh/year***	**176,074**
Generation factor	*kWh/year·kWp*	*1,467*
Load factor		*16.7%*
% of energy demand		**81%**
PV surplus (simple)	*kWh/year*	54,341

With battery

Avg surplus energy	kWh/day	149	
Battery capacity (@C10)	**kWh**	**64**	
Max depth discharge		100%	
Useful storage	Wh	64	
Energy loss in battery		10.0%	
Energy out from battery	kWh/year	15,107	
Renewable Energy consumed	*kWh/year*	136,841	*63%*
Gen/grid support	*kWh/day*	80,869	*37%*
Surplus/Exported energy	*kWh/day*	37,552	*17%*

Tables show data for an analysis performed for Farfan's Head Office

INSTALLATION EXAMPLES

Complete Micro Grid Solar PV System w/ BESS Installed @ Kato

Typical On-Grid Inverter Installation w/ Load Management Capability

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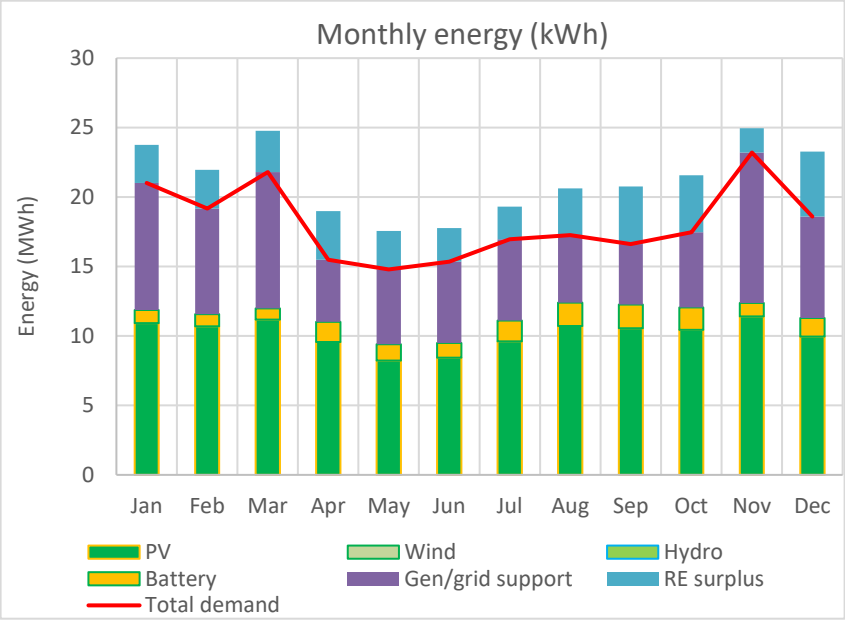
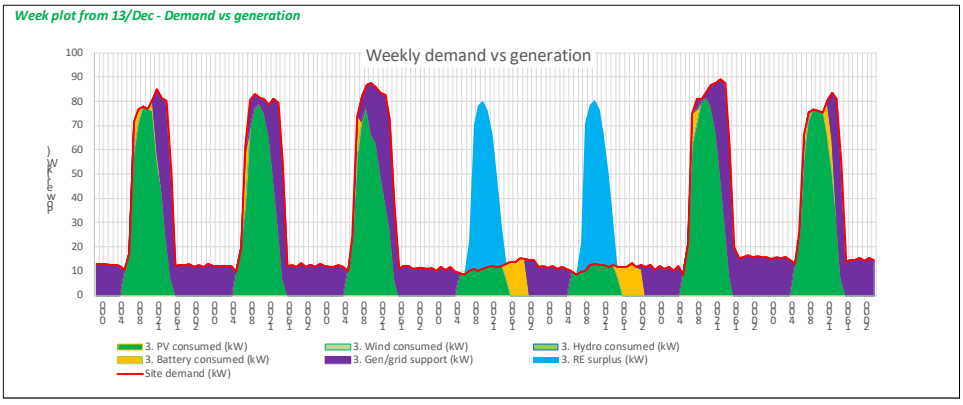
Analysis of this nature is important for understanding how energy will be produced and consumed because these factors have financial implications for the investment or the client. Wrong decisions at this stage can provide a functioning system but at the same time lead to an investment that is not prudent thereby costing the customer a higher price of energy in the long term.



Systems with interconnectivity to the grid particularly require this level of analysis because the implications can also have a significant impact on the ROI for the system as there may be no compensation from the utility company for energy exported to the grid.



As is shown above, mostly businesses not operating on the weekend will have excess PV power generating and fed back into the utility. This may not be accepted by the utility or no compensation received. If not managed correctly, the utility will charge the customer for putting excess energy into the grid.

INSTALLATION EXAMPLES

AC Coupled Systems & BESS w/Grid Feed In & Frequency Shifting Capability Installed @ Pedestrian Overpasses EBD

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Economic Analysis

Most important in our considerations is the economic analysis for various models. Realistic figures are used to consider both the base case scenario and the new scenario to accurately determine the return on investment for the proposed design. Below is an illustration.

2a. Grid connected- Baseline

Total electrical demand	*kWh/year*	217,709
Power contracted	*kVA*	155
Demand charge	*GYD/kVA·month*	1,760
Energy charge	*GYD/kWh*	48.78
Demand charge	*GYD/year*	3,267,813
Electricity charge	*GYD/year*	10,620,185
TOTAL RUNNING COST	***GYD/year***	**13,887,997**
Unit cost Electricity	*GYD/kWh*	*63.8*
Emission	*tonCO2/year*	199

2b. RE systems grid connected- New Scenario

Total electrical demand	*kWh/year*	217,709
RE consumed	*kWh/year*	136,841
O&M cost of RE systems	*GYD/year*	608,137
Energy needed from grid	*kWh/year*	80,869
Demand charge	*GYD/year*	3,267,813
Electricity charge	*GYD/year*	3,944,898
RE Surplus energy	*GYD/year*	37,552
Income for energy surplus	*GYD/kWh*	0
Income for energy surplus	*GYD/year*	0
TOTAL RUNNING COST	***GYD/year***	**7,820,847**
Unit cost Electricity (no inv)	*GYD/kWh*	*35.9*
Emission	*tonCO2/year*	74

Comparison

1st year Cost Baseline	*GYD/year*	13,887,997
1st year Cost New Scenario	*GYD/year*	7,820,847
1st year Savings	***GYD/year***	**6,067,150**
Cost of Hydro	*GYD*	0
Cost of Wind	*GYD*	0
Cost of PV system	*GYD*	42,093,709
Cost for new generators	*GYD*	0
Total upfront cost	***GYD***	**42,093,709**
Payback Period	***year***	**5.3**

INSTALLATION EXAMPLES

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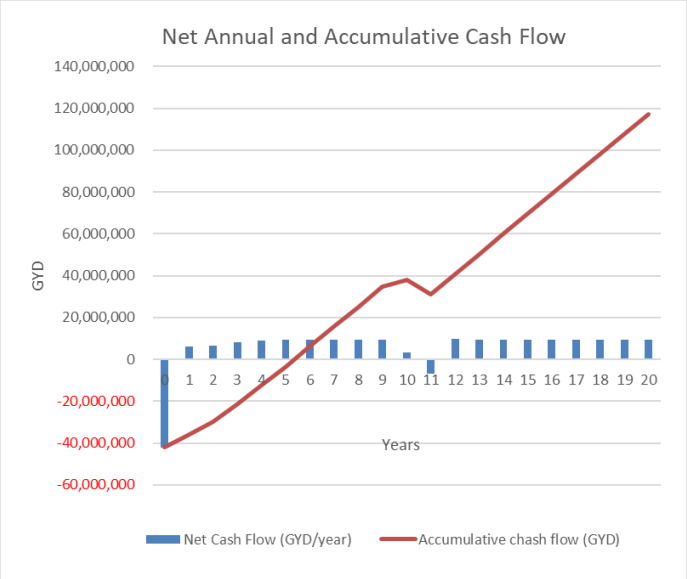
Finally, from our modelling, net cash flows for any proposed project can be determined as shown below.



The general methodology employed in our approach is to fully understand the customer's needs, assess the premises for the intended solar system and make recommendations to ensure the client gets the value from his/her investment.

Site Evaluations

Example of a roof overlay with the proposed PV Array

INSTALLATION EXAMPLES

System Installed @ Dubalay Ranch w/ Remote Conectivity

PV Array Installed @ 15m to Clear Shading

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Once the client gives the approval, our technical team conducts an extensive site assessment to determine the structural integrity of the roof and building to accommodate the installation of the PV array and Balance of System components, recommendations for suitable ground mounted systems may be necessary depending on our findings. All our recommendations follow and observe applicable building and electrical codes/guidelines for best practices to ensure longevity of the installation.

Our findings and assessment are then presented in a comprehensive report to the client.

Project Development & Implementation

Development: This starts with the preparation of the main contract between the client and our company. This stage may also include the preparation of the contracts between our company and the subcontractors based on the Scope of Works for the project that will be updated based on the main contract requirements. All studies required for the successful design and planning of the PV plant are also included in this stage. A Limited Notice to proceed will be required to proceed with the activities of this stage.

Design: This stage depends on the completion of the milestones within the development stage. The design scope is divided into 3 different packages:

Basis of Design (BoD): Within this package the main assumption of the design will be agreed between the client and the EPC company. The assessment report should be in place to complete the BoD package that include layout of the Plant, Single Line Diagram, technical description and datasheets of the main components. The approval of the basis of design allow the EPC for the purchase of the main components of the PV Plant: PV modules, inverters, transformers, mounting structure, battery system and monitoring equipment.

Preliminary Design (PD): The PD package presents the detailed engineering of the PV Plant, including the civil works, electrical and mechanical design. The approval of the PD package allows the EPC for the procurement of all material and services required for the construction of the PV plant.

Issue for Construction (IFC): The IFC package include all necessary details for the subcontractors to execute the works required for the construction, commissioning and operation of the PV plant.

INSTALLATION EXAMPLES

Typical PV Array Installation

Lithium Iron Phosphate Battery Bank

Typical Medium Size Inverter System Installation with BoS Components

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The design of the PV system will be performed by a highly experienced team with more than 10 years of experience on the design, construction and operation of successful PV Projects, following best international practice.

Purchase: This stage includes all the procurement required for the construction, commissioning and operation of the PV plant (Services, equipment, tools and materials). The development of the Scope of Works and Scope of Supplies, Purchase orders and contracts are included within this stage.

Logistics: This stage includes all the preparation, importation transport, custom process and local transport to site of all the material and equipment needed for the project.

Construction: The construction of the PV plant starts with the site preparation and installation of construction facilities; construction offices and welfare facilities, for all the personnel working on the site and visitors (if applicable). The site preparation includes the security and health and safety preparation works. The following precede the site preparation:

- Civil Works: Fencing, Trenching, Drainage system, concrete basement
- Mechanical Installation: Water treatment system installation, pilling, PV structure assembly, Module mounting, Inverters mounting, Battery Energy Storage System mounting.
- Electrical installation
- Commissioning of the PV Plant, Cold Commissioning and Hot Commissioning.

Interconnection: Includes all the required verification and technical and legal procedures for the interconnection of the PV plant to the existing electrical system and/or utility grid network.

Test Period: Estimated duration: Depending on the system size and complexity.

Final acceptance, according to client indications.

INSTALLATION EXAMPLES

Grid Connected Inverter System @ Public Building

PV Array Installed @ NIS

Grid Connected Inverter Installation