Emerald Coast Solar

WE PUT THE POWER OF THE SUN TO WORK FOR YOU!

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Welcome to the Emerald Coast Solar

Solar System Primer

With over 5 years in business installing solar systems all along the coast of Yucatan, we have seen the good the bad and the ugly sides of solar systems and solar companies.

We have found, the #1 contributor to people having a bad experience with their solar system install, is a lack of knowledge about solar systems. This guidebook is designed to answer most basic questions about solar systems and solar installation companies.

It is important to us, that you have the knowledge to make an informed decision about your solar system. There are many factors that go into construction of a solar system. Many small details can have a major impact on the level of production you will get from your system. Most systems installed in our areas, underproduce and most homeowners have no idea that their systems are producing far less power than they are capable of. Systems that maximize power production, are more economical than those that waste power or, do not access all the power they could.

It is our hope that, with this guide, people will be more informed about solar systems and, through this knowledge, be able to select the correct system and installation company to maximize their power harvest.

We have divided this booklet into sections. The first section focuses on solar systems in general with each subsequent section focusing on a different part of the solar system. The final sections deal with solar installation companies and, as a bonus, we have included printable sheets of questions to ask solar installers.

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The following is a list of terms used and an explanation for each:

AC power	Alternating Current
Amps	A measure of electrical current when multiplied by Volts = Watts. Amps are generally different with each electrical appliance while volts (generally) remain constant (127 or 240).
Average power production	This is the average production for a solar panel or system. It is useful for determining the power a system will produce over a period of time.
Battery back-up	A grid tied solar system with batteries for power storage and use during periods of grid failure.
Bi-directional meter	The meter supplied by the electric company to measure both the power you use from the grid and the power you send to the grid
Cut-out voltage	This is the maximum voltage delivered by the electric company the inverter(s) can operate with. When the voltage being delivered by the electric company exceeds a certain level (usually around 262 volts, the inverter(s) cannot operate and shut down to protect the solar system.
DC power	Direct Current
Dual adjustment support	Both the front and the back supports can be adjusted independently, allowing the widest range of panel array movement
Grid	The system delivering power from the electric company to homes and business'
Grid agnostic	A solar system that can operate either connected to the grid or completely independent of the grid – the Enphase Encharge System is grid agnostic.
Grid tied	A solar system that is connected to the electrical grid
Encharge battery	A lithium iron phosphate battery forming part of the Enphase Ensemble
Enlighten	The Enphase monitoring system for the IQ series of micro-inverters and the Enphase Ensemble system.
Enphase	Top tier manufacturer of micro-inverters and the Encharge battery
Ensemble	The entire grid agnostic production and storage system from Enphase
Fixed position support	The panels are supported in a single position and cannot be adjusted.
Lead acid batteries	Traditional batteries used for off grid and hybrid system power storage.

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LFP — lithium ion phosphate	Enphase Encharge storage systems are made with LFP — lithium ion phosphate. The most advanced rechargeable battery chemistry, LFP batteries are cobalt-free and have the best thermal performance compared to other Lithium-ion batteries with minimum risk of overheating, fire, or explosion. Plus, adding safety doesn't mean losing power.
Micro-inverter	Small, single panel inverters that convert the DC energy from a solar panel to AC energy – usually mounted under the solar panel
Monocrystalline	Monocrystalline solar panels are generally thought of as a premium solar product. The main advantages of monocrystalline panels are higher efficiencies.
MPPT	MPPT stands for **Maximum Power Point Tracker**. It is a circuit (typically a DC to DC converter). Its function is to maximize the energy available from the connected solar module arrays.
Multi-row panel supports	This support system has multiple rows of panels interconnected in one support structure
NOCT/NOPT	Normal operating cell temperature/Normal operating panel temperature
Optimizers	These are added onto solar panels and work to separate each panel connected to a string inverter to increase system performance by separating each panel in the string (similar to what a micro-inverter does).
Peak power production	This is the maximum possible production from a panel or a solar system. It is expressed in watts or kilowatts and can be a point in time, a day or a longer period
Pivot point adjustable supports	This system support is for multiple rows of panels on one support structure. The pivot point support, allows this type of support to pivot at the center support, allowing for almost any angle to be achieved
Polycrystalline	Polycrystalline solar panels generally have lower efficiencies than monocrystalline panels, due to their construction
Power harvest	Amount of power the solar system is able to capture from the sun
Sliding scale of diminishing returns	Generally used to indicate the efficiency of a panel as it ages, for warranty purposes.
Solar panels	The panels used to capture the light from the sun and convert it to electrical energy
Shoulder light from the sun.	Light produced by the sun outside of the core production hours of 10am – 2pm

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Single row panel supports	This support system is a single row of panels interconnected with the panels side by side.
single support adjustment	Only the back support legs are adjustable. The front supports are fixed in position.
String inverter	An older style of inverter that is mounted on the wall inside the home. This inverter works by taking the power from a string of interconnected solar panels and converting this DC power to AC power
Solar array	A group of solar panels interconnected together
Solar cell	One segment of a solar panel. The panel is comprised of many solar cells all interconnected to form the solar panel.
Solar Hours	Taken from the World Solar Map – it is the average hours of full production a solar panel is expected to produce when installed in a certain geographical area of the world.
Solar inverter	The part of the solar system that converts the electrical energy produced by the solar panels into AC power for use in the home
Volts	A measure of electrical power that when multiplied by amps = watts. Volts are generally constant (127 or 240) while amps are different for each electrical appliance.
Watts	Watts are measure of power consumption in either a single point of time or over a longer period of time such as a Watt hour. Example: an air conditioner will use 1-kilowatt of power to operate for 1 hour and a solar panel will produce 500-watts of power in one hour. The consumption rate in watts is measured by multiplying the volts of the unit X the amps of the unit.
World Solar Map	World map denoting the solar production hours for each region.
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Part One:

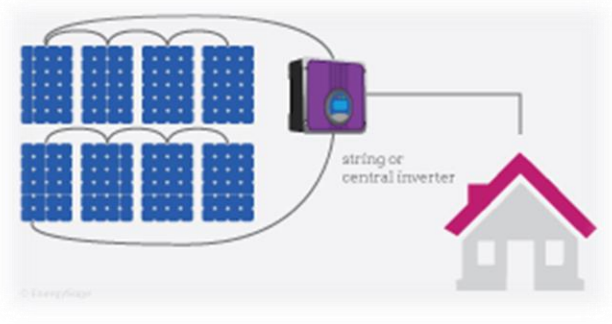
The basics of solar

Solar systems take solar energy (light) and turn it into electrical power.

How do they do this?

They do this by a process that captures the light and converts it to electrical energy using solar cells and solar energy inverters.

There are a number of different parts that make up a solar system. These include:



Solar panels,
A solar inverter,
A support structure for the solar panels,
Electrical cables that run between the solar panels (forming a solar panel string),
Electrical cables that run from the solar panel string to the solar inverter,
The solar inverter,
Electrical cables that run from the solar inverter to the main electrical junction with the electrical grid (through the connection of the system to the bi-directional electrical meter).

The solar panel, is made up of many solar cells that receive the light from the sun and convert it to DC power (like the power used in your car). DC power is Direct Current and can be stored in batteries for later use. Unfortunately, our homes and businesses use AC power (alternating

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current). AC power cannot be stored and needs to be used as it is produced, or it is lost. So, the DC power created in a solar panel, needs to be converted to AC power. This is where the solar inverter comes in. The inverter is really the core of any solar system. These inverters can be either large wall mount units (*traditional String Inverters*) or, small individual panel units (*Micro-Inverters*), that mount under the solar panel(s).

There has been much discussion and much written on the differences between the large wall mount string inverters and small micro-inverters. They both do the same thing – they convert DC power to AC power. The discussion on the benefits and drawbacks for each is a separate section.

Both types of inverter send converted AC power to your home, for use as needed. Any extra power is sent back to the grid, through the bi-directional meter. This meter measures both the power you use from the electrical company, and the power you send back as a credit to the grid.

Some systems also have traditional lead acid batteries and are either connected to the grid – A Hybrid System or are “Off-Grid”.

The latest systems (available) from Enphase are grid agnostic systems. These are connected to the grid but, can function as an off-grid system when needed.

This is the basics of a solar system. There are many variations on this system which we will go into in more detail in each following section. These variations are what will separate solar systems into the categories of good, better, and best.

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Part two:

Solar Panels:

There are literally hundreds of solar companies making thousands of different solar panels. With this many options how can you separate the good from the bad?

It is not that difficult really. There are some key features you need to understand and apply these features to any panel you are offered. We use the following tests when deciding if we will use a solar panel for the systems we build. These features are:

#1 – The manufacturing company must be a tier one solar panel manufacturer. This means the company has been in business (making solar panels) for at least ten years. They must also be in the top ten manufacturers worldwide in both volume and research and development.

#2 – The company must be100% vertically integrated. This means the company handles the entire manufacturing process for building a solar panel. They do not use subcontractors for any part of the build process.

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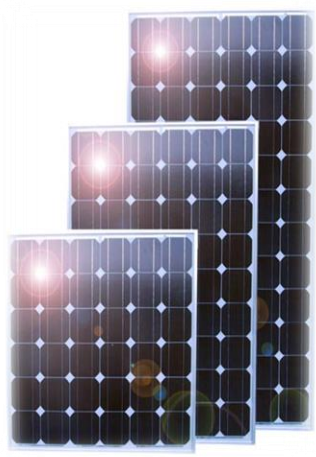
#3 – The company must be 100% automated. They have no humans involved in the build process. Everything is handled by robots. This ensures the most consistent build and ensures that the failure rate of panels is greatly reduced.

#4 – The panels must be tested and pass a number of 3rd party tests, including:



a) A salt mist test. This ensures the panel can withstand our beach climate of salt concentration in the air.

b) A sand abrasion test. This ensures the panel can survive the blowing sand common in the beach area.

c) An ammonia corrosion test. This ensures the panels can withstand the bird and animal droppings that will accumulate on the panel surface between cleanings.

d) The panel must be a “low light panel”. This indicates they will work more efficiently during cloudy conditions as well as both early and later in the day. This will allow for better light capture and longer production days.

The panel must have a high NOCT rating.

This is a rating for the panel’s overall performance that is different from the

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manufactures panel rating. You will see panels rated in watts and or % performance. These are two very different things. The watt rating of the panels is how many watts the panel will produce. This ranges from under 100-watts to well over 400 – 500-watts. This is the size of the panel and is determined at the factory by shining light at the panel in a “flash” test. This test measures the power the panel will peak at and is the size label that is put on the panel. This test also reveals the % performance of the panels. The % is how close to producing 1 kilowatt (1,000-watts) of power the panel produces per square meter of panel. 1,000-watts per meter of solar panel is considered 100% effective in light to power conversion. As solar panels get better, the % goes up. Right now, panels are in the 15% - 23% range. This means that for every square meter of size, the panel can produce between 150 – 230-watts. Each panel line will have this # noted on the panel data sheet. The higher the % of light to power conversion – the better the panel.

Even this is not the whole story. All of the above is about peak performance, however, solar panels rarely perform at peak. Many factors

affect panel performance – heat, clouds, dirt, angle to the sun etc. – all have a negative effect on a solar panel and reduce the power it can produce. This is where the NOCT (nominal operating cell temperature) rating comes in. The NOCT reduces the overall performance based on about a 20% reduction in performance. This is the number that you should be using to determine overall panel and system performance.

For example: a 400-watt solar panel is expected to peak in performance at

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400-watts. This is only under perfect conditions. For everyday conditions, you can expect the panel to perform at 320 or possibly more depending on the NOCT rating for the panel. A poor panel would be NOCT rated closer to the 320-watt level with higher quality panels getting a higher NOCT rating. In a nutshell, the better the panel the less power it loses in day-to-day operating conditions.

All of this is good information and, an understanding of it will help you to determine the right panel for your system. What you really need to know, however, is where to find the NOCT. Unfortunately, not all panel manufacturers provide the NOCT. Our advice is, if the manufacturer does not provide the NOCT rating for the panel, do not buy that panel. The NOCT rating should be on the panel data sheet.

As well, the panel needs to have a low Temperature Coefficient of Pmax(γ_Pmp). Panels are tested in the lab under perfect conditions in order to determine the wattage of the panel. They are also tested to see what the power reduction is if the conditions are not perfect. This is the PMax. Every panel has a properties data sheet and, listed on this data sheet is the PMAX %. This will be a number such as 0.42%. What this means, is that for every degree rise in ambient temperature, the panel will be reduced in power output by this amount. For example: all panels are tested at 25 degrees Celsius. Our normal roof top temperature is easily 35 degrees. This is a 10 degree increase in temperature and results in a 4.2% drop in output power from the panel, so a 400-watt panel would be reduced to a maximum output of 383.2 watts.

The bottom line is – the higher the PMAX% the less you want the panel.

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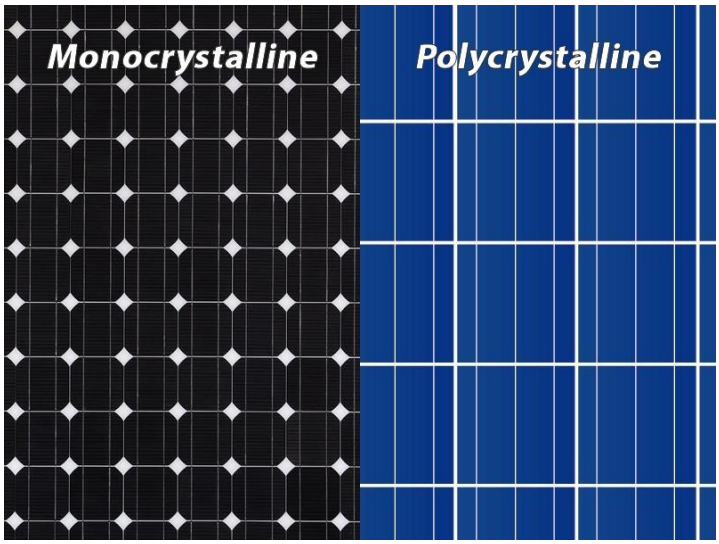

The type of panel is also a consideration, there are two – polycrystalline and monocrystalline. Although polycrystalline panels have been getting better, they are not as good as monocrystalline. The mono panels cost more and perform better in many of the conditions we experience in Yucatan. Saving a little money, per panel, may cost you a lot when it comes to how the panels perform.

System size does matter. The more panels you have the more power you will produce – right?

Wrong! Having high quality panels that produce substantially greater amounts of power will ensure you have a system that produces high levels of power with the minimum number of panels. Less panels equals greater savings in other areas of the system build - including the support structure, size/number of inverter(s) and overall labor cost for the install.

Construction and warranties for solar panels:

Panels are ruggedly designed; they all must be able to withstand substantial wind (many are hurricane rated). They need to withstand hail (although not a consideration here in Yucatan) and large snow loads (again not something we normally consider here in Yucatan). This rugged construction is generally guaranteed for 10 – 12 years. This is different than

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the performance guarantee. The performance guarantee is usually between 20 and 30 years and is based on a sliding scale of diminishing returns from the panel as it ages (much like a tire for your car has less warranty the more it is used).

Solar panel guarantees are all slanted to be in favor of the manufacturer. Your best protection, is to ensure you have a top-quality panel from a company with an excellent track record.

Review - What to look for:

Company:

Tier one Vertically integrated 100% automated

Panels:

Tested for salt mist, sand abrasion and ammonia corrosion.

Rated for low light performance.

Highest performance percentage at least 19% or higher, over 20 is better.

NOCT rating with as little difference between the overall size of the panel (in watts) and the NOCT size (in watts).

Low Temperature Coefficient of Pmax(γ_Pmp).

Construction guarantee of 12 years or longer

Production guarantee of 25 years or longer and at least 85% production at the end of the warranty period.

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Part Three
The inverter:

Is the inverter a string inverter or a micro-inverter?

String inverters are big boxes that hang on your wall and take all the power produced by the solar panels as a chunk of power and convert it from D/C power (same as your car battery) to A/C power for use in your home.

Micro-inverters are, as the name indicates, small power inverters that mount on your roof under the panels. Each inverter converts the power from one solar panel and sends it to your home for use as A/C power.

This is the very basic difference between the two types of inverters, but the differences are much deeper than this. Micro-inverters are far more efficient in power delivery. A micro-inverter system will produce far more power per panel, than any string inverter system.

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Who makes the inverter or Micro-inverter?

Top level companies have stood the test of time. Their products are dependable, and the companies are dependable, if there is a problem. These days, the market is being flooded with cheap, lower quality knockoffs, made by companies that either will not be around to help when there is a problem, or simply do not stand behind their products.

The top-level micro-inverter manufacturer is Enphase and it is a huge step down to look at any other micro-inverter or string inverter.

The field of string inverters is more open. There are many, top of the line companies such as, Fronius and Sunnyboy to name a couple. Other offerings should be looked at carefully both for the quality of the inverter and the quality of the company that made the inverter. Specifically, what is the track record for the inverter and what is the track record for the company when there is a problem. These are questions that your installer should be able to provide you information on.

How long is the standard warranty? Also, can it be extended?

Most string inverters of high quality, will carry either a five-year warranty that can be extended to 10 years or, they will have a ten-year warranty. However, a warranty is only as good as the company standing behind it. Many lesser inverter companies offer similar warranties but, actually getting them to live up to the warranty, can be next to impossible. Here is the real

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issue for you. If there is a problem with your inverter and the company that made it is in China and refuses to correct/fix/or replace the product, what can you do? Your installer (in most cases) only offers the manufactures warranty. By saving a few pesos up front you can easily pay far more in the long term.

Enphase micro-inverters have a standard 10-year warranty. In fact, they are so sure of their product, that the warranty is 25 years in the US and Canada, and ***if you buy through Emerald Coast Solar, we have a program to extend the warranty up to 25 years***.

It is important to understand the various components of the solar system as they all have different warranty periods. When you ask some companies what the warranty is, they will give you a short answer of twenty-five years. This is false. Only panel production is warrantied for 25 years. In many cases, when buying a lower class of inverter, you can expect to replace it (out of warranty) four times, before your panels are finished their production warranty. Factor that cost against a warranty as long as the panels.

What is the starting wattage for the inverter?

It does not sound like an issue; however, a high starting wattage can rob you of valuable operating time. The longer a system is in operation per day, the more power it produces. The Kaco string inverter for example, does not start operating until the panels are feeding 150 watts into the inverter. With only a few panels connected, this could substantially delay when the inverter starts working. On the other hand, Enphase micro-inverters only need 1 watt in order to start processing power.

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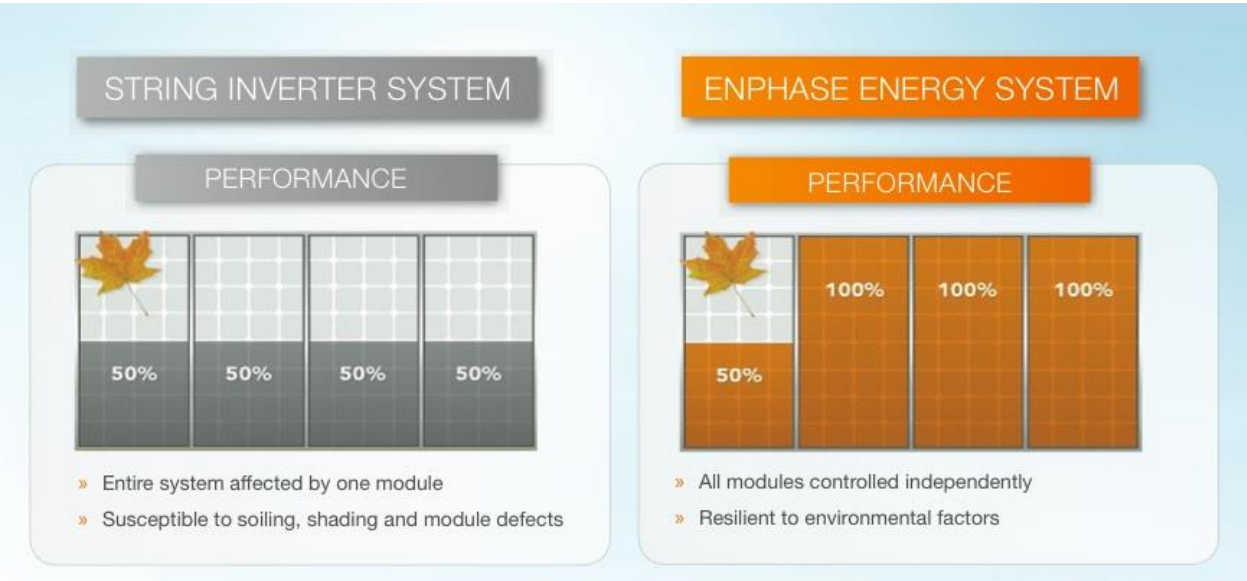
This is a techy question. How many MPPT's does the inverter have?

String inverters have inputs for the cables from the solar panels. These are called MPPT's. Each MPPT will take the string of a number of panels. Why are MPPT's important? They are important because a string inverter processes all the power from every panel in a string (all connected together) as one chunk of power. Here is the issue: the string inverter will only process power based on the least producing panel in the string. If, for example, you have 12 panels connected to an inverter with 1 MPPT and one of the panels is producing 10% less power, all the panels will produce 10% less power. On the other hand, if there are 12 panels on 2 MPPT's (6 and 6) one panel will reduce the power for only six panels.



The more MPPT's the better to a point. Unfortunately, with too many MPPTs, you can have the problem detailed in 4 above or worse, the system will not turn on at all.

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Micro-inverter systems do not use MPPT's. They process the power directly at each panel and therefore, have no issues with differing production levels for the panels.

What are the cut-out voltages for the inverter?

In order for an inverter to work, it needs to communicate with the power grid from CFE. It does this by reading the voltage sent from CFE to your house. If the voltage is too high or too low, the inverter will shut down. In many areas of the beach, the voltage is undependable. It is supposed to be 240 volts +/- 5%. However, in many cases, it is much higher than this. If the inverter cannot be adjusted to allow for a greater range of voltage from CFE, it will not work properly. Generally, a wall mount inverter can be adjusted less than micro-inverters and therefore, the micro-inverters can handle greater highs and lows from CFE and continue to function properly.

What happens if the inverter fails?

This is important when deciding on the type of inverter you want. When a string inverter fails, your entire solar system does not work. It will not work until the inverter is either fixed or replaced.

If an Enphase micro-inverter fails, only that panel stops working. The rest of the system remains in operation as normal.

Is there any other equipment necessary for a correct installation of the inverter?

String inverters require special wiring using photovoltaic cables, as well as

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a manual shut off to disconnect them from the rest of the electrical system. In addition, they require a fuse or breaker to prevent excessive voltage from entering the home electrical system. It is also required that they be grounded with a separate ground rod and ground cable connected to the panels and that the panels be interconnected for grounding.

The Enphase micro-inverters require a special cable to connect the inverters to the home electrical system. This cable is run between each inverter and is then fed into a junction box where it connects to normal household cable, that can be run directly to the breaker panel for the home. All the safety features that are add-ons to the string inverter system, are built into the Enphase micro-inverters.

How is system monitoring handled?

String inverter or micro-inverter, you want to be able to monitor your production simply and easily. Most string inverters have the ability to remotely monitor the system production. However, they do require the additional expense of added equipment in order to connect to wi/fi. As well, the system can only monitor the power as a whole or, at best, the power delivered on each MPPT (see 5 above). They also do not have the ability to monitor the power you use, only what the solar system produces.

Enphase micro-inverters come with the Enlighten remote monitoring system, built in. In fact, Enphase micro-inverters have the best monitoring system available. Not only do they monitor the power produced (by the entire system and at each panel individually), they also have the ability, to

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monitor power consumption. As well, they have a three-level monitoring system that allows you and the installer/maintenance technician and Enphase to remotely monitor your system, and affect repairs/upgrades and diagnostics without having to make a house call.

What is the expandability of the inverter?

The system you install today, may not be the system you need in a year or 3 or 5. It is important to look at expandability for 2 reasons:

1) Your power needs may increase in the future and,
2) As your panels age, they will produce less power.

Given these two conditions, it is important to ensure you get a system that can be expanded as your needs require. String inverters are restricted in their ability to be expanded. String inverters are based on total power and are scaled on a kilowatt basis. You can buy a 2,3,4,5 or higher kilowatt inverter, however once it reaches maximum power load, you need to either buy a second, string inverter, or replace the one you have with a bigger one.

Micro-inverters do not have this issue. The expandability of a micro-inverter system is almost unlimited. As many as 330 micro-inverters can be connected to one monitor. You will run out of roof space before you run out of expandability, with a micro-inverter system.

As well, with a micro-inverter system, you do not lose power as the system ages. Because micro-inverters make use of the core power for longer periods of the day, instead of peak power for short periods, to deliver the highest power harvest, they are not as susceptible to losing power as the system ages. The loss of power due to age is off the peak power end. The core power yield will remain the same for 10 years or longer.

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Part Four:
Batteries as back-up power:

Batteries have a long history of being used in combination with solar panels to store power for later use. Unfortunately, the solar inverter industry moved to a grid passed inverter system as a simple connection for homeowners to capitalize on solar energy without the need for power storage. Sun is out you produce power. No sun, you get your power from the electric company. This drastically reduced the cost of solar systems and made them available for most homeowners.

Battery systems were relegated to the fringes. People wanted to be “off-grid” or those who had no power provider nearby, could turn to solar systems with battery storage. They were very expensive and came with some risks of dangerous gasses being released by the lead acid batteries.

More recently, traditional lead acid battery systems have made a come back as hybrid solar systems. These are systems that are connected to the electrical grid and have lead acid batteries as a back-up in the event of grid failure. The main problems with this system are; initial cost, longevity of the batteries and poor solar system performance, due to the use of special solar inverters.

Many top tier solar inverters are designed to work solely as grid tied systems and do not work in a hybrid system. It can take as much as 30% more solar panels, in a hybrid system, to equal the power harvest of an Enphase micro-inverter system. As well, the lead acid batteries do not have a long-life span and require replacement on a regular basis. Even most

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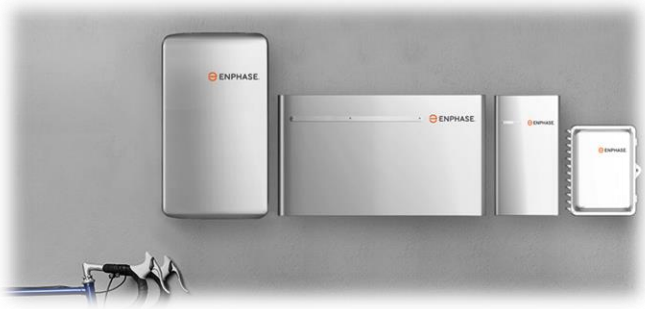
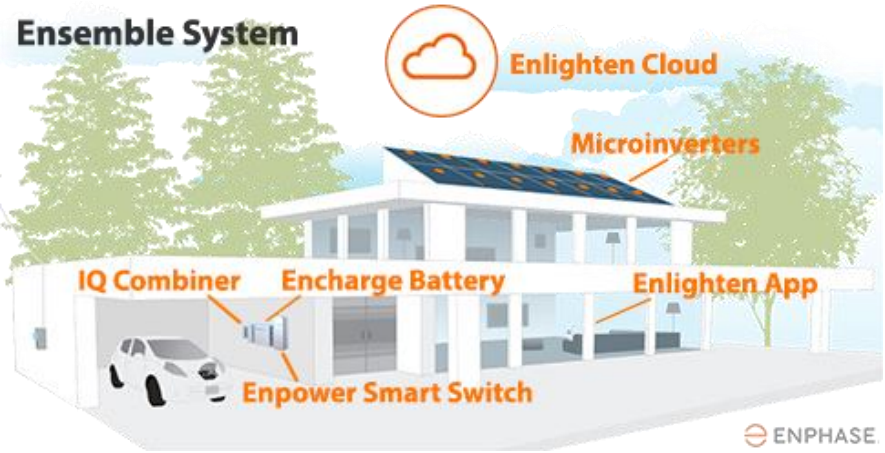
solar manufacturing companies recommend a grid tied solar system and a separate back-up generator, instead of a hybrid solar system.



With the introduction of a different battery, the horizon looks brighter for a truly economically sound battery back up option. The grid agnostic system available from Enphase – The Encharge Ensemble – is the first of its kind, allowing batteries to be used as the primary power source for the home and remain connected to the grid. Using lithium-ion-phosphate batteries (guaranteed for 4,000 charges), in a simple plug-and-play setup, Enphase has created a long-lasting system designed to run your home however you want. It remains expensive initially, however, it may be less expensive than a whole home generator, over the lifecycles of each. The best part, like the rest of the Enphase line up, you can start with a small Ensemble system and build it up over time.



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Part Five:
The support structure:

The support structure does more than hold the panels. It secures the panels in case of storm, it keeps the panels in the correct position for maximum power production and, in some cases, is adjustable to be able to move the panels to increase power production at different times of the year. It is important to understand the crucial role this part of the solar system plays, in ensuring your system produces the highest level of power possible.

Is the support system a fixed angle system or is it adjustable?

A fixed angle support system locks your panels into a fixed position on your roof. This means that as the sun changes position on the horizon, your panels will not be as efficient. If the panels are set for the summertime, they are close to flat on your roof to maximize power harvest in the summer. If they are set for a spring and fall, they will be set at more of an angle (20 degrees) to get the most power from these times of the year. The problem is, they will not be as efficient during the rest of the year and will miss out on substantial power harvests during the winter and the summer.

An adjustable angle system will allow for seasonal adjustments to the angle of the panels and will be a much more efficient system, producing much higher levels of power production for more of the year.

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However, a single angle adjustable system will still be limited in range of adjustment and therefore will not achieve the greatest energy harvest available.

A dual adjustable system (where both the front and back support legs can be adjusted) will allow for the greatest range of adjustment and will produce the most power year-round. ***Emerald Coast Solar is the only company to offer dual adjustable support systems, standard for each of our system installs.***

What angle is the system going to be set to?

Here in Yucatan the standard angle set for a fixed position system is 20 degrees. This is a compromise set, designed to maximize power harvest in the spring and fall. A low angle set (less than 20 degrees) will increase production in the summertime and a high set (over 20 degrees) will increase production in the winter.

At ECS, we maximize production through most of the year by adjusting our systems to maximize power harvest through spring, summer and fall. It is unfortunate but, the winter set is too great an angle (given our winter weather conditions) to be a safe angle for the panels to be positioned. This does not sound like it would make much of a difference in performance but, it does. Our dual adjustable systems have an average year-round power gain over fixed position and single adjustable position systems of 10% or more. That is (on a ten-panel system) equal to adding one more panel.

What is the support system made of?

All support systems are not created equal! The differences in the construction of your solar system support structure, can make the

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difference between a system that will last five years and one that will last 25 years or longer.

Is the system made of anodized aluminum? Most support systems are constructed of aluminum. If you are offered a system not made of aluminum show the salesperson the door and contact a different company, especially if you live on the coast. However, not all aluminum is created equal. Normal aluminum has no protection against the elements. Anodized aluminum is higher quality and is designed to withstand the rigors of our environment. Unfortunately, it costs more, and most companies will not use it. As well, the largest supplier of support systems in Mexico does not normally stock anodized supports, they need to be special ordered. ***ECS only uses anodized support rails for all our installs.***

How is the support structure interconnected? The standard is to connect the various components of the support structure with galvanized nuts and bolts. Unfortunately, even galvanized will rust in our coastal environment (and quite quickly). The better choice is to use stainless steel for all connections. Of course, this is more expensive in the short term but, it is a support system that will stand the test of time unless… The aluminum and the stainless are not kept separate from each other. ***ECS uses only stainless steel for our structure connections.***

It is very important to ensure that the two different metals remain separate from each other. If not, then the stronger metal will deteriorate the weaker metal. We have seen systems under two years old where the aluminum is

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turning to powder where it is in contact with the galvanized or stainless connecting bolts. So, does the company separate the different metals in the support structure? ***ECS separates all our metals in all our systems.***

How is the system attached to the roof?

There are many different ways of attaching your system to your roof. These range from the basic of attaching the support legs directly to your roof with a single bolt, up to building cement support columns bonded to your roof with stainless steel threaded rod running the length of the column and secured into the roof with expansion nuts. Each of these methods increases both the cost of the system and the system security on your roof.

The weakest system is the one attached directly to your roof using galvanized screws or bolts to hold it in place.

Next is the system mounted on small cement columns poured directly onto your roof with a single galvanized bolt passing through the column into the roof. Next is the same column with 2 bolts/screws secured into your roof.

The highest level of security for your support system is to chip the roof, insert two expansion anchors into the roof, attach stainless steel threaded rod and then pour the columns. ***This is the ECS method of attaching the roof supports for your solar system.***

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These are some systems that have even stronger support structures However, these are fixed position systems that lose 10 – 30% and sometimes more, potential power harvest for the structural security.

What wind force is the structure rated to withstand?

This is one of the big lies the solar industry and, most install companies continue to promote. They will tell you that the panels are rated to withstand winds in excess of 100 miles per hour. They may also tell you that the support system is rated to the same or even higher winds, however, here is what they do not tell you.

a. The guarantees for the panels and the support structures are provided by the manufacturer, not the installer.
b. If a panel breaks free of the support system and crashes to the ground, the panel is not guaranteed. It was the support system that failed, not the panel.
c. If the support system failed the manufacturing company may replace the parts of the support system but, not the panel, as they do not guarantee the panel only the support structure.
d. In the event of a hurricane, there is no guarantee for either the support system or the panels, as the winds in a hurricane will normally exceed (in gusts) what either the support system or the panels are guaranteed for.
e. Access to any of these warranties is usually the responsibility of the homeowner, not the installation company. Most guarantees cover the parts only. Labor is the responsibility of the homeowner and in many cases, the home owner may be responsible for the cost to ship the defective part back to the manufacturer for analysis and pay for shipping of the repaired or replacement part back to the homeowner. These costs will

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easily exceed the cost to buy replacement parts.

Your best protection is to hire a reputable company that stands behind their products with guarantees separate from those of the manufacturer. A company that practices superior installation methods and backs up their products (in writing) with after install service and maintenance programs. ***ECS is one such company. Our install methods are the best available and we back up our systems with the best warranties and after sale service available.***

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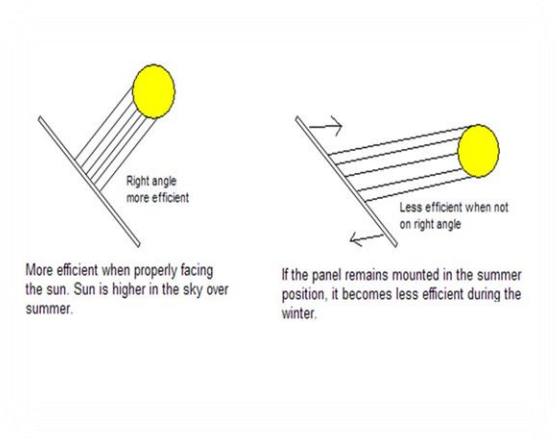
Part Six:
Solar system performance:

Having discussed the parts to a solar system, we want to discuss how it is all put together to achieve the results you want.

The best systems combine the best of each part of a solar system including high quality solar panels, built on a secure, adjustable mounting structure, and connected to a high quality, high production inverter system with the correct electrical cables and a long-lasting system of protective tubing for the electrical cables.

When it comes to building the most efficient and secure systems, cost does matter. Most of what goes into a solar system, clients rarely see. It is very unusual for the homeowner to spend time on the roof ensuring the solar company is doing the job right. There are, however, a number of steps in the process of building a system that the homeowner can ensure are done right by asking the right questions.



1) Panel angle to the sun – East to West:
Panels perform best when they are angled so the sun hits them directly. This is a problem for fixed position panels because the sun is always changing position (Ok, so it is the world that is moving – not the sun. It is simpler to refer to the sun moving for explanation purposes).
The sun changes position in two ways:

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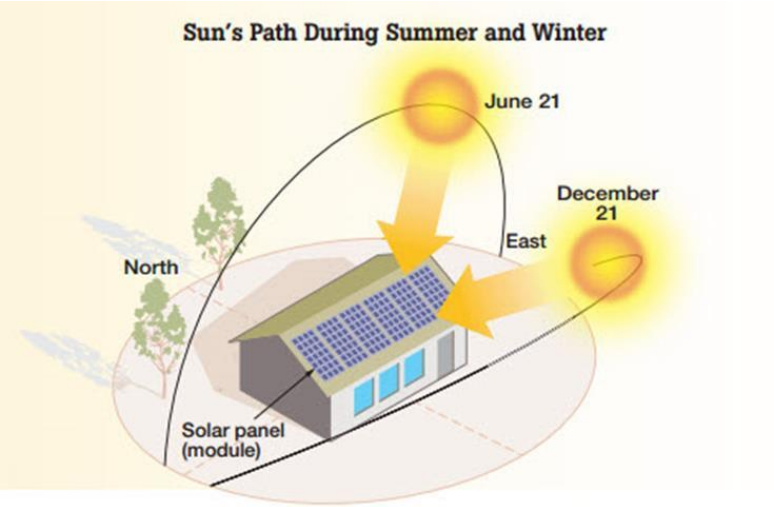
a) During the day it moves from low in the Eastern horizon in the mornings, to being overhead through the middle of the day, and back to low on the horizon, as it sets in the West. As it moves through this range, it shines light onto the panels from different angles. The greater the angle, the less the solar panel will be able to process the light. This is why the panels only achieve full performance during the core hours of the day (from about 10am – 2pm). The rest of the day the panels are performing well below full power. Unfortunately, having a system that will track the sun across the sky from East to West is quite expensive and not available here. Every solar system is at a disadvantage by not being able to fully harvest the more than eight hours of sunlight available. This is why it is important to get a high quality “low light” panel. They are designed to be able to make better use of this “shoulder” light from the sun.

b) Seasonal changes in the sun’s position on the horizon. This is where substantial gains in power harvest can be achieved. The sun changes position on the horizon as the earth moves around it. Due to the earth being tilted, there are longer and shorter days of sunlight based on if the area we live in is tilted toward the sun or away from the sun.



Source: U.S. Dept. of Energy, https://www1.eere.energy.gov/solar/pdfs/43844.pdf

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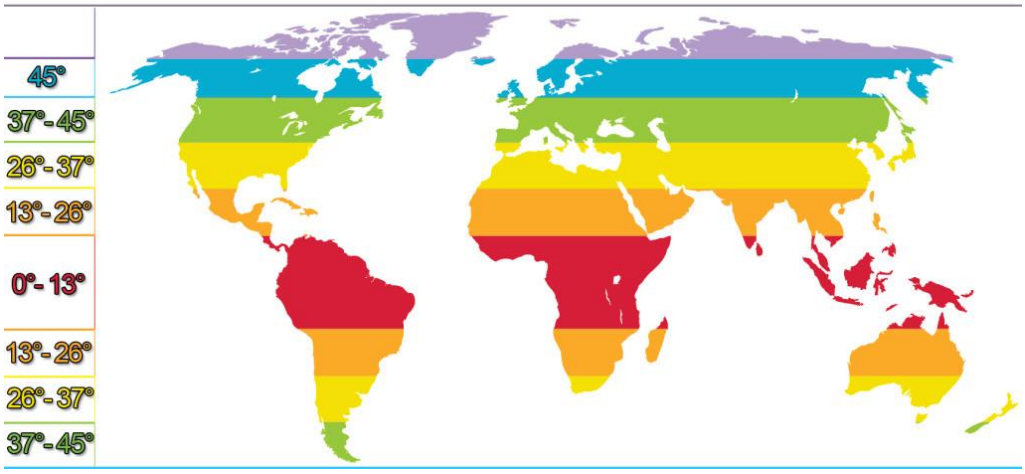
Here in Yucatan, the seasonal differences for the sun's horizontal position, constitute about a 40-degree range of possible panel angles, from 0 degrees (in the summer) up to 40 degrees (in the winter). However, these angles have other factors that influence the usefulness of the angle.

Optimal angle for fixed solar panels depending on installation position



[The optimal set in Yucatan is 13 – 26 degrees with 20 being the mid-point or Spring/Fall setting.]

Winter, has two main issues. The winter angle of 40 degrees is too great an angle for a fixed position system to use year-round as it would reduce power harvest for the other three seasons by too great a margin. Plus, having the panels set at 40 degrees facing South would expose them to the winter storms and they would not be safe.

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Summer has a similar problem to Winter. The panel angle for summer is 0 degrees. While this angle is great for the summer and allows for huge power harvest during the longest days of the year, it is very poor for the other 9 months of the year.

Spring and Fall are the complementary seasons. They both have the same angle of 20 degrees as the mid-point between Summer and Winter. It is possible to angle slightly below this set to take greater advantage of the longer days (maybe up to 3 degrees) however, there will be additional power losses during the winter.

In a fixed panel system, the best angle is around the 20-degree mark as it is the correct angle for the longest period of time in the year.

For adjustable systems (single support adjustment) the correct angle remains 20 degrees and a summertime adjustment as close to 0 as possible will increase power harvest during this time. Unfortunately, most systems available today (that are adjustable) can only adjust in a very limited amount. This is usually between 10 – 15 degrees or 15 – 30 degrees as provided by the manufacturer.

A dual adjustable system will give the greatest opportunity for the highest power harvest. The dual adjustable system takes advantage of the ability to adjust both the front and back supports through a greater range of motion. These systems can generally be set

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anywhere from 0 degrees up to about 25 degrees. A wider range of motion allows for Summer sets of 0 degrees and the rest of the year can be set to 20 degrees providing excellent power harvest in both the Spring and Fall with highest power harvest during the Summer and marginal power losses through the Winter.

A pivot point adjustable system will work the same as the dual adjustable system, except it is used for multi-row panel supports vs single-line panel supports. At Emerald Coast Solar we have installed fixed position systems, single support adjustable, dual support adjustable and pivot point adjustable systems. Our testing of all of these systems has demonstrated the best system support is the dual adjustable. It has the best combination of security and power harvest of all the options.

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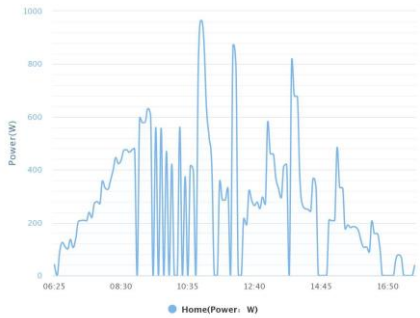
Part Seven:
Peak vs Average Performance:

How system production is measured is very important when deciding what system will be right for you. There are two basic ways to measure a system performance – peak power production and average power production.

With peak power production, the panels are measured for the maximum wattage they can produce. This number is multiplied by the solar hours listed for the area the system is installed in. The solar hours are based on a world map that has divided the world into sections based on the amount of average sunlight each area receives. This is then further broken down to give total average hours of maximum production for a solar panel.



As we discussed earlier, panels rarely produce at maximum because of the issues with sun angle to panel angle and other factors. The world solar map takes this into consideration and makes an hour determination for each area that a solar panel can be multiplied by to estimate power harvest.

For example: An area is listed at 5 solar hours you can then multiply the watts of the solar panel by 5 and the result is the expected performance of that solar panel daily. Use a 400-watt panel and you can expect 2-kilowatts of production, on average, per day from that panel.

This method of calculating panel performance is fairly accurate for basic string inverters. It is not accurate, however, for advanced string inverters using optimization software or add on optimizers. It is also not accurate for

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systems using micro-inverters. Both optimized string inverter systems and micro-inverter systems produce far more power, on average, than the world map indicates they should. This can make a huge difference in the size of system a homeowner requires. If the solar company does not make adjustments for this increased power production, a homeowner can have a system that is much larger than they require.

For example: At ECS, we calculate our power projections based on past performance, not the world solar map. If we used the WSM and a 385-watt panel we would get (385 X 4.5) an average production of 1,732.5-watts per panel per day. We would say that a 10-panel system would produce on average 17.32-kilowatts per day. In reality, our system using Enphase micro-inverters produces 2-kilowatts per day. This is over 15% more power and is power the homeowner does not need that they have paid for. Instead, we calculate the past performance of similar panels (2-kilowatts per day) and sell a nine-panel system. Saving the homeowner about 10% (Unfortunately we cannot cut a panel in half to get the 15% reduction).

The other issue is the calculation of string-inverter size vs micro-inverters. String inverters are sized based on the size of the solar panel. A string inverter calculation must consider the full panel output when designing the system. A system of 10, 400-watt panels is considered a 4-kilowatt system and requires at least a 4-kilowatt string inverter. A 20-panel x 400-watt system requires an 8-kilowatt inverter etc.

Here is the thing that many companies do. They estimate the size of the inverter and sell you the inverter based on the above calculation, knowing that the system will underperform by about 20%. Or they increase the number of panels to get the additional 20% output and then sell the

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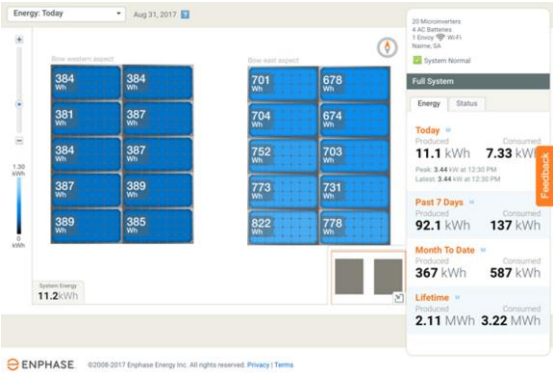
homeowner an inverter that is 20% larger and more expensive.

Micro-inverter systems are different. They are dependent on panel size only to calculate the best size for the micro-inverter to perform at peak for the longest period of time in a day. Micro-inverters limit the power from the panel that can be processed. They come in different sizes with maximum power ratings. As long as the installation company can accurately calculate the average power output based on the combination of micro-inverter and panel size, a correct system size is easy to calculate. Follow the link for more information on Enphase Bigger is Better. Although it is an older article the results hold true and are, in fact, more significant than with the older micro-inverters.



One final point, String inverters process the power coming from the panels based on the lowest power output in the string of panels. If one panel is underperforming, all panels in the string will underperform to the same level. Micro-inverters do not process power in the same way and are therefor not restricted to the lowest performing panel. You can even have panels of different sizes connected together in a Micro-inverter system and they will all perform to the top level of the micro-inverters. This is even more important if you decide to add panels in the future. Solar panels are advancing rapidly. The size you put on your roof today, may not be available in the future. With a string inverter, adding panels may require additional equipment such optimizers, to get the full power out of the new panels. With micro-inverters the add is easy, add panel add micro-inverter.

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The bottom line is that string inverter systems are sized based on maximum panel output, a level of power that is rarely achieved and even then, only for a short period of time. Micro-inverter systems are sized based on average daily performance (at least they are at ECS). A micro-inverter system is higher performing, with greater power output, on a daily average and is therefore a smaller more efficient system that will save the homeowner money.

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Part Eight:
The installation company:

We have posted this section in various forms over the years. Always hoping people will make use of it, and the section that follows, to separate the truly great companies from the rest of the others clamoring for your business.

With the increased demand, more and more companies are offering solar installs, and while competition is generally good for the consumer, we would offer the following list of questions to ask and or check on with any company you are thinking of using to supply and install your grid tie solar system. Solar is a major purchase, one that can save you 10's of thousands of pesos over the life of the system. It is in your best interests to ensure you get a quality install, done by a quality company, that will back up their products with excellent warranties and service.

It is important to remember, that beach solar systems, face a much harsher environment than systems installed away from the beach.

Are the installers certified to install solar systems and where did they get their certification?

How many systems does the company have in operation?

Ask for references!!! And contact the references supplied!! As well, check the internet and ask what people know of this company. It is important to get as many references as possible. Having 1, 2 or even 5 references is easy for any company to do. Providing you with 10, 15, 20 or more clients to contact takes a lot more effort and the best companies should have this

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easily for you. You can then decide, contact a few or contact them all. As well, ask for references that span at least 2 years. A company may be great at the initial install but have no follow up. You want a company that is great at both initial install and ongoing follow up/maintenance.

What customer support is offered and is there a cost for this support?

Does the company monitor your system, to ensure productivity and correct functioning of the system? If so, how is this monitoring conducted and is there a cost for this service?

How does the company handle a warranty issue? This is an important question because under normal circumstances your system could be down for days or even weeks, while the equipment in question is checked out.

Does the company have a guaranteed time that they will have your system back in operation, if there is a problem? If so, what is the penalty to the company if they fail to live up to their guarantee? Anyone can say anything, however, unless they put it in writing and have a cost to the company for not living up to their commitment there really is no commitment.

Does the company have a guaranteed response time if you have a problem and is there a charge for this service? Also, and perhaps most important - what will they do for you if they fail to respond in the guaranteed time? Again, it is the question of putting the commitment in writing and having a penalty to the company for failure to live up to their commitment.

Does the company put everything in writing? Any one can say anything to you but, it has no force and effect unless it is in writing. If a company representative commits to do something, make sure you get it in writing and in a language you can understand.

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Does the company offer a maintenance program and if so, what is the charge?

Does the company only use new equipment and, what is the quality of the equipment used? For example, most decent solar panels carry a 12 year+ warranty against manufacturers' defects and such things as perforation. However, as far as I know, no manufacturer specifically guarantees against salt corrosion. What you need to look for at the very least, are panels that have been tested in a high salt environment. In fact, one company producing panels in Mexico only has a 2-year warranty and specifically excludes high salt environments - not the panels you want to use at the beach.

Does the company base their system recommendation solely on what your average CFE bill has been for the past year or, do they take the time to sit down with you and discuss your current AND future energy requirements?

Does the company take the time to look at how you are consuming your energy and make recommendations to lessen your consumption and thereby, reduce the size of system you will require?

Does the company offer you options - such as different sized systems to meet your needs, not only now, but into the future, that will allow for expansion of the system?

Does the company do a site inspection before giving you a quote? This is very important as many factors can affect the install of a solar system and our roofs are generally littered with satellite dishes, air conditioners, tinacos etc. that can all affect where and how a system is installed. This can also affect the final cost of the system, leaving you with a nasty surprise at the completion.

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Does the company handle everything from the initial paperwork with CFE through to the system going online and into service?

Does the company have someone you can talk to? It is important to be able to deal with someone who can understand you and you can understand. While we do live in Mexico and it would be great if we all spoke Spanish, the fact is many of us struggle with learning a new language and a purchase of this magnitude should not be open to misinterpretation due to a language issue.

Does the company provide a quotation and contract for services and installation in English as well as Spanish? This is an important consideration. If you cannot read the quotation and its details you cannot know what you are being sold.

Is the quotation detailed and does it offer you options? Does it include information about the panels, the string inverter/micro-inverters. Does it list the power you can expect the system to produce on a daily, bi-monthly and annual basis. Does it detail what the company will provide in in both materials and services.

Is the company prepared to explain all the parts that go into the installation as to type of materials used and why, brand of panels and their specifications, type of support structure to be built and how the system will be secured to your roof?

During and after meeting with the company representative, how do you feel? Was the representative informative, did they know their stuff, were they able to answer your questions, did they offer advice, did they inspect your electrical system and roof. Did they get to know you and how you use

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power. Were they interested in any plans you have for additional electrical loads (freezer, more A/C units etc.) in the future?

What does the company offer that is not offered by other companies? There should be a reason for going with one company over another. It may be price, it may be service, it may be what one company offers that others do not, or it may be just the feeling you get from sitting down with the company representative, but there needs to be something that makes the decision easy for you. Having something that nobody else can or is offering, may help to make your decision easier.

What does the company do differently for a beach area install, compared to an install in Merida? The beach is a different climate and presents different challenges, compared to installing away from the beach. It is important to know if the installation company takes these differences into consideration, when designing your beach area system. How do they account for the higher winds, the higher salt content in the air, the blowing sand, and the greater chance of ammonia corrosion from bird droppings?

Does the company have solar installed on their house(s) and or business? If so, did they do the installation? If not, why not?

Does the company have a full-time installation staff or are they just resellers? This question is really important when it comes to areas such as quality control for the installation, system maintenance and who deals with problems and/or warranty issues.

As many companies down here do many different things, the question you should be asking is: What is the primary focus of the company? Is it solar or is solar either a new add to the company or is it something they do as well as other stuff? If it is an addition to what the company already does,

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say construction, what is going to take precedence now and in the future? Will it be your install/maintenance/or problem or, will it be the new construction job they have underway.

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Part Nine

Putting it all together:

There are many combinations of systems available, depending on your budget and what you want out of a system. However, if you are looking for a system that is economical, secure and will stand the test of time, you will need to spend more money up front.

Given our experience installing different solar panels, assorted string and micro-inverters, working with different mounting systems and seeing the work done by other solar installation companies (both good and bad). We recommend the following basic levels of equipment and service:

1) Tier one solar panel manufacturer
2) Monocrystalline panels with low light rating, designed for our harsh weather. Minimum 12-year build and 25-year production guarantee.
3) A dual adjustable support system using aluminum legs and rails with stainless steel securing nuts, bolts, and rods (anodized aluminum whenever possible).
4) Enphase micro-inverters (the best choice) when properly matched with the right solar panels.
5) The most comprehensive system monitoring by the installation company and/or the manufacturer.
6) A solar installation company with an excellent track record that has substantial guarantees separate from the manufacturer's warranties.
7) A solar installation company with excellent after install service and support.
8) A solar installation company that puts everything in writing and backs it up.

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We want to thank you for taking the time to go through this booklet. We hope this has provided you with the information you need to make an informed decision when choosing both a solar system and a company to provide the installation and support services you require.

If you would like additional information or want to talk to us about installing your system, please let us know. We would be happy to discuss what you want and how we can help you become energy self-sufficient with a solar system from Emerald Coast Solar.

You can also check our web site @ - www.ecsolarmx.com for additional information on our company and the systems we have in operation.

You can visit our You Tube channel for more information on ECS and Enphase - @ - ECS information videos - YouTube

The final section – questions to ask is attached below.

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Part Ten
The questions to ask:

Compare solar companies the easy way!

Use this handy checklist to ensure you get the best company for your system install.

	Companies		
Questions			
Questions on the panels			
Is the solar panel manufacturer a top tier company?			
How long is the panel warranty?			
How long is the production warranty?			
What is the start and finish levels of the warranty?			
Are the panels 3rd party tested against salt corrosion and abrasion?			

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Are the panels 3rd party tested against ammonia corrosion?			
What is the Pmax% for the panel?			
Are the panels designed for low light operation?			
What is the average power output for the panel? NOCT %?			
Are the panels poly or monocrystalline			
Questions on the inverter			
Is the inverter a string inverter or a micro-inverter?			
Who makes the inverter or string inverter?			
How long is the inverter warranty?			
Can the inverter warranty be extended?			
What are the starting watts for the inverter?			
How many MPPT's does the string inverter have?			

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What is the cut-out voltage for the inverter?			
What happens if the inverter fails?			
How is system monitoring handled?			
How many panels can be added to the inverter?			
Questions on the support system			
Is the support system a fixed angle system or is it adjustable?			
If adjustable, what is the range of adjustment?			
What angle(s) will the system be set to?			
What is the support system made of?			
What type of screws and nuts and bolts are used to put the system together?			
Are the different metals kept separate?			
If kept separate – how?			
How is the system attached to the roof?			

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What wind force is the structure rated to withstand?			
Questions about the company			
Are the installers certified to install solar systems?			
How long has the company been in business?			
How many systems does the company have in operation?			
Ask for references!!!			
Contact the references supplied!!			
What customer support is offered?			
Is there a cost for this support?			
Does the company monitor your system, to ensure productivity and correct functioning of the system?			
If yes, how is the monitoring conducted and is there a cost for this service?			

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How does the company handle a warranty issue?			
How long does the company warranty their work and labor?			
Is any warranty extension available?			
In the event of a problem, does the company have a guaranteed time that they will have your system back in operation?			
What is the penalty to the company if they fail to live up to their guarantee?			
Does the company have a guaranteed response time?			
If yes to above, is there a charge for this service?			
And, what will they do for you if they fail to respond in the guaranteed time?			
Does the company put everything in writing?			
Does the company offer a maintenance program?			
If so, what is the			

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charge?			
Does the company only use new equipment?			
Does the company base their system recommendation solely on your CFE bill?			
Does the company take time to discuss your current AND future energy needs?			
Does the company take the time to look at how you are consuming your energy?			
Does the company make recommendations to lessen your power consumption			
Does the company offer you options on system size?			
Does the company do a site inspection before giving you a quote?			
Does the company handle everything from the initial paperwork with CFE through to the system going			

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online and into service?			
Does the company have someone you can talk to in your native language?			
What does the company offer that is not offered by others?			
What does the company do differently for a beach area install, compared to an install in Merida?			
Does the company have solar installed on their house(s) and or business? If not, why not?			
If so, did they do the installation?			
What system do they have installed and why?			
How does the company charge you for the system?			
Other comments:			

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