The Louisiana Department of Natural Resources

Presents
A Series on Energy Efficiency

Guide #Five
Solar Electric & Solar Water Heating

Provided by

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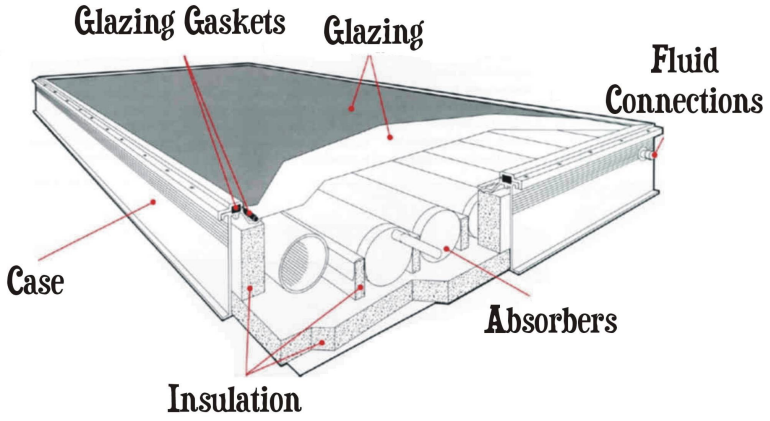
Solar Water Heating

Effective January 1, 2006 through December 31, 2011, under EPACT 2005, purchases of solar water heaters for residential use are eligible for a 30% tax credit of up to $2,000

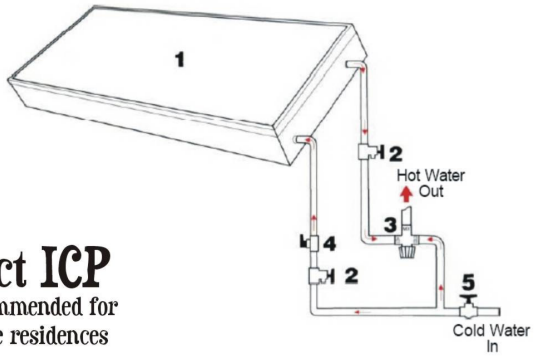
- If the correct type of system is installed, and installed by a qualified installer Louisiana's climate can be highly suited to the use of solar collectors for hot water generation. Because Louisiana's winters are milder than our neighbors in the Northern United States, in most areas of Louisiana, particularly South of Interstate 10/12, a solar collector system can be installed for much less than it can be installed for in most Northern parts of the country. Our winters are much milder with temperatures rarely falling below freezing for any extended period of time, therefore the need for elaborate, very expensive freeze protection measures, which are needed in the North, and with specific types of collectors are not as critical in Louisiana. Even in Northern Louisiana, where the temperatures generally fall lower during winter than they do in South Louisiana, minimal freeze protection measures will sustain a solar collection system. Without the need for expensive freeze protection systems, the cost for installing a solar collector water heater can have dramatic pay back.

  Domestic hot water falls only behind heating and cooling as the highest energy consumers in residences. Integrated Collection Panels or ICP's are solar collectors that integrate water storage capacity into the collector. ICP's perform extremely well in climate zones 3 and 4 (Southern Louisiana) with no freeze protection, and perform extremely well in climate zones 5 and 6 (Northern Louisiana) with minimal freeze protection,. ICP's perform well without freeze protection simply due to their mass and size. The ICP absorber tubes are large (4" diameter), and the tube case maximizes heat retention. The ICP's design of mass and volume simply protect it very effectively from freezing.

Integrated Collection Panel

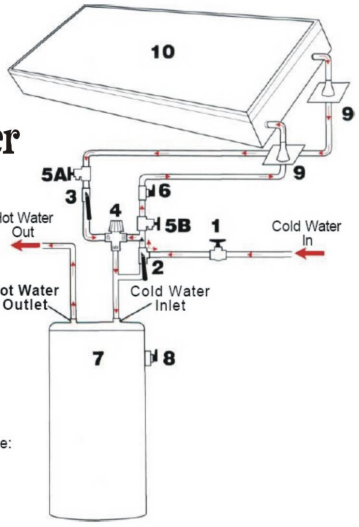


- ICP's serve as the hot water storage tank, therefore they are purchased according to capacity as you would purchase a conventional electric or gas water heater (30 gallon, 40 gallon, 50 gallon). This also means that the amount of hot water available is as predictable as with a conventional water heater. ICP's can be configured in many ways, even as a direct system where it alone provides the only source of hot water, however the recommended installation for the ICP is to be used as a pre-heater for your existing water heater. With ICP's properly sized, and installed as pre-heaters they alone can handle total home hot water needs except on those rare occasions where high demand may call for the use of the existing water heater to supplement the water heating output of the ICP. This means that you will only pay for hot water during those rare occasions when you exceed the output capacity of the ICP (the rest of the time heating your water costs nothing), and since the ICP serves as a storage tank – you double your hot water capacity and should never run out of hot water.



Direct ICP
Not recommended for full time residences

1. **ICP**
2. Boiler Drains: *Bronze*
3. Tempering Valve: *Set between 140°Fand 160°F*
4. Pressure Relief Valve: *150 psi*
5. Supply shut off valve.



ICP as Pre-heater
Recommended installation for residences

1. Supply shut off valve
2. 3-way Ball Valve: *Bronze*
3. 2-way Ball Valve: *Bronze*
4. Tempering Valve
5. Boiler Drains: *Bronze*
6. Pressure Relief Valve: *150 psi*
7. Conventional Water Heater
8. Temperature/Pressure Relief Valve: *210°F/150psi*
9. Roof Jacks
10. **ICP**

- A 50 gallon ICP system will cost about three and a half times as much as a conventional 50 gallon electric water heater, and about two times as much as a conventional gas water heater (before applying the tax credit incentive) but will pay for itself in about three years in the way of saved utility. Based on a 10 cent per Kwh rate, after the three year payback you can expect to save about $25.00 per month or $300 per year over electric water heating utility. A 30 gallon ICP will yield about one third less savings or about $200 per year.

Performance Data for ICP

Florida Solar Energy Center
(FSEC - GP - 5 - 80)
(FSEC - GP - 6 - 80)
(FSEC - GP - 7 - 80)

ASHRAE 95-87
Thermal Performance
Standard
for
Solar Water Heaters

Solar Ratings &
Certification Corp.
SRCC Standard 200 - 88
(RA 92)
SRCC OG - 300

Uniform Solar Energy Code
International Association
of Plumbing &
Mechanical Officials

	FSEC Qnet		Florida Energy Factor			SRCC Solar Energy
MODEL	(BTU/day)	(KWH)	North	South/Central	Efficiency	Factor
30 Gallon	22,100	6.48	2.6	2.9	67.0%	1.4
35 Gallon	22,400	6.56	2.6	2.9	67.9%	1.4
40 Gallon	28,400	8.33	4.1	4.9	63.4%	1.6
50 Gallon	28,700	8.42	4.2	5.7	64.1%	1.6

For more information visit:
www.solardirect.com/swh/swh.htm
www.lses.org

To find a vendor visit:
www.tctsolar.com

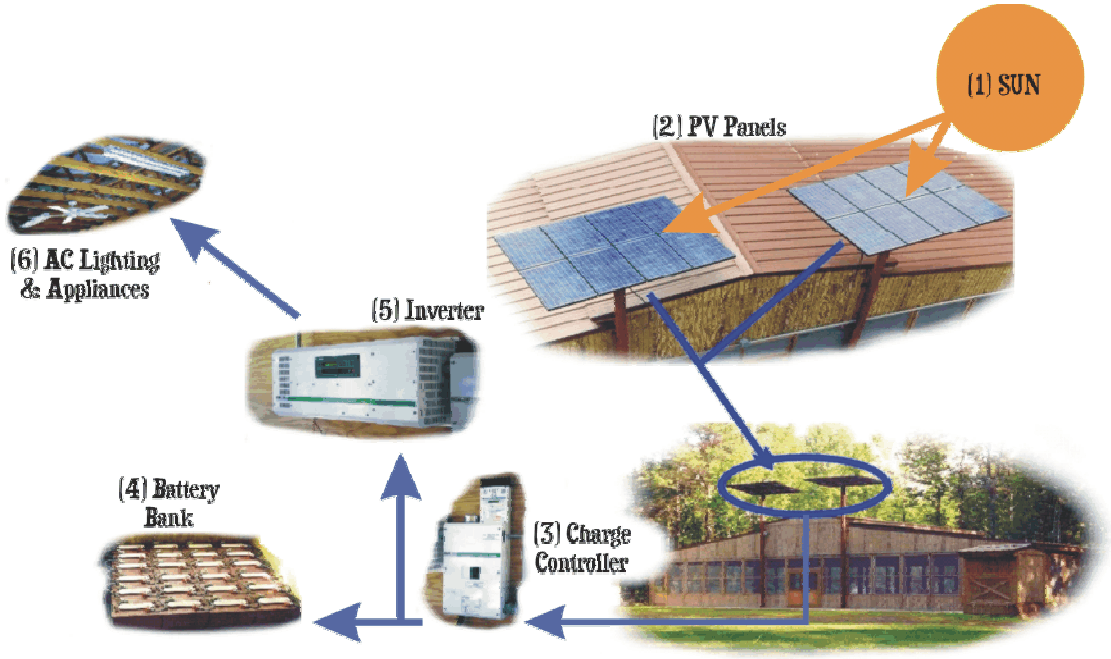
To find a Louisiana contractor visit:
www.findsolar.com/index.php?page=findacontractor

Solar Electric (Photovoltaics)

Effective January 1, 2006 through December 31, 2007, under EPACT 2005, purchases of photovoltaic panels for residential use are eligible for a 30% tax credit of up to $2,000

- Photovoltaic systems use semiconductor technology to convert sunlight directly into electricity. The systems are simple and quiet and require no moving parts. Batteries can store energy for use when the sun is not shining. Photovoltaic systems come in a near infinite number of sizes, ranging from a single cell to power a calculator or a single module (containing multiple cells) to power a light; to multiple modules to power a water pump or a home; to large arrays of modules to provide industrial-scale power. Photovoltaic technology is well established and field proven, and many sizes and types of modules are commercially available from a number of different companies.

- Photovoltaic (PV) Cell is the industry term for a more commonly used term from decades past - Solar Cell. The type of electricity that PV cells generate is direct current electricity. Some household devices operate on direct current electricity and can be powered directly from PV, but typically, most household lighting and appliances operate on alternating current electricity. In order to turn the DC electricity generated by the PV panels into AC electricity, you must incorporate a device called an inverter. An inverter changes direct current electricity into alternating current electricity, which can then be used by the lighting and appliance devices in the home.



PV - Flow Diagram

The PV – Flow Diagram above shows the major components that make up a photovoltaic system and how they work together. The numbers below correspond with the numbers in the PV – Flow Diagram above.

1. The sun must be shining in order for a PV system to generate electricity.

2. The PV panels convert sunlight into DC electricity.

3. DC electricity, from the PV panels, is directed through the charge controller. The charge controller monitors the charge state of the battery bank, while it monitors the amount of power the PV panels are producing. The charge controller continues to charge the battery bank until it is fully charged and then disconnects the PV panels from the batteries. Without the charge controller, the battery bank could overcharge to a point where it could explode.

4. The battery bank is used as the reservoir of power for the system. During the times when the sky is overcast, or at night, the system pulls power from the battery bank. The battery bank is sized to accommodate the anticipated load to be drawn by the building. When PV systems are being used in critical applications, such as emergency backup power for life supporting equipment, the battery bank sizing must also take into account and accommodate for the capacity needed to provide power during times when there may be extended periods of no sun.

5. As DC electricity is drawn through the inverter, it is changed into AC electricity.

6. AC electricity powers the AC devices in the building.

- Before deciding to install a PV system on your home, it is extremely important to make the home as energy efficient as is economically possible ***(see Sections One - Four of this guide)***. Every bit of power shaved from the home's utility usage will reduce the amount of PV required to power the home. It will always be much less expensive to make the home more energy efficient than it would be to over-size the PV system in order to accommodate a poor by performing home.

- It is also important to realize that operating a home powered by PV is different from operating a home that is powered by a utility company ***(grid tied)***. A homeowner that owns a home that gets all of its power from the grid may not like it when the grid goes down, but he/she doesn't have to do anything other than call their utility provider and complain until the power comes back on. That may not necessarily be the case on a home that is powered by PV. All PV systems will require some type of maintenance. The larger the system and more removed it is from the grid the more maintenance that will be required to maintain that system.

- When you are billed by your utility company, you are billed according to the amount of positive change indicated on your utility meter from month to month ***(utility meter spins positively in one direction)***. The positive change from month to month determines what you pay for electricity. Net metering refers to a metering system that literally allows the utility meter to spin in both directions. When installed on a home that

incorporates energy producing equipment, such as a PV system, the utility meter monitors the net electrical energy used on that home. In a billing cycle, if the home uses more electricity than is produced by the PV system, the home pulls whatever it needs to make up the difference from the grid through the utility meter. The utility meter records the usage as a positive change in the meter reading and the home is billed for only that difference. If the PV system produces more electricity than the home uses in a billing cycle, it sends the surplus through the utility meter onto the grid. In this case, the utility meter spins backwards, subtracting the meter reading as it passes through the meter. At the end of this billing cycle, the meter would have a lower reading then it had at the end of the previous billing cycle. This would indicate a surplus in utility for the billing cycle. The homeowner will not receive any payment for any surplus power that the PV system sends to the grid ***(this is common in all states that have adopted net metering legislation)***. The surplus of power sent to the grid simply remains there as a surplus waiting to be pulled off by that home during a time when the home is using more power than it is producing ***(just like storing it in a battery)***.

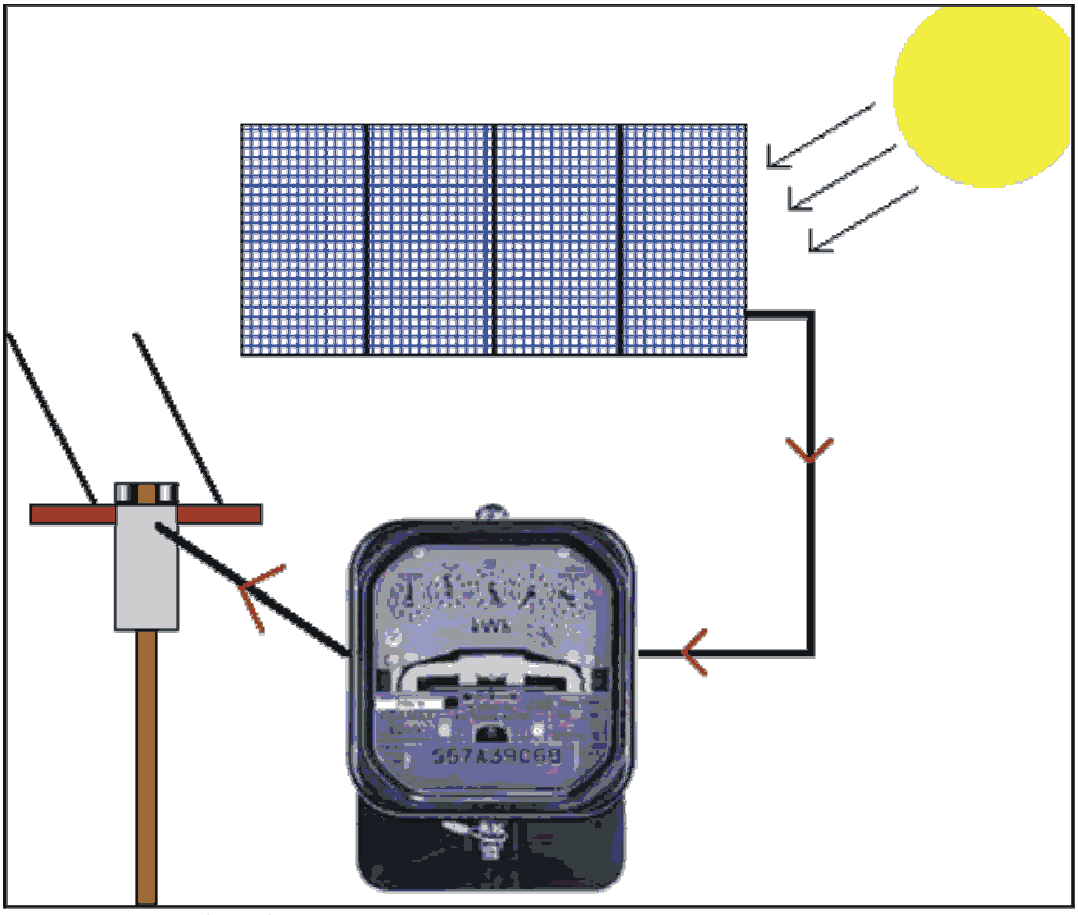


Figure 5 – Net Metering Diagram

Although you do not receive a check from the utility company for any extra power that you produce and send to the grid, you do save the cost of what the PV produces and is used by the home. It's okay if the system surpluses a small amount of power each month to the grid in order to cover the home's usage during lean sun times, but if the system surpluses more power than can be used by the home, you are just wasting money; therefore, properly sizing your PV system is very important.

- Once you have decided that you want PV on your home, before sizing your PV system, and in addition to making the home as energy efficient as possible, you must also address one major consideration: will the system be a **Complete Stand Alone System** ***(PV with a battery bank large enough to power the entire home, as well as reserve power),*** a **Complete Grid Tied System** ***(only tied into the grid – no battery backup)***, or a **Combination System** ***(grid tied with limited battery back-up).***

Complete Stand Alone System ***(PV generates all of the power used by the building and stores a reserve in a battery bank)***

- Advantages
  1. No utility bill
  2. Full power when grid is down
- Disadvantages
  1. Highest costs of the three type systems
  2. Highest maintenance of the three type systems

Complete Grid Tied System ***(PV generates either part or all of the power used by the building with no battery backup)***

- Advantages
  1. Lowest costs of the three type systems
  2. Lowest maintenance of the three type systems
  3. Partial to full reduction in utility bills
- Disadvantages
  1. No power when grid is down

Combination System ***(PV generates either part or all of the power used by the building with a limited battery back up)***

- Advantages
  1. Partial to full reduction in utility bills
  2. Lower maintenance than complete stand alone systems
  3. Provides base-line power when grid is down
- Disadvantages
  1. Moderate costs as compared to the other two type systems
  2. Moderate maintenance as compared to the other two type systems

- Systems that contain batteries will cost more than systems that do not contain batteries due to the added costs of the batteries themselves as well as the extra control equipment needed in connection with the batteries. Battery systems also require more maintenance than do systems without batteries. If you are planning on a complete stand alone system - your system will have to contain a battery bank large enough to fully power the home. However, if you are planning to have a system that will simply provide limited backup power during the times when the grid is down, it is highly recommended that you restrict the amount of required battery capacity to accommodate the smallest load possible. Doing so will reduce the costs and maintenance associated with large battery banks. Even with above average battery maintenance you will only get about 7 years of life out of a set of batteries, so the smaller you can keep the battery bank the lower the replacement costs will be.

  EXAMPLE: ***(just to get you through a blackout)***

  Enough battery power for:

  1 refrigerator to keep food from spoiling
  1 fan to keep you cool
  1 additional 500 to 600 watt capacity circuit to trade off among lights, a microwave, and a tv ***(Green Acres style)***

- Properly sizing your PV system is the most important consideration to take into account before purchasing any PV equipment. If your system is undersized, it will not deliver the expected power and you will be disappointed with the system's performance. If your system is oversized it will produce more power than is needed and will not allow you to benefit from the overproduction. There are many free PV sizing calculators available. Sizing calculators are only as good as the information that you put into them. The more detailed the information that goes in, the more accurate and detailed the information that comes out. Sizing calculators that require only two to four entries with no reference to the actual building performance or operating conditions will yield poor results. Because PV equipment is such a large investment, be certain to spend the extra needed time to come up with a true and accurate system sizing calculation before you make any purchases. Once you have accurately determined the amount of PV needed, it will be much easier to shop for the best available price.

- Once you have accurate sizing information, it is also very important to determine the amount of space that will be required to accommodate the panel installation and where the installation will be placed. Knowing the system square footage requirements ahead of time may lead you to discover that you do not have enough roof area to install all of the panels facing south. If you do not take this important step, you may be forced to install the system in a place that you really did not want to install it.

- Finally, be sure to conduct a detailed site analysis using a "Solar Path Finder", or similar type instrument to determine the best placement of the panels. Where you want to install the panels is not necessarily the best location to take advantage of the best sun. A 10 minute site analysis with a "Solar Path Finder" will show exactly how much sun will strike a specific site over a full year. Conducting a site analysis for several locations will also insure that there will be no surprises.

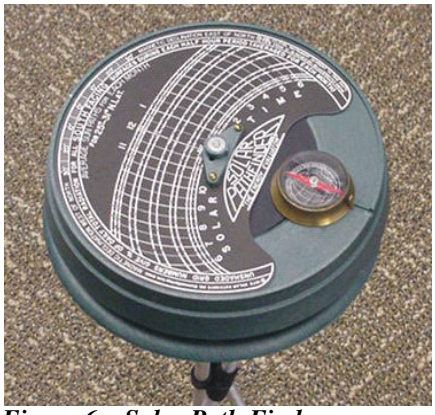


Figure 6 – Solar Path Finder

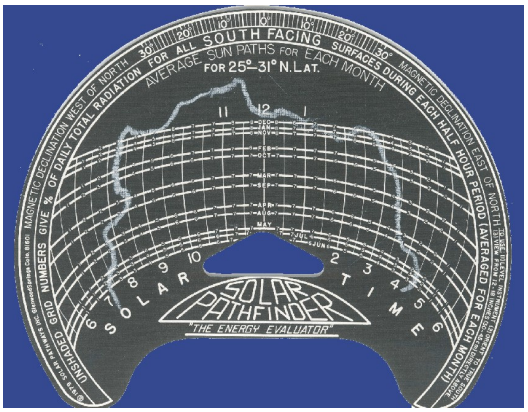


Figure7 – Solar Path Finder Template

- *Figure 6* above shows a Solar Path Finder instrument. When positioned level and facing due south, it allows you to manually plot the amount of sun that will strike the spot where the instrument is placed. *Figure 7* above shows a completed site analysis with detailed sun coverage data for every month in the year.

For more information on Photovoltaics visit:
www.solardirect.com/swh/swh.htm
www.lses.org

To find a vendor for Photovoltaics visit:
www.findsolar.com

To find a Louisiana contractor to install or service Photovoltaics visit:
www.findsolar.com/index.php?page=findacontractor

PV Sizing calculators: (remember – these are just rough calculators)
www.rredc.nrel.gov/solar/codes_algs/PVWATTS/
www.xantrex.com/support/gtsizing/disclaimer.asp?lang=eng
www.infinitepower.org/pdf/FactSheet-24.pdf
www.pvresources.com/en/software.php