

## OFF-GRID SOLAR ELECTRIC BASICS:

Despite the long, dark winter, Vermont has an average of 4.2 sun-hrs/day—more than Germany, a country with 30-40% of its energy produced by solar. Solar power is a very feasible option for homeowners in Vermont. A family can easily and comfortably power a home with the sun! In rural Vermont, remotely located homes and camps can have electricity because a well-designed and maintained off-grid solar electric system provides the needed power.

**Living "off-grid" is a lifestyle choice.** It takes planning, commitment, and active engagement from the homeowner. The rewards of off-grid living are significant: self-sufficiency and energy independence. Installing a renewable energy system contributes to a brighter future for everyone because one's impact on the environment is considerably reduced.

**Energy efficiency.** It is essential that every electrical load in an off-grid home be considered. If less power is consumed, there will be significant savings in system costs. Consider that for every \$1 invested in efficiency, ~\$4 will be saved in system expense. Therefore, cooking, heating, lighting, water pumping, & major appliances must all be carefully considered & chosen. However, off-grid systems are very capable of providing every comfort & convenience of a "standard" home. The household "necessities" are at the discretion of the homeowners & their budgets.

**Off-grid solar system components.** The components in an off-grid system can be understood easily when divided into three groups.

- **Charging:** consists of the solar array and generator. The array size determines the amount of power that can be generated. It's size is based on one's average energy consumption over the period of a year. The generator makes up for any production deficits. Vermont has exceptional sun part of the year while being sun-starved during late fall/early winter. The generator evens out charging capacity, preventing investment in an oversized array.
- **Storage:** this is the battery bank. The batteries contain the reserve power. Batteries must be recharged completely at least once a week.
- **Balance of System:** the remaining components are the inverter, charge controller, and metering components. The inverter changes the DC power produced by the array into AC power for household loads. The charge controller regulates power from the PV array to efficiently charge the battery bank. Metering provides system information, allowing the homeowner to monitor loads, charging, and the condition of the battery bank.



**What size system do I need?** This depends on the individual's power usage. Here are some system sizing basics: The smallest systems provide DC voltage only. These systems are great for camps and cabins, providing power for simple living with lighting, small entertainment systems, and in some cases, DC water pumping or refrigeration. They range in price from around \$3000 to \$6000. More solar modules increase charging capacity and the price of the system by about \$400-800 for each module. Add an inverter and the cost rises by another \$300 to \$4,000. As the inverter price increases, so does the component's capabilities.

Many inverters include battery chargers that work with the generator as it backs up the solar array as the source of power. A built-in transfer switch allows the AC circuits to run off the generator while the batteries are charging. Larger systems provide many or all of the conveniences of a standard, grid-tied home and range in price from \$13,000 to \$35,000. Systems may be much larger, thereby capable of producing, converting, and storing more power. The equation is simple: more watts = more dollars invested!

**Careful design and homeowner engagement equals a successful system.** A quality installation specifically matches the needs of the customer and includes:

- The right size solar array with proper mounting.
- Wiring, fuses, & breakers specified for both safety & system efficiency.
- A battery bank, of the correct type and size, installed safely.
- Inverters, charge controllers, and other components chosen for seamless operation and maximum performance.

**Incentives are available for off-grid installations.**

A 30% federal tax credit is available to the off-grid user to help lower

costs. This is 30% of the total system price, applicable to components & labor for installed systems. (Note: This is a credit against what you owe in taxes. It is not a write-off to lower your taxable income.) Also, renewable energy components are sold without sales tax in VT.

With careful planning, an off-grid solar electric system can be a great solution for your energy needs whether you have a camp and need a few lights, or a home with a need for modern conveniences.



## GRID-TIE SOLAR ELECTRIC BASICS:

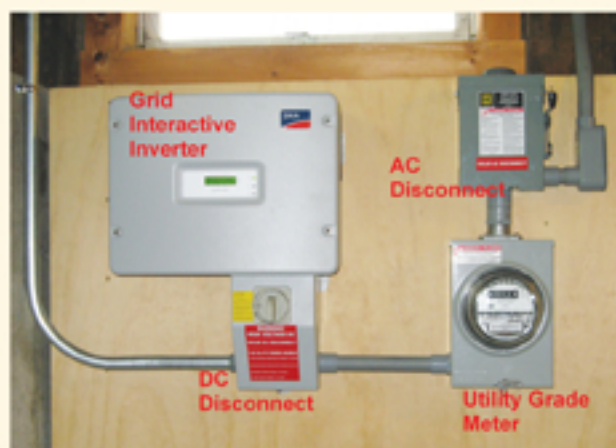
**Grid interconnected solar generation systems** are widely considered to be the most efficient form of small-scale, photovoltaic power. These are solar electric systems in which power is generated at the home site, used by the homeowners, and then any excess power generated is sent into the grid, reducing the homeowner's electric bill.

Grid-tie systems are designed to offset a portion of the average annual energy consumed at a home or business. Investment in a solar system is proportional to the amount of energy one wishes to produce to offset utility costs. Systems will range in cost, and the final price is based on the size of the system and how the solar array is mounted. An array can be mounted on either the roof, the ground, or on a pole.

Generally speaking, 1000 watts of solar array capacity will produce around 1050 kilowatt hours of power per year. A 3000 W system will produce around 3150 kWh/yr. If 6300 kWh/yr are consumed, this system would offset 50% of the power used. One's investment is proportional to power generation with a slight decrease in price per watt as the system size increases.

**The Grid-tie system.** A grid-tie system has only a few components. It is made up of:

- **Solar modules:** The solar array is composed of solar modules (panels), and they produce DC (direct current) power. They are built to produce at least 80% of their rated power production in 25 years.
- **Metering:** A utility-grade meter is installed so that the homeowner can track the amount of electricity produced and fed into the grid.



- **Inverter:** The inverter changes the DC power produced by the array into AC power for household loads. Power is controlled and back-fed by the inverter into a standard household service panel.

**Incentives** to install grid-tied systems are available from the state and federal government. An installation by a "Solar Partner" is required for grid-tied system owners to receive the state managed incentive. The amount of the incentive is determined by the size of the solar array installed. The incentives fluctuate based on funding availability. The best source for current information on incentives is [www.dsire.org](http://www.dsire.org) (Database of State Incentives for Renewables and Efficiency).

The second incentive available to install a PV system is a 30% federal income tax credit. Note that this is a credit toward taxes owed and not an income deduction. This tax credit can be rolled over for use in future tax years. Additional details are available from the IRS, from tax preparation services, or refer to IRS Form 5695. The last financial incentive is from the state which exempts renewable energy purchases from the state sales tax.

The lasting financial benefit available once purchase and installation incentives are realized is net metering. The power generated by a grid-tie system is utilized by the home or business, but any excess power is fed back into the utility grid. This results in the electric meter either slowing down or spinning backward in proportion to the amount of energy generated and consumed. The utility customer then receives a credit at the retail electric rate for the amount of power produced and fed back into the grid.

A grid-tie solar electric system is rewarding both financially and environmentally! When investing in PV, the home or business owner locks in their electricity rate resulting in a great long term investment while also providing much needed clean and renewable energy to the community.

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