



Getting Started with Renewable Energy

PROFESSIONAL LOAD ANALYSIS & SITE SURVEY

Ian Woofenden with Chris LaForge



Are you thinking about having a renewable energy (RE) system installed at your home or business? Perhaps you're wondering how to approach the project, and how best to get started. Whether you're new to renewables and need a helping hand or an RE enthusiast who wants some straightforward advice, an RE professional can provide valuable insight and expertise. This article will help you understand the process of working with a pro, so you can be an educated consumer—and get the system you've always wanted!



Load Analysis

The first step in renewable energy system planning is to determine how much energy you want or need to make. A key question is whether you will be off grid or on grid.

Off-grid electrical systems are installed in locations where the cost of bringing in utility power is prohibitive. These stand-alone systems must provide all the site's required electricity, either with renewable energy sources or a backup engine generator. Energy efficiency and conservation become critical, and the viability of the system can hinge on your ability to make the most out of a kilowatt-hour (KWH). For this reason, most RE consultants will ask you for a detailed load profile of your current or projected use. They'll want to know each electrical appliance you use or intend to use, what it draws in watts, and how many hours per day you will use it.

Off-grid system design must also take into account seasonal energy availability and use. For example, you may require more energy in the summer because your home is for vacation use or you pump a lot of water for irrigation. In a year-round home, the critical energy time may be winter, when more lights and other loads are typically used. If your main resource is sunshine, you may size the system based on the availability of winter sun at your location, since that's when you'll have a critical need. Wind and hydro resources will lead your design in other directions. The question in the end may be "how often do I want to run a backup generator?"



On-grid electrical systems require a different approach, in more ways than one. First of all, there is no pressing need to accommodate the complete load. Systems can be designed to cover 10, 50, or 100 percent of your home's electrical use, or anywhere in between. The utility will pick up any balance, supplying whatever is demanded by the users and their electrical loads. Also, if your state or utility has an annualized net metering program, *when* you have renewable resources is not as important. During the sunny summer months, your grid-tied RE system can produce surplus

Top left: Courtesy www.windenergy.com

solar energy, offsetting all your energy use and building up KWH credits that you can use in the cloudy months, when the system's output is lower.

It is still good to know what your home's loads are so you can replace inefficient appliances with more efficient ones, but compared to off-grid systems, it's much easier to determine your electricity use. Just look at recent utility bills and find the average KWH used per day. Using this figure, a system can be designed that will offset all of your energy use. Or if the budget doesn't allow it, your dealer can give you a realistic expectation of what percentage of your energy use a specific system will cover. Ideally, a detailed load analysis should be done for *all homes*, so the owners understand how and where they are using energy, and can learn how to use it more efficiently.

Site Survey

Once your energy requirement is quantified, many dealers start by talking about cost, even before looking at a site. They will roughly calculate what size of system you might need, and then give you a ballpark cost figure. This reality check will help you understand how much an RE system will cost and what it will do for you. Don't let this no-nonsense approach put you off. It means you've found someone who wants you to be satisfied, not disappointed, with the system.

If you decide to move forward with your potential RE project, your installing dealer or renewable energy consultant will schedule a site visit to assess what RE resources are available on your property. This site survey may cost from \$100 to \$300 plus travel, but it can save you from poor choices and wasting thousands of dollars later on. A good survey leads to a good system in the same way that a tailor custom fits a suit to your build. Skilled design makes all the difference in system performance.

Although you might come to the table with preconceptions about what you want to do, be open to looking at all options. Often a potential customer is focused on wind, when solar energy makes more sense for their site, or a stream cascading down through their woodlot can provide the most cost-effective energy.

Savvy consultants talk not just about electricity, but about how folks want to heat the home, pump and heat their water, dry clothes, cook, operate their shops—you name it. They should always stress the primary untapped resource—efficiency. When you price a system for an inefficient load profile and compare it to the cost of upgrading appliances and the smaller RE system that will result, you'll quickly see how conservation and efficiency save you money.

Getting your whole family, or at least you and your spouse, involved in the site

survey and energy analysis process is ideal. Especially with off-grid systems, all the people who will be using the system need to know as much as possible about how it was planned, how it works, and what they can do to make it run well.

These questions and more may be asked of you:

- Why are you interested in renewable energy? (Motivation is a significant issue in system design—"why" is often more important than "what" or "how.")
- What resources do you want to use?
- How do you plan to use the site (full-time residence, vacation cabin, etc.)?
- Who else will be using the system? How many people?
- What is your conservation/convenience quotient? How flexible are you and the others who will use the system?
- Do you want to conserve and minimize your consumption, or do you want your power on demand without worrying about how much energy you're making?
- Do you want the system to grow over time, or should it be full-blown at the beginning?
- What is your timeline?
- What is your desired budget?

Solar Energy

The site surveyor will evaluate your property with a solar site selector tool. This equipment helps determine in which locations your property or roof are shade free, and during what times of year. This will identify the best location for your solar-electric array or solar hot water collectors. Several sites on your property can be assessed for their potential production.

Sample Electrical Loads Worksheet

Item	Watts (W)	Summer Months			Winter Months			
		Avg. Hrs. / Day	Avg. Days / Wk.	Avg. WH / Day	Avg. Hrs. / Day	Avg. Days / Wk.	Avg. WH / Day	
Evaporative cooler	400	8.0	7	3,200	0.0	0	0	
Fridge, 18.5 c.f.	510	4.0	7	2,040	3.6	7	1,836	
Well pump, 1 hp	1,600	1.0	7	1,600	0.9	7	1,440	
Computer & peripherals	190	3.0	7	570	3.0	7	570	
Microwave oven	1,500	0.2	7	300	0.2	7	300	
TV & home entertainment center	75	4.0	7	300	5.0	7	375	
Lighting (4 CFLs, 25 W ea.)	100	2.5	7	250	4.0	7	400	
Answering machines, clocks, etc.	8	24.0	7	192	24.0	7	192	
Clothes washer	350	1.0	3	150	1.0	3	150	
Clothes dryer (gas)	350	1.0	3	150	1.0	3	150	
Furnace blower	350	0.0	0	0	6.0	7	2,100	
				Total Watt-Hours Per Day	8,752			7,513

Photovoltaic (PV) modules are expensive, so it's best to optimize their production. This means a minimum of full sun from 10:30 AM to 2:30 PM, and preferably more. Solar hot water collectors are somewhat more forgiving as far as partial sunlight from shading and poor angles. But the fuel for both technologies is sunshine, so it's critical to find the best locations for the equipment.

If necessary, PV arrays can be sited a few hundred feet or more from the home to find a good site. Because modern arrays often run at high voltage, smaller-gauge (and less expensive) wire can be used to transmit the energy. Solar hot water systems need to be much closer to their point of use. Running pipes more than 100 feet becomes costly and incurs high heat losses.

Solar hot water systems are usually sized to provide enough hot water for a household each day the sun shines. Instead of having a recovery time of an hour or a few hours like tank-style gas or electric water heaters, a solar water heater has a recovery time based on the daily sun cycle. Keep in mind that solar hot water systems usually depend on a backup water heater for days of no sunshine or times of heavier use like when your holiday guests greedily drain all your stored solar hot water.

In the United States, typical hot water use ranges from 10 to 30 gallons per day, per person. Fifteen gallons of hot water per day per person is reasonable if you use basic conservation measures, making a solar hot water system a cost-effective solution with a quick payback. Keep in mind that all solar thermal systems can produce about twice as much heat in the summer as they do in the winter. Although this isn't normally a problem in the United States with small systems, this seasonal load imbalance should be considered for larger systems—in particular solar space heating systems.

Your dealer may ask you questions like these:

- Where would you prefer to locate your solar-electric array and solar collectors?
- What are your aesthetic issues?
- Do you prefer the look of roof mounts, pole mounts, or ground mounts?
- Where do you want the balance of system (BOS) components located?
- Where is your electrical service panel and meter?
- Where is your existing water heater?

Wind Energy

If you have a potential wind energy site, your consultant should be asking if you are a hands-on person—or at least “eyes on.” With no moving parts, PV systems lend themselves to near maintenance-free operation. Wind turbines have moving parts, which means wear and tear, regular maintenance, and possible failure and repair. Neglecting to maintain equipment properly will not only decrease system life, but poorly cared for components can also become hazards.

A wind site survey includes looking for the obvious indications of wind potential, such as tree branch deformities due to wind (called “flagging”), documented average wind speeds, and anecdotal evidence from local old-timers. Your surveyor will hunt for possible tower sites, and observe

obstructions within 300 feet of them. She or he will determine if adequate room exists for a tilt-up tower, or if a guyed lattice or freestanding tower is necessary. Freestanding towers have the smallest footprint, and may be the only appropriate tower if you live on a small lot. Guyed lattice and tilt-up towers require lots of space for guy wires, or for raising and lowering the tower for turbine maintenance.

Your dealer may ask at least the following wind-specific questions:

- Why do you want a wind energy system?
- Will you really perform the required maintenance or hire a technician to do it?
- Are you willing to participate in the ongoing “research and development” of wind-electric systems? These systems can and do fail, and owners need to expect this. If you are not one to roll with the punches, you need to consider other systems with fewer potential problems.

Microhydro-Electric Energy

Microhydro-electric systems can be some of the most cost-effective systems available, though they are sometimes difficult to implement. Local, state, and federal authorities all can have jurisdiction over your activities. Unless you have complete ownership of the water resource, you often end up right at the authorities' door. That said, the constant charging output from the careful use of microhydro is ideal. It also works well paired with a solar- or wind-electric system, since good creek flows often come at times when sunlight is limited and winds are slow.

When considering a microhydro-electric system, your dealer may ask you these questions:

- Do you own the resource?
- What is the available head (vertical drop from collection point to the turbine site)?
- What is the rough flow rate available (in gallons per minute)?
- What is the distance between the low end of your stream and your home?
- Is the resource year-round or seasonal?
- What authorities have jurisdiction over the stream?
- Is it a fish stream?
- Are any stream-reliant species present, or does the potential exist?

Hybrid Systems

Most off-grid RE systems are hybrids in the broad sense of using more than one energy resource. Often, engine generators provide backup energy for extended cloudy or windless periods. But PV-wind hybrid systems can be ideal if the client fits the wind system profile. They work exceptionally well in many areas because it is often windy when it's not sunny, and vice versa. The same goes for solar-hydro hybrid systems, with water typically flowing at higher rates in the winter, when it's less sunny. These systems can reduce the use of nonrenewable sources substantially—or even completely. This fact makes hybrid

systems very attractive to people who want to minimize the use of nonrenewable energy sources.

Hybrid capability is less important with grid-tied systems, which use the utility grid as a backup. Batteryless grid-tied systems are often the most cost-effective, environmentally friendly, and easy to operate systems available.

Good Analysis Pays Off

A professional load analysis will help you understand where your energy is used and how to reduce it. A site survey will assess what your property has to offer, and may even reveal resources that you may not have recognized.

Together, these two steps should lead to a well-designed RE system that fits your circumstances and needs. They should also result in a smooth installation and help you avoid unnecessary expenses. Don't overlook these critical steps on your road to using renewable energy in your home!

Access

Ian Woofenden, PO Box 1001, Anacortes, WA 98221 •
ian.woofenden@homepower.com

Chris LaForge, Great Northern Solar, 77480 Evergreen Rd.,
Ste. 1, Port Wing, WI 54865 • Phone/Fax: 715-774-3374 •
gosolar@cheqnet.net

