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Guide for electrical contractors to pre-wire an off-grid home.

This document is designed to give the electrical contractor who is unfamiliar with renewable energy systems some general guidelines. This document does not replace our in-class training sessions and electrical code always has the final word. ***This is a general guideline – there are many possible variations!***

The Energy Alternatives *renewable energy buyers guide and product catalogue* is an excellent source of detailed information about what does, and does not work with renewable energy systems. We also carry several books written on the topics.

Considerations for pre-wiring renewable energy systems:

1. **AC System Voltage.** Many smaller off-grid systems are 120-only. Split phase 120/240 systems are certainly possible, for the larger systems typically – either a full-time residence, or large cottage. Three-phase systems are also possible.
 - a. If your installation is small, you will want to wire for 120-only. In particular, this means no shared neutrals (ie kitchen plugs).
 - b. For more complex installations, it's best to consult with one of our designers to determine the best solution.
2. **DC Systems Voltage.** Currently, 24 VDC is the most common system voltage. 12V is suitable for very small systems (ie one solar panel, couple batteries). 48 VDC is common for larger systems. This is more of a design issue.
3. **Grounding.** Canadian Electrical Code dictates that the ground conductor must be equivalent to the largest conductor in the system. In renewable energy systems, this is typically 2/0 or 4/0.
4. **Monitoring.** We install a digital monitor (ie a fuel gauge) on all our systems that gives the customer information on the system status. This meter fits in a standard double-gang electrical box (rotated 90o from normal). It uses 18/4 twisted communications cable, running from the batteries to the meter location. Mount it somewhere that is easily seen.
5. **Generator Input.** Depending on the type of generator (portable or stationary), you will need to make provisions for the generator feed to reach the inverter. For portable generators, installing a 30A twist lock plug on the outside of the building, such as found on boats and RV's will simplify the interconnection of a generator.
6. **Solar input (DC).** Solar panels can be mounted anywhere, as long as they get full, unobstructed sun. Choosing the best location for solar modules is of critical importance. Common mounting options include: Roof, Wall, Ground, Pole. Wherever the panels are located, there will need to be provisions for a large conductor from the solar panels to batteries. If you are unsure, the best approach will be to install large conduit, to allow for pulling the appropriate wire later. Another option will be to install teck cable – 6/2 or 4/2 is common, but will depend on the size of the array. Modern options allow us to configure the solar array at much higher voltages than system voltage to allow for longer distance transmissions.
7. **Other DC inputs – Wind, Microhydro.** Similar to item (6) above, you will need to consider the other feeds from, for instance, a wind generator. Wind generators may be low voltage DC, or may be higher voltage AC, possibly three-phase.
8. **Smoke Detectors.** The code requirement of a hard-wired AC smoke detector is problematic. The code does not recognize that while an off-grid system may have continuous power, there are many reasons why the inverter may be off. We strongly recommend using battery-powered smoke detectors for the best safety
9. **Phantom Loads.** These are electrical loads, which consume a small amount of power continually – ie anything with a power transformer, clock, remote control, etc. These small loads will rob your system of valuable power. The best approach is to minimize them through choosing appliances carefully. IE digital clocks are not appropriate loads. Many

modern appliances (ie ovens, dishwashers, washing machines) have digital features built in. The best approach to these is to install switched outlets to allow for convenient control. Another approach is power bars.

10. **Water Pumping.** There are many modern options to the jet pump. Jet pumps are inexpensive, but they consume a tremendous amount of power. There are many options for water pumping, and it's best to discuss with one of our designers directly to select the best pump solution for your customer's needs.
11. **Avoid electric resistive heating loads.** Electric space heaters, in all but the largest systems, are to be avoided. Simply put, the cost to operate these loads will be above the budget of most customers. Best approach: use a combustion-based source for heat (ie burn something – propane, wood, pellet, etc).
12. **Inverter Panel.** The inverter system is typically mounted on a metal back plane. 4'x4' is a common size for this. Typical location for the inverter panel is in the electrical room. The inverters have a buzzing sound when operational – the level of this varies with load and inverter type. .
13. **Batteries.** Batteries are hazardous materials and must be treated with care. They produce hydrogen gas when in use. Hydrogen is explosive and corrosive and needs to be ventilated safely. The battery bank **MUST** be very close to the inverter. 10' of wire is ideal for best inverter performance. We provide a variety of custom battery boxes for indoor, outdoors, insulated or not to fit any application. If liquid electrolyte batteries are used, the battery box will require a vent – we use a modified form of central vacuum tubing for this. If the box is on an outside wall, it can be vented through that. Otherwise a vertical pipe to a roof vent will work very well. Most batteries require maintenance, so a location that is easily accessed is preferred.

Please understand this is a guideline only. For specific questions, please contact Energy Alternatives and we will advise you the best course of action.

Our design guide and catalogue is available free of charge via mail, or you can download it from www.EnergyAlternatives.ca/downloads.html.

If you expect to be doing many of these systems, please consider our formal training offerings. We have 3-4 day in-class trainings throughout the year, as well as we have a self-study course, which is comprised of a 7-DVD recording of previous trainings. For more details on dealer training opportunities, contact Rick Weatherhead at extension 26.

We look forward to working with you on your renewable energy projects. Please don't hesitate to call with your questions.