

You rely on many appliances and systems in your home for your health, comfort and security. Most depend completely on utility-supplied electricity. It makes sense to have a backup system that will keep your family comfortable and your home safe in a power failure.

This fact sheet has 10 tips about backup power systems. Following the tips, six basic types of backup systems are described in [Table 1](#).

## 1 — Plan

Careful preparation is essential to select, buy and install a backup system. Don't leave it to the last minute — your household should have time to learn how to use the system in advance. And during a power failure, you may not be able to find suitable, reasonably priced equipment, fuel, and/or installation help. Keep the system simple, so you and your family can operate and maintain it. Your emergency system must work reliably when needed.

## 2 — Depending on the Season, Keep the Heat In (or Out)

During winter months, the main purpose of a backup system is to keep the house warm (and sometimes to keep the basement dry). You have to be able to keep the heat in, prevent unnecessary air infiltration and prevent pipes from freezing. The starting point is proper insulation and air sealing, before you consider your backup power needs.



In summer months, the main purpose of a backup system for Canadians is to keep the house from becoming too warm. People who have difficulties with extreme heat (seniors, asthmatics, and so on) especially need an alternative plan to power their homes. The starting point is proper insulation and shading. External blinds or shutters can help.

## 3 — Change to Energy-Efficient Appliances

Your backup system will do the most good if it is powering efficient appliances. Check if there is an

[EnerGuide](#) label to determine each appliance's power consumption, or use an electrician's ammeter to find out how much power each appliance uses — its current draw in amps. Ammeters can be purchased in a hardware or electrical supply store.

The energy requirements of some appliances will surprise you. Replace the inefficient appliances with efficient models. Change to energy-efficient light bulbs like compact fluorescents. When buying new equipment, get the most efficient possible — for example, an [Energy Star](#)® qualified refrigerator or a ~~lower-volume~~, smaller horsepower well pump or sump pump.



Make sure your furnace-fan motor is the most efficient available. If you are replacing your heating system, choose a furnace with a variable speed motor and an AFUE (Annual Fuel Utilization Efficiency) rating of 90 or more.

Consider switching your water heater to gas or propane. Add a solar water heater to your existing fossil-fuelled or electric water heating system. A solar heater works in tandem with your conventional system to reduce your daily energy consumption. Some solar water heating systems make use of a small 15 – 20 watt photovoltaic (PV) solar panel to power the circulating pump, so they will operate normally in a power outage. A properly sized solar water heater can provide about 50 per cent of your annual water heating load; and 80 – 100 per cent of your load in the summer months (\$3,000 – \$4,000 installed cost).

Remember: when you use a backup system you must manage your electrical load. You will have to operate even your most efficient appliances wisely, so that you have essential power as long as possible.

You may wish to purchase good quality surge protection devices for your consumer electronics. This isn't simply a power bar, but units designed to absorb a surge. The newer models are improved over older models; however, you should have a good ground and manage your phantom loads — such as standby mode to your electronics.

## 4 — If Your House Is All-Electric...

Don't use a backup generator to heat your house if it is all-electric, or to power resistance heaters, such as baseboards and fan heaters (a very poor choice — gas-powered generators are only 20 per cent efficient).

Install a wood, oil, natural gas or propane stove that uses a chimney; or install a pellet, oil, natural gas or propane stove that vents through the wall. Fan-assisted air circulation makes auxiliary heating devices more effective.



You may need backup power for a fan, stove motors, and pumps.

Consider installing a “high efficiency” wood or wall-venting stove. They burn more efficiently and cleaner. If you have a pellet stove, you will need additional backup power; however, a pellet stove uses a less-costly through-the-wall chimney. Propane, natural gas heaters and oil heaters use through-the-wall chimneys and need a reliable fuel source. Check delivery with your local fuel supplier. Some oil-fired furnaces and space heaters can provide both hot water and space heat. Some of these appliances are suitable for cooking and keeping food warm.

Most fireplaces are not very effective. They may heat you and one room. However, they draw air from other rooms and actually cool the rest of the house. Many fireplaces are not built for continuous use or are in poor condition, creating a real fire hazard.

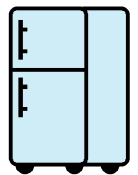
Direct-vent gas fireplaces are a better option because they are sealed combustion units and don't use the chimney for venting. If your home has a chimney, be sure to have it cleaned annually. You can also consider

an advanced combustion wood stove (see [Additional Resources](#)).

## 5 — Decide What Needs Power

Your backup system must provide power for the circuits you depend on for comfort, safety and security. Decide what is essential and should be running in a power outage. You may find you don't need an elaborate backup.

If you only need your sump pump, a small gasoline-powered pump could be simpler and cheaper than a full backup system. Critical loads are the essential loads. They might include lights, refrigerator-freezer, microwave, sump pump, furnace, well pump, medical equipment, garage door opener and the home office.



Your backup power system's capacity is the maximum power draw (in kilowatts) of all the fixtures and appliances that have to be served at one time, including higher startup loads. A startup load is the energy required when an appliance is first turned on. Remember: ventilation and fresh-air supply can also be important loads.

To determine the size of your backup power system:

- Identify the critical loads that you really need, and check whether they can be safely served by alternatives that don't require electricity. For example, a properly vented stove fuelled by wood, oil or gas could substitute for your furnace.



- Total the wattage of the lights and appliances on the circuits you'd like to power.
- Check the labels or owner's manuals for each appliance's rating.
- Add about 25 per cent as a reserve for the startup power needed for most electrical devices. This may not be enough for some furnaces and well pumps. Motor startups can draw as much as three to five

times more power, especially from a cold start, making a 2,500-watt generator borderline for starting an 800-watt furnace motor. (When purchasing a new furnace, ask your furnace sales and service specialist about “slow start” motor options that draw less startup current. If you are designing a house around a backup power system, ask the electrician/designer about energy-efficient furnace fans.) The total will probably be between 1,500 and 5,000 watts. However a basic system for efficient lights and a radio will require much less, say 100 – 300 watts.

- Some utilities have online calculators to figure out whole-house electrical use.

## 6 — Choose a Backup System

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Some of the systems (see [Table 1](#)) include battery storage, a battery charger and an inverter. The inverter converts 12 volt DC battery power to standard 110 or 220 volt AC power. These systems can also recharge the batteries using photovoltaic (PV) solar panels, a generator and your vehicle, or your vehicle alone — but remember that unless you have a recreational vehicle (RV) your car battery is not a deep cycle type and should not be allowed to go flat. The more expensive systems can power an entire, energy-efficient house. Please note that solar panels used to recharge your backup system are weather-and size-dependent and may take two to three days to recharge your battery.

## 7 — Hire an Electrician

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An electrician or electrical-contractor should install and prepare your backup system to make sure it is safe for your family and your home. You will need a manual transfer switch to send electricity from either the municipal power supply or your backup to the vital circuits. The switches cost approximately \$100 to \$230.

Some residential uninterruptible power systems are pre-assembled on wall mounting boards, with all the necessary safety disconnects and code approved wiring already done.

More sophisticated inverter power panels that automatically flip the transfer switch and start the backup can cost \$3,000 just for the panel with the breakers and an inverter. It is a good idea for an electrician to check wiring and ground, and determine if you need spike protection. In rural areas, voltage fluctuations and even over-voltages that can damage sensitive equipment are not uncommon.

Never connect a backup power system without a transfer switch that disconnects your home from the municipal power supply. This is to protect electric utility field crews from being electrocuted by your home power system when working on municipal lines.

## 8 — Don't Use Unvented Appliances Indoors

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Never use unvented combustion appliances, such as barbecues, cookstoves, fondues, propane or kerosene heaters and lamps inside your house. They burn up available oxygen. They produce CO<sub>2</sub> (carbon dioxide) and other combustion gases and fumes.

Some produce huge quantities of colourless, odourless and deadly carbon monoxide. Sterno cookers, fondues and charcoal-burning devices are especially dangerous. Room ventilation won't get rid of fumes from unvented appliances. Use portable propane or naphtha cookstoves, heaters and lamps outside only. There is a very real risk of fire, explosion, asphyxiation or poisoning from fumes.

## 9 — Install Smoke and Carbon Monoxide Alarms

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Install battery-powered smoke and carbon monoxide alarms. They are inexpensive and reliable — and they can save your life. Remember to keep spare batteries on hand.

## 10 — Test Your System Regularly

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Regularly test your backup system to make sure it can start your critical loads and keep them running. Remember to disconnect your main breaker before starting your backup system, or you can use an auxiliary circuit panel.

Note that modern inverters can make it possible to use variable speed DC generators which charge batteries directly and use half as much fuel as a constant-speed AC generator. They can produce very high quality AC power, which is crucial for sensitive electronic controls, provided that the inverter is manufactured by an established company and produces sine wave or modified sine wave outputs.

To protect sensitive equipment, such as computers, from power surges, generator owners should run these loads with a pure sine wave inverter instead of directly through the generator. If you are counting on your generator or inverter to power critical house systems during a power failure, test beforehand to make sure that the quantity and quality of power produced will handle the appliances you need to run.



Table 1 — Backup power systems

Backup Power Systems	What it Runs	Examples of Costs	Buying Tips
1A — Battery backup with inverter/charger for short blackouts of 12 – 48 hours: \$2,350	Essential AC loads only. Furnace, sump pump, well pump, fridge, plus efficient lights and small DC appliances.	Battery bank: \$725 (16 KWhr) Inverter/charger: \$1,400 (1,100 W) Transfer switch: \$225 (50 Amp, 240 V).	Choose deep-cycle batteries, best connected in series, not in parallel. Choose a modern inverter/ charger of suitable quality and surge capacity.
1B — Single-battery backup with inverter/ charger for very short outages of 3 – 6 hours: \$250	Critical loads only. DC sump pump, DC ventilation fan. DC lighting — preferably LED, not halogen — plus AC for charging cell phones, fax and small computers, emergency radios, medical devices, even small well pumps.	Single battery power system: \$250 — on cart (60 Amp/hr) with 1,200 W inverter for 110 V. AC, also built-in charger. Also capable of jump starting vehicles.  Remember you must manage your electrical load. Operate even your most efficient appliances wisely, so that you have essential power as long as possible.	Choose a deep-cycle battery. Ensure that inverter/charger has suitable power quality and/or surge capacity for the load.  Remember to keep the unit charged. Check for a charger with a trickle mode to avoid overheating.
2 — Car, RV, or truck as backup generator plus DC/AC inverter (must be grounded): \$110 – \$5,500	Essential AC loads only. Furnace, sump pump, well pump, fridge, plus efficient lights and even a microwave.	300 W inverter: \$110, engine can be off. 1,000 W inverter: \$550, engine must be ON (limited by rating of vehicle components, important not to let car battery run flat). 5,000 W truck power system: \$5,500.	Magazine and Internet searches include Canadian <i>Sol</i> magazine, U.S. <i>Homepower</i> magazine, RV/ trailer/boat catalogues.
3 — Single PV panel and battery system normally DC only, could add small inverter for AC: \$885	Power for a weekend cabin. Efficient lights, small DC appliances, radio/TV, CD player, cell phone, small pumps/fans, car vacuum, tools.	Solar power kit: \$650 (45 W) Battery: \$125 (220 Amp/hr) Inverter: \$110 (300 W) Excludes costs of DC appliances.	Small marine 12 V water pumps for bilges may be suitable for sumps. Sources include marine, boat and yacht suppliers, RV/trailer and auto-truck centres.
4 — Twin PV panel and battery system with inverter/charger to convert DC to AC: \$3,780	Power for a small cottage (as in # 3 above) and some larger AC appliances, such as microwave, vacuum, water pumps.	Solar power kit: \$2,400 (150 W) Battery bank: \$580 (700 Amp/hr) Inverter: \$800 (1,750 W) Installation costs not included.	Sources include Canadian solar energy and equipment suppliers, Canadian Solar Industries Association.
5 — Portable generator must be grounded and should be connected via auxiliary breaker panel: \$660 – \$2,500	Preferably essential AC loads. Furnace, sump pump, well pump, fridge, plus efficient lights and some appliances.	500 W AC generator: \$660 3,000 W DC generator: \$2,200 (including AC inverter) 5,000 W AC generator: \$2,500.	Sources include hardware stores, building supply and rental centres, generator sales and service specialists.
6 — Fixed generator gasoline, diesel, propane. Must be installed by a licensed electrician: \$3,925	Preferably essential AC loads. Furnace, sump pump, well pump, fridge, plus efficient lights and some appliances.	6,500 W AC generator: \$3,700 2-cylinder liquid cooled, less noise. Transfer switch: \$225 (50 Amp, 240 V). Installation costs not included.	To reduce generator running costs consider adding a battery bank with an inverter/charger (see # 1 above).

## Generator Maintenance Tips

(Typical 5,000 Watt Gasoline Engine)

These instructions are for maintenance of a modern 3,000 to 5,000 watt, air cooled, gasoline engine generator for residential service. Most points, however, apply to all generators.

Remember: gasoline and diesel fuels require special care for proper and safe storage, so they don't become unusable as gums and gels form when not in use, or they become contaminated by water and dirt. Special additives can prevent these problems.

## Warnings and Cautions

- Is your generator wiring safely insulated AND properly grounded?
- Disconnect main breaker (and non-critical circuits) before starting generator.
- Connect auxiliary breaker panel to generator output. Observe correct polarity.
- Never refuel engine while it is running. Fire Hazard!
- Once you have started your generator, do not start all your appliances at once. Turn them on one at a time. Avoid using the biggest loads simultaneously.
- Most generators are not designed to work inside your home. They should be placed outside, secured and protected from the weather to avoid carburetor or breather icing.
- A generator should not be left running without someone nearby to supervise. It may overheat and cause a fire. Always have a fire extinguisher nearby.
- If your generator causes a fire, your fire insurance may not pay if your generator was not CSA-approved or was not installed by a master electrician.

## After the First Five Hours

- Change oil. Use 10W30 motor oil or 5W30. Use synthetic oil to prolong engine life and ease starting in cold weather.

## After Every 50 hours

- Change oil.

## After Four Months

- Start engine and run for 15 to 20 minutes with electrical load to maintain engine and generator.

## Annual Maintenance — Fall is Best

- Start engine and run with electrical load until it runs out of fuel — this can take all day.
- Refuel with fresh fuel (ethanol blended regular gasoline is recommended and burns 30% cleaner).
- Clean and lubricate battery terminals with wire brush and petroleum jelly if there is corrosion.
- Inspect air and fuel filters and fuel shutoff for cleanliness.

## Every Five Years

- Replace battery, air filter and fuel filter.
- Replace fuel lines if deteriorated.

## General

- Check oil level with every tank of fuel used.
- Use a fuel stabilizer for fuel storage of up to one year.
- If not using a fuel stabilizer, do not store or use fuel more than one month old (stale gasoline is not a dependable fuel).
- Keep generator fuel tank full to reduce condensation in tank (less of a concern if using ethanol blend).
- Keep a spare spark plug and wrench nearby.
- Have the generator tuned if it has been used extensively or runs poorly.

## Additional Resources

To obtain information on energy efficiency contact:

Publications Office of Energy Efficiency  
Natural Resources Canada  
580 Booth St., 18<sup>th</sup> Floor  
Ottawa ON  
K1A 0E4  
1-800-387-2000  
[www.oeo.nrcan.gc.ca](http://www.oeo.nrcan.gc.ca)

## Publications

Natural Resources Canada, Office of Energy Efficiency. (2007). [EnerGuide Appliance Directory 2007](#). Ottawa, ON, Canada: Government of Canada. Retrieved December 31, 2008.

Natural Resources Canada, Renewable and Electrical Energy Division. (2003). *Photovoltaic Systems: A Buyer's Guide*. Ottawa, ON, Canada: Government of Canada.

## Websites

Environment Canada — Clean Air Online:

- [Advanced Woodstove Technology — Video](#) (December 2008)
- [Choosing an Appliance](#) (December 2008)

Natural Resources Canada — Office of Energy Efficiency:

- [EnerGuide Appliance Directory — Energy Consumption Ratings of Major Household Appliances](#) (December 2008)
- [ENERGY STAR<sup>®</sup>, EnerGuide and R-2000](#) (February 2009)

## Related Information from CMHC

- [Efficient, Convenient Wood Heating](#)
- [Insulating Your House](#)
- [When You Must Leave Your House Due to a Prolonged Winter Power Outage](#)
- [Wood Heat Safety in an Emergency](#)
- [Combustion Gases in Your Home — Things You Should Know About Combustion Spillage](#)
- [Carbon Monoxide](#)
- [Dealing with Power Outages](#)
- [A Guide to Residential Wood Heating](#)