Backup Power Options for Houses

Solution	Features	Advantages	Disadvantages	Cautions and Notes
Portable generator	• Most home generators gasoline-powered • Propane and diesel options available • Output from 500 watts to over 10 kW • One to several receptacles for plugging in electric loads—portable generators usually only serve devices plugged into the generator, though some can be connected to the home's electrical panel	• Inexpensive • May be set up and operated by homeowners—unless tied into to a critical loads electrical panel • Readily movable	• Light-duty - usually not designed for long operation • Limited fuel supply – requires manual re-fuelling after a few hours to a day of operation • Noisy • Potentially dangerous • Most require manual starting • Stored fuel may go stale	• Must be operated outdoors • Risk of fire • Risk of carbon monoxide poisoning — especially if operated in a garage that can auto-close when power comes back on • Portable generators are usually not used for powering the home's electrical circuit
Stationary generator	• Permanently installed generator • Connects to the home's wiring with an automatic or manual *transfer switch* that provides a hard disconnect from the grid to prevent back-feed. (The transfer switch may connect to a critical loads circuit, rather than the entire house.) • Operates on diesel, propane, or natural gas — rarely gasoline	• Much higher output than portable generators (6 kW to several hundred kW) • Auto-start option on many models adds convenience • Virtually unlimited run-time when using natural gas • Long run-time on diesel or propane, depending on tank size.	• Expensive • Must be professionally installed — especially fuel line and transfer switch • Generator sits idle the vast majority of the time • If powered by natural gas, will not function if natural gas pipelines are shut down (common during emergencies)	• If unused for a long period of time, diesel may go stale • Regular maintenance required to keep in working order • Generator must be installed outdoors or in a shelter outside of the house • Generator should be installed away from any air inlets for the house so that combustion gases do not enter house
Battery storage with grid power (e.g., UPS and Tesla PowerWall)	• This option often used with a grid-connected solar system, but the solar system is not required • Uninterruptible Power Supply (UPS) common for computer equipment • Tesla PowerWall and other home power systems coming onto the market • Includes battery storage and a DC-to-AC inverter • Some newer systems use lithium-ion batteries; though lead-acid batteries are still usually more affordable • Distributed battery storage can provide electricity demand management to utility companies	• Very rapid response times (2-4 milliseconds (ms) for most UPS systems; 20 ms for Tesla PowerWall) • Very quiet, though may be an alert when activated • Safer than generators for indoor installation and operation (some risks with lead-acid batteries) • Little, if any, maintenance required • When used with a solar system (for example, with a net-zero-energy system), allows the power grid to supply most of the storage, limiting the size of the solar system needed to achieve net-zero-energy performance	• Limited run time, depending on connected loads and battery capacity • Systems usually sits idle the vast majority of the time (unless used to manage utility loads) • Required professional installation by licensed electrician • High cost, particularly large systems that provide significant back-up power • When this option used with solar systems, a specialized inverter is required that provides for "islanding" • There may be current or future utility charges that affect economics of solar system	• Rapid advances and improvements being made in battery storage • New technologies being introduced that may reduce costs • Progressive utility companies may offer incentives for installation of such systems with "dispatchable loads" • Check local regulations about where batteries can be installed—there may be restrictions, especially with lead-acid batteries

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Battery storage for off-grid solar system	• Off-grid (stand-alone) solar homes rely on battery storage for use at nighttime and cloudy periods • Battery system is sized for the full nighttime demand of the house or facility, rather then just emergency power needs • With alternating current (AC) loads in the home or facility, an inverter is used	• Not affected by utility power outages • Not vulnerable to utility policies that may add fees to grid-connected solar systems	• Expensive if battery system serving significant loads • Most battery technologies have limited life and may need replacement • Dependent on the local equipment functioning—no utility to come out in a storm and fix • Usually requires professional installation with a critical load panel and transfer switch	• Potential for wiring home or facility for direct current (DC), eliminating the cost of an inverter
Solar inverter with functionality during power outages	• Most grid-tied solar systems do not function during power outages • The TL inverters from SMA, allow hard disconnect from the grid during outages and plugging in AC loads to outlet.	• When grid is down, allows daytime draw of electricity being generated by a grid-connected solar system • Little or no added cost over standard inverters • Transformerless, so quieter inverter operation	• Electricity available only during daytime hours with adequate sunshine • Requires some additional equipment • Fluctuating current as clouds cover sun may harm some electrical equipment	• Currently only one inverter manufacturer known to offer such a product
Electric vehicle (EV) used for back-up power	• Plug-in electric vehicles, including plug-in hybrids, have significant battery storage (typically 10 – 80 kWh) • May be feasible to draw from this stored electricity during emergencies • May be possible to clip an inverter onto the 12-volt battery (not the drive-system battery) to power emergency loads • This option today would serve plug loads only (like a portable generator); it would not be connected to the home's electrical panel or a critical-load panel	• The expensive batteries for back-up power needs are used regularly for vehicle—not just during power outages • With a plug-in *hybrid* vehicle, the gasoline motor should kick in after the stored electricity is depleted—working like a gasoline generator • This emergency generator is fully mobile	• Current EVs are not set up for their use in providing emergency back-up power • Clipping an inverter onto the 12-volt battery may cause damage to delicate electronics or void a vehicle warranty—most EV manufacturers recommend against this practice	• Use of EVs—and especially plug-in hybrid vehicles—as emergency back-up power sources could be a feature that EV manufacturers embrace and promote—eliminating the need for stand-alone generators • Future EVs could have integrated inverters and 120-volt AC plugs, as some pick-up trucks now have • It may be possible to wire an inverter to the higher-voltage drive battery, but this should be done only by the manufacturer • In the future, utility companies could embrace this idea for using EVs to help manage the electric grid, with EVs feeding power into the grid during peak periods