## Backup Power Options for Houses

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

- **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

- **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

- **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

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**Features**

- Inexpensive
- May be set up and operated by homeowners—unless tied into a critical loads electrical panel
- Readily movable
- 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.
- 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
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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 than 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 | |
| **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 | • Currently only one inverter manufacturer known to offer such a product |