



HOME GENERATOR GUIDE 2013

Will
O'Neil

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WILL O'NEIL

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ISBN:
ISBN-13:

INTRODUCTION

THE COMMUNITY MY WIFE AND I live in has steep, narrow streets thickly lined with big, old trees. We love the rustic beauty of the neighborhood, a few miles from Washington, D.C., but the power lines are overhead, among the trees, and severe weather of any kind is all too prone to drop a tree or limb across a line, cutting off electricity to many homes. We have a good power company which does its best to keep trees trimmed and restore power when it does go out, but when there are widespread blackouts it can take them many hours or even days to get everyone back on the grid. In the meantime, life can sometimes be miserable, or even dangerous.

A sudden crisis

ON FRIDAY, JUNE 29, 2012 THE temperature in our area hit a record 104 degrees Fahrenheit (40°C). In late afternoon, the news channels began warning of an extremely destructive line of thunderstorms racing across Ohio, hundreds of miles to the west of us, and expected to reach Northern Virginia in the evening, bringing high winds. As torrid afternoon faded into stifling

evening, warnings became more insistent, with a possibility even of hurricane-force winds.

Known as a derecho, such a line of intense, persistent, fast-moving storms can strike over much of North America. That day it was the turn of Indiana, Ohio, Kentucky, West Virginia, Pennsylvania, Virginia, North Carolina, Maryland, Delaware, and New Jersey. But the Washington area was right at the center of the worst of it.

Winds began rising near us about ten in the evening. My wife and I sat in my office, on the lower level and away from any risk of falling trees. Watched via the Internet, the weather radar showed a ring of fiery red sweeping toward us, marking extremely intense winds and rain. By 10:20 our house was shuddering, buffeted by 70-mph gusts. The ring of fire engulfed our location on the map.

The lights failed and the air conditioning fell silent. We sat in the still darkness, waiting, for about ten seconds. Then from outside we heard the sound of an engine turning over. Once—twice—and then it caught with a throaty roar. Within seconds the sound settled down to low rumble.

The lights came on. After a short while the air conditioning followed. We'd done nothing; it had all happened automatically.

The storm inflicted chaos and destruction over a wide area. Millions were without power. The main electric utility serving Northern Virginia reported that it was the third most destructive storm ever to hit the area in terms of impact on the electric grid, worse than many hurricanes. In our community, scarcely anyone got through with power on.

Our generator ran smoothly for more than four days. On the fourth day I shut it down briefly to check it out and add a small amount of oil. I started it again and it ran for about another twelve hours. Then it fell silent: for us power had returned and the generator, recognizing this, had switched the house back to utility power and shut itself down, ready to start again the next time power failed.

But for some of our neighbors, power stayed out for another two days, and for many in our area it took even longer than that. For those without power they were miserable days, with 100-degree heat and high humidity. For many they were quite costly as food spoiled, sometimes damaging their refrigerators with rancid moisture. Vital medications were lost, forcing urgent searches for a pharmacy that was open and in stock. Some homes were inundated with storm runoff or raw sewage because of lack of power for sump pumps or sewage pumps. People ran short of food; the few restaurants and groceries that were open (usually because they had their own generators) struggled to meet their needs, faced with inability to get supplies due to roads obstructed with fallen trees.

Ours was only one of a number of generator-equipped homes in our neighborhood. Those so blessed aided neighbors, providing place to get out of the heat, get a cold drink or some hot food, recharge cell phones, or share some refrigerator or freezer space.

Our generator provided virtually all the power we might ever have wanted. With the air conditioning flat out, we avoided turning on a few

appliances that make especially heavy power demands, but it didn't even amount to an inconvenience. We had friends over for dinner and to watch a film via streaming video—our cable connection had not been affected. Away from the end of the house right that was next to it, we couldn't even hear the generator; there was nothing to remind us we were not on grid power.



Figure 1. Our standby generator can provide power for days or even weeks—automatically.

Aside from the oil check, we did nothing to keep the generator running and adjusting its output to meet varying demands. For fuel it drew from our natural gas line. (Some others in the area, in places without natural gas lines, ran on propane from large tanks.) Its sophisticated control system monitored its operation and made adjustments as necessary. It ran for 4½ days, but it could have run twice as long if need be. With a little more care, it could have run for weeks on end. And when the lights had gone out we had felt little anxiety, for we knew that the generator automatically started up and tested itself weekly; the last test had come two days before and results

had been normal, as the green indicator light on the generator had assured me.

Ours is what's usually called a standby backup generator—*standby* because it's ready to take the electrical power load nearly instantly at all times, *backup* because it backs up the primary power supply from the utility. We have it because in 2010, after one too many inconvenient, uncomfortable, and costly power outages, we had finally paid a contractor US\$12,000 to install it. That was a lot of money for us. We thought it all over very carefully and I put a great deal of research into the options before we finally decided. We wanted to make very sure that we got a system that would meet our needs and be durable and reliable, without paying any more than necessary.

Since I had an engineering background and researched complex issues for a living, I was able to assemble an especially clear and comprehensive picture of the options and their costs and implications. I shared what I learned with my neighbors, prompting some more of them to invest in standby backup generator installations, at prices ranging from \$8,500 to \$24,000, depending on what they needed and wanted (but mostly near the \$12,000 we had paid).

But others in our area took a different, less costly approach. One neighbor keeps a portable generator in his garage. When the power went out he wheeled to a place where it was sheltered from the rain—but with no possibility that the acutely poisonous carbon monoxide from its exhaust could reach his house. (He has a carbon monoxide alarm in his garage as an added safety measure.)

Next he connected a heavy cable between the generator and a transfer switch that allowed current from the generator to reach selected circuits in his home—but he kept the circuits switched to utility power while he got the generator going.

The gasoline tank for the generator he detaches and keeps in a shed, since he would void his fire insurance if he kept a gasoline container in his garage. (Although his generator has an adapter to run on propane or natural gas, he uses gasoline.) After getting and attaching the tank he started the generator up. He maintains and tests it carefully and had no difficulty getting it going. With the generator running he switched circuits from the dead utility grid to the generator, one by one. The generator was more than twice as loud as ours but he strung an extension to the neighbors and they put up with the racket with good humor. The generator was turned off during sleeping hours.

Once or twice a day he shut the generator down, allowed it to cool, filled the gas tank, topped up the oil, and re-started it. He keeps the gasoline in cans stored in a locked shed well away from the house. By the time he ran short of gasoline he had no trouble finding a gas station to refill his cans. His family was not as comfortable as ours, but they were in far better shape than those who had to endure four days or more entirely without power. And they'd spent much less money than we had. Depending on how much power it provides and how many convenience and safety features are included, a portable generator setup for home backup might cost anywhere from under \$1,000 to over \$8,000, although most are

toward the lower end.



Figure 2. This portable generator has served through many outages over six years.

My friend, also an engineer, understands the dangers of his portable generator clearly and is very careful to operate it in a way that minimizes them. But many are not as aware. During November 2012, in the wake of Hurricane Sandy, at least 16 people died in accidents related to portable generator use.

Another nearby family has a smaller portable without a transfer switch—all connections are with extensions run from the generator. It kept their koi pond water circulating and aerated, kept the refrigerator running and preserving essential medications, provided light, and powered a TV. Fuel concerns were reduced because the generator runs on liquefied propane gas rather than gasoline; the small generator will run for hours on a 20 pound barbeque tank. The propane fuel also reduces carbon monoxide emissions, but care still

had to be taken to keep the exhaust fumes well away from the house. Despite its small size the generator is very noisy, but problems were minimized because the nearest neighbors are down a steep hill.

In our area many businesses were forced to shut down for days due to lack of power. Others, however, were able to remain open on the power from their own generators. They not only avoided the costs of losing business but helped to establish themselves in the minds of their customers as reliable sources. For some, the rush of added business during the outage period paid back everything they had spent on the generator installation.

In the two years that we've had it, our generator has started many times in response to power outages. Most were very brief and it quickly shut down again. Twice it has run for less than two hours. In an outage in 2011 it kept us comfortable for 2½ days. And then there was the derecho. There's every reason to expect that it will continue to see a lot of usage. Bad weather has been getting steadily more severe and frequent, and most blackouts are weather related. Moreover, all over North America the electrical grid infrastructure is coming under growing stress while at the same time that a number of other threats lurk, from geomagnetic storms to hostile attacks.

Options for you

THIS BOOK WILL EXPLAIN THE entire range of options for home backup power: standby and portable generators of all kinds, and many others

as well. Whether your budget is \$1,000 or upwards of \$30,000, whether you need to power just a few essentials or an entire large house or small business, whether you live in the country, suburbs, or city—the answers are here. It will tell you how to meet your needs with power from natural gas, propane, gasoline, diesel fuel, sun, or wind. (I haven't found a way to generate electricity from wood chips, but I'm looking.)

There's a tremendous range of alternatives. This book tells you what you need to understand them and make an intelligent choice. While it doesn't tell you the specifics of particular models or contractors, it tells you how to find them. It lays stress on economics and where you can save money—and where there are hidden pitfalls.

Updates and additional information

THIS IS THE FIRST EDITION of what I envision will become a multi-edition book of gradually expanding scope. The field of home generators is evolving rapidly as demand grows and technology advances, and I'll be revising and updating the book to reflect it.

In the short term you can find additional information and updates on the Web site, <http://Home-Generator-Guide.com>.

If you have comments, questions, or suggestions, please send them to me at Will@Home-Generator-Guide.com. I'd also be interested in photos and/or descriptions of unusual or challenging installations or generators.

Acknowledgements

MANY THANKS ARE DUE TO my friend and neighbor, Bill Cook, who not only encouraged me in writing this but also helped with his professional advice and editing.

I also want to acknowledge the help of Bill Uhr. His contracting firm, called MAX Energy Systems (<http://www.maxenergysystems.com/>), which serves Washington, D.C. and its suburbs, installed our generator, as well as a number of others in our neighborhood. He's taken time to answer a number of questions from the contractor's point of view, and also provided a photo of an interesting installation.

Local friends and neighbors allowed me to photograph their generator installations: Peter Browne, Brian and Chica Brunsvold, Walter Buzzetta, Don Christian, Regina and James Derzon, Charlie Fumagali, Steve and Burma Klein, Elizabeth Lower-Basch, Elaine O'Malley, Joe Siefried, Christine and Bob Wax, and others who prefer to remain anonymous. Many more have shared their experiences.

Any mistakes or errors are mine alone, however. Like anyone else, there are limits to my knowledge and understanding. I've tried to warn of areas where you will need to check other sources to get the precise information that applies to your situation, but there could certainly be issues I'm unaware of.

In any event, you should always check with local authorities for the requirements where you live. Be sure to consult a licensed electrician if you have doubts about any technical point. And

remember that any electrical equipment must be installed and used in accordance with the manufacturer's instructions—it's a legal requirement.

I do guarantee that I've done everything in my own power to make this a knowledgeable and completely objective guide. In writing it I have not taken a cent from anyone, not even so much as a cup of coffee.

HOME STANDBY BACKUP GENERATOR SYSTEMS

SOME OF THE TERMINOLOGY COMMONLY used in connection with home generator systems isn't quite correct, technically. I'm going to stick to the usual ways of talking about home generators, however.

If your house is like the great majority in North America it normally draws its power from a utility line that delivers it at 240 volts (240V). (Voltage is a measure of the strength of the force in the electric current, analogous to the pressure in a stream of water.) It goes first to a meter (which may be outside or inside) and then to an electrical panel (usually inside) that has a master circuit breaker for the whole house. From there it's routed to a series of individual circuit breakers in the panel, one (or sometimes two) for each electrical circuit in the house. Most of the circuits are 120V, although there will also be 240V circuits (requiring two breakers, one for each of the two hot wires in a 240V circuit) for heavy equipment such as a central air conditioner, electric oven, or electric clothes dryer. It's all

quite a complex, carefully engineered system that works very smoothly—as long as it is installed properly and the electricity keeps flowing from the utility.

If the electrical system isn't installed properly it can electrocute people and/or burn down your house, which is why it's subject to a strict set of legal standards, usually called the electrical code. Various jurisdictions have their own specific codes, which can vary locally, but in the United States they are all based largely on the U.S. National Electrical Code (NEC), while in Canada they derive from the broadly similar Canadian Electrical Code (CEC). Both master codes, which are developed by broadly-based private standards associations, are revised and updated at three-year intervals.

Some people resent the electrical and other building codes as infringing on their freedom and the exercise of their judgment. But the codes aren't theoretical; they're based on experience, and usually the experience of serious accidents. Violations invite not only legal and insurance issues but much more immediate and serious consequences.

The NEC is the basis for the electrical codes in some Latin American nations. There is an International Electrical Code (IEC) that's widely used elsewhere, and various countries have their own national electrical codes. Because of the wide variations in codes and standards in different countries, what this book says is only very broadly applicable outside of places served by the NEC or CEC.

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Every year, tens of millions of homes throughout the U.S. and Canada lose power for hours, days, even weeks. With weather growing fiercer and electrical grids more overloaded, it's likely to get worse.

You can assure yourself and your family of comfort and safety in an outage with backup power. Regardless of your situation, needs, and budget, there's probably an option for you.

Home Generator Guide 2013 is your only comprehensive and up-to-date guide to backup options for homes and small businesses. Everything you need to know is here, fully and clearly explained in non-technical terms.

Will O'Neil has researched home backup systems thoroughly, based on many years of background as an engineer in the aerospace industry and direct experience with backup systems.

Automatic standby



portable



**or solar or wind
backup systems**



**to keep your home
safe and comfortable.**