

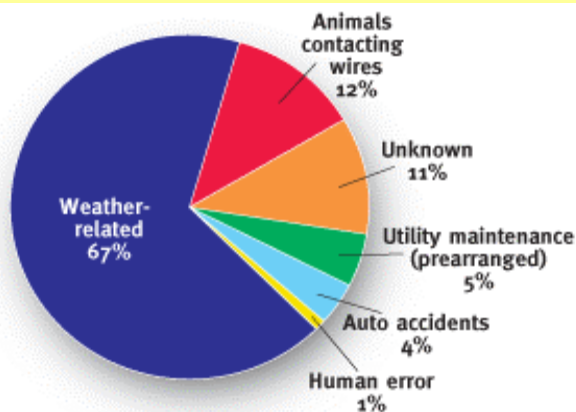
Historical Power Outages:

The Great Northeast Blackout of 1965:

The 1950's, Post-World War II, prosperity remade the American home into a palace of electric consumption. Electrical appliances had become commonplace, purchased partly in response to widespread promotional efforts by manufacturers and utilities, such as General Electric, whose "Live Better Electrically" campaign encouraged consumers to adopt a fully electrified existence. Household products like washers and dryers, televisions, coffee makers, dishwashers, and air conditioners established a new standard of living unparalleled in American history.

American offices and factories had also been transformed by electricity. Elevators, lights, air conditioners, typewriters, adding machines, and even the budding computer industry all demanded electricity. Manufacturing facilities relied more and more on electricity to increase production.

Causes of Power Outages



Source: Edison Electric Institute
1999 Reliability Report
(survey of 62 shareholder-owned utilities)

During the 1960s, engineers and architects began sealing off building from the outdoors, constructing mechanical environments solely controlled by electric power. So it was that by the mid-1960s, the astonishing growth and plummeting price of electricity had reshaped the world in which millions of Americans lived, worked, and increasingly played.

By 1965, electricity was an everyday part of American life. Post-World War II prosperity remade the American home into a palace of electric consumption. Electrical appliances had become commonplace, purchased partly in response to widespread promotional efforts by manufacturers and utilities, such as General Electric, whose "Live Better Electrically" campaign encouraged consumers to adopt a fully electrified existence. Household products like washers and dryers, televisions, coffee makers, dishwashers, and air conditioners

established a new standard of living unparalleled in American history. Despite persisting inequalities in the distribution of the new postwar affluence, per capita consumption of electricity roughly doubled in each of the three decades following World War II.

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As early as the 1950s, the effects of increased home, office and factory power usage compelled the power industry to develop strategies to meet the growing demand. In the Northeast, the power industry established a network or power "grid" to better control the distribution of electricity. Power stations in one utility's service area were interconnected by high-voltage transmission lines with other utilities' power stations generating electricity hundreds or even thousands of miles away. The idea behind this elaborate system was to enable power suppliers to balance generation and consumption of electricity across a wide geographic region, thereby improving service to consumers. The grid allowed utilities to efficiently provide enough electricity to during periods of maximum demand ("peak load") without wasting large amounts of reserve generating capacity simply to meet this peak for a few hours each day. Two major power grids-the Ontario-New York-New England pool (formally known as the Canada-United States Eastern Interconnection, or CANUSE area) and the Pennsylvania-New Jersey-Maryland pool (the PJM interconnection)-together made up the northeast power grid, which provided a flexible network of power suppliers that could quickly meet fluctuating demands within the many parts of North America's most densely populated region. While the grid, which remains intact today, has proven to be highly effective, the night of November 9, 1965 serves as a reminder of how thoroughly our electricity-dependent lifestyles are tightly interwoven with the complex workings of a massive but often overlooked technological system.

At 5:27 p.m., November 9, 1965, the entire Northeast area of the United States and large parts of Canada went dark. From Buffalo to the eastern border of New Hampshire and from New York City to Ontario, a massive power outage struck without warning. Trains were stuck between subway stops. People were trapped in elevators. Failed traffic signals stopped traffic dead. And, at the height of the Cold War, many thought Armageddon had arrived. One pilot flying over a darkened New York City stated, "I thought, 'another Pearl Harbor!'" By 5:40 p.m. that evening, 80,000 square miles of the Northeast United States and Ontario, Canada, were without power, leaving 30 million people in the dark.

New York City was particularly hit by this blackout, due to its reliance on electricity for nearly all aspects of city life. Office workers, ready for an evening at home with their families in the suburbs, were forced to find alternative lodging, some seeking shelter in their offices or on benches in Grand Central Station. Theaters closed for the night. The "Great White Way," Times Square, usually a glimmering crossroads of light, was covered in darkness. Thousands of travelers stranded in New York were forced to sleep in hotel lobbies, leading the Times to report that the "city's hotels looked like biovac areas." Approximately ten thousand commuters were stuck on subway cars, unable to escape the darkened tunnels. By midnight, the Transit Authority began sending food and coffee to those trapped underground.

Despite the confusion and disarray, New Yorkers spent the night in peace. There were no riots or widespread looting. Instead, New Yorkers helped each other. Some directed traffic. Others assisted the New York fire department as they rescued stranded subway passengers. In many cases, New Yorkers just shared extra candles and flashlights with neighbors, reveling in the opportunity to get to know the people who lived across the hall.

By 11 o'clock, the power was restored in 75 percent of Brooklyn, and by 2 a.m., the borough was fully equipped with electric power. By midnight, much of the Bronx and Queens were lit. And, at 6:58 a.m., almost fourteen hours after the massive blackout struck New York, power was restored citywide.

It took six days to locate the cause. Federal Power Commission investigators found a single faulty relay at the Sir Adam Beck Station no. 2 in Ontario, Canada, which caused a key transmission line to disconnect ("open"). This small failure triggered a sequence of escalating line overloads that quickly raced down the main trunk lines of the grid, separating major generation sources from load centers and weakening the entire system with each subsequent separation. As town after town went dark throughout the northeast, power plants in the New York City area automatically shut themselves off to prevent the surging grid from overloading their turbines. Within a quarter of an hour the entire CANUSE area was down. Investigators referred to the 1965 blackout as a "cascade effect"-much like a row of dominoes falling one after another.

The massive blackout of 1965 had many ramifications. It forced Americans to reconsider their dependence on electricity, and propelled electrical engineers to reexamine the power grid system. New Yorkers learned to keep caches of candles, batteries, flashlights and transistor radios close at hand. The electric utility industry also learned to plan for the unexpected. Regional coordinating councils such as the Northeast Reliability Council (NERC) and power pools such as the New York Power Pool (NYPP) were formed to develop industry standards for equipment testing and reserve generation capacity, as well as preventative measures governing interconnection and reliability, so that a similar failure would not happen again. For the first time, both producers and consumers of electricity felt vulnerable. They could no longer rely on electrical power without thinking about the night of November 9, 1965. Thus, the blackout holds a particular resonance for people who lived through the "The Night the Lights Went Out." One woman who spent her evening in a Lexington Avenue luncheonette said, "This is the type of day were you remember everything...everything you did, everything you ate. I'll remember it all."

The New York Blackout of 1977:

On a hot July night in 1977, the lights went out in New York City. The purr of air conditioners, cooling millions of New Yorkers, was replaced by stultifying silence-and then the sound of breaking glass. Faced with the second blackout in twelve years, New Yorkers responded with resilience as well as violence. Many stories emerged from the night of July 13th that revealed New Yorkers' divergent feelings about the city in which they lived. In some places, neighbors helped neighbors, and strangers helped strangers. Yet, at the same time, neighborhoods throughout New York exploded into violence. Stores were ransacked, looted and destroyed. Buildings were set ablaze. And the police, for the most part, stood helpless. In these stark contradictions, an unusual yet definitive moment left its mark on New York history-the night the lights went out.

Well-seasoned after the 1965 blackout, many New Yorkers took to the streets in search of friends, neighbors, candles, and most importantly, an explanation. In some communities, people found solace in the streets, where they swapped stories, chatted with strangers, and enjoyed an unelectrified nightlife. In Greenwich Village, for example, the streets became an improvised festival as people strolled out to witness the city without power. Some listened to news reports on battery-powered transistor radios, and all wondered when the lights would return.

In other parts of the city the experience was starkly different. News broadcasts reported outbreaks of violence, looting, and fires. Areas of Harlem, Brooklyn, and the South Bronx experienced the most damage, where thousands of people took to the streets and smashed store windows looking for TVs, furniture, or clothing. In one report, 50 cars were stolen from a car dealership in the Bronx. The police made 3,776 arrests, although from all accounts, many thousands escaped before being caught. 1,037 fires burned throughout the City, six times the average rate, while the fire department also responded to 1,700 false alarms. Regardless of where you were when the lights went out, New York's streets teemed-and sometimes burned-with life.

In stark contrast to the Great Northeast Blackout of 1965, when a massive, cascading power failure darkened the entire Northeast and parts of Canada, New Yorkers faced this latest power outage alone. By 9:41 p.m., New Jersey's lighted shoreline stood in stark contrast to the darkened skyline of Manhattan. All five New York City boroughs, as well as areas north in Westchester County, were plunged into darkness. Successive lightning strikes just to the north of the City knocked out vital power lines feeding its massive power grid. With each lightning strike (there were four in total, the first one at 8:37 p.m.), neighboring electric utility companies in New Jersey, New England and Long Island were faced with a difficult choice-whether to remain interconnected with the city's power company, Con Edison, thereby providing it with the electricity it so badly needed while risking possible damage to their own systems, or to protect their systems and maintain power for their customers by "opening" (disconnecting) the transmission lines that connected them to the massive power loss in the City. Before most system operators had time to choose, automated equipment reacted to the sudden change in system conditions and "tripped out" all ties to Con Edison except those from Long Island. By 9:21 p.m., Long Island Lighting Company (LILCO), overloaded by power demands of the City, opened its ties to Con Ed as well. The city's power grid had become an "island" of electricity, separated from all outside sources of generation. Within minutes New York descended into darkness.

As minutes pass into hours, New Yorkers looked to Con Edison for an explanation and a quick resolution to the blackout. Con Edison claimed the blackout was caused by a natural phenomenon over which they had no control. It was an "act of God," stated Con Edison chairman Charles Luce. Despite Con Edison's efforts to deflect blame from itself, the City, led by Mayor Abraham Beame, launched an all-out attack on the power company, claiming it was guilty of "... [at] the very least gross negligence-and at the worst something far more serious." Beame, along with other local and state officials, could not fathom how four lightning bolts could effectively cripple the nation's largest city. They were not alone. New Yorkers, too, questioned Con Edison's explanation. As looters, vandals, and arsonists endangered neighborhoods, pressure mounted on Con Edison to re-light the City. While the lights would not be turned on in some neighborhoods for another twenty-five hours, the blackout led many to question the reliability of New York's power system. Ironically, this attitude was partly the result of unusually high expectations for power reliability on the part of metro area consumers; Con Edison had (and still has) the least interrupted electrical service of all utilities in the nation.

The 1977 Blackout came during a troubled time in New York City. The City was under tremendous financial stress, forcing government officials to cut back city services. These cutbacks fell most heavily on New York's working poor communities, since many relied on public services to ease financial hardships in a time of deep economic recession. Increased crime, which had risen dramatically in the previous decade, also added to the crisis. The summer of 1977 was known as the "Summer of Sam," named after David Berkowitz's nationally publicized murder rampage which sent the City into a state of constant fear verging on panic. When the lights went out on July 13th, unleashing what Time magazine called a "night of terror," New Yorkers wondered if their worst fears had finally come true. In a mixed metaphor that expressed his mixed feelings, one New Yorker asked, "if New York is the Big Apple, then why am I living in the pits?"



Traffic lights were out in several states (Courtesy KLAS)

In retrospect, the social and economic conditions of 1977 provide many clues to the conflicting blackout experiences. The fiscal crisis and the ensuing cutbacks had been precipitated by a crippling economic recession which intensified growing public expressions of mistrust and consternation, leading some communities to lash out in the darkened night. Growing crime rates, coinciding with a City government unable to grapple with escalating social and economic problems, also provided the backdrop for the explosion of violence. Contrasting with the good memories most New Yorkers had of a peaceful blackout only twelve years prior, the garish images of the 1977 blackout confirmed just how much the City had changed in a decade. The "urban crisis" had become a permanent national emergency, claiming New York as its latest victim.

Because many of the problems behind the urban crisis remain unsolved despite the prosperity of recent years, the memories of the 1977 blackout have taken on the quality of morality play or myth, with widely diverging views of what the myth means. New York had always "contained multitudes," to borrow Walt Whitman's aptly democratic phrase, but now those multitudes were visibly antagonistic to each other and willing to brawl at the slightest provocation. The City had splintered into many cities, a painful fact which the blackout unveiled and

subsequent good times have not obscured. Some of the splinters, such as Greenwich Village, could revel in festival, while others burned in desperation.

The summer of 1977 permanently altered New York's self-image, and, perhaps as important, its self-confidence. Not only did crime and economic strain transform the City, but the blackout fused the significance of the two in a perception that New York, the largest city in the United States, was on the road to ruin. It had become the standard-bearer for the urban crisis. In future years, when New York would make dramatic strides to address the problems that surfaced in the seventies and forge a new image of national and world leadership, the memories of these times would linger as a reminder of how hard it could be to fall from skyscraper heights.

The Northwestern Blackout of 1996:

(CNN) -- The power outage that cut electricity to more than four million people in nine Western states was triggered by sagging power lines, searing temperatures and an unusually high demand for electricity, authorities said Sunday.

Most if not all customers had power restored by early Sunday, although some problems lingered.



Traffic lights were out in several states (Courtesy KLAS)

The outage -- one of the worst in U.S. history -- began Saturday afternoon in Oregon, swept across southern California and stretched as far east as Texas.

Not only were millions left in the dark, but traffic lights and movie screens went black. Amusement park rides even stopped in their tracks. Complicating the matter, the outage struck intermittently, affecting some areas while ignoring neighboring regions on one of the hottest days of the summer.

Problems began about 2 p.m. PST in the Pacific Northwest, about two hours before widespread outages occurred, according to Dulcy Mahar of the Bonneville Power Administration in Portland, Oregon.

Temperatures in the 90s in Oregon and Washington caused power lines to sag into trees, forcing the power to shut off, Mahar said. Thus, fewer lines were available to carry the unusually high load of electricity, which weakened the Pacific Northwest's power grid.

Officials said the weakened grid knocked out the four main power highways that send electricity to the other states, causing a virtual domino effect.



(238 [AIFF](#) or [WAV](#) sound)

Saturday's outage was the second this summer for the power grid. In July, a tree fell onto a major power line supplying the grid, causing power failures across 15 states. The outages are unrelated, officials said.

Popular beaches closed

Although power was restored to most affected areas, some problems remain still occurred Sunday. In San Francisco, travelers were hoping to catch connecting flights after some of Saturday's flights were grounded.

The most noticeable problems, however, were at beaches along a popular 10-mile stretch near Los Angeles. The area was closed due to a six-million-gallon sewage release from Hyperion Treatment Plant allegedly caused by the power failure.

Crowds hoping to escape the treacherous heat were turned away, and health officials said it could be three days until the beaches are reopened.

"It doesn't mean to say there is an imminent threat. It means as public policy you err on the side of caution," said Chuck Ellis of the Los Angeles Department of Public Works.

For some, that wasn't good enough. Beachgoers tried to sneak past lifeguards, hoping to cool off. Others, however, abided by officials' requests.

"It's a shame because I can't stay out so long today," one sunbather said. "I can't cool off."



Spilled sewage caused beaches to close (CNN)

The outage also shut down cellular telephone service in many areas. High demand caused busy signals for some users. Others lost service because there was no power to supply cell sites, which house the antennas that transmit calls. ([Full story](#))

Big Blackouts in U.S. History

- **The Great Northeast Blackout of 1965**: After a relay failure, more than 80,000 square miles of the northeastern United States and parts of Canada lost power, turning the lights out on 30 million people.
- **The New York Blackout of 1977**: One hot night in July, multiple [lightning strikes](#) knocked out power to the entire city of [New York](#), leaving 8 million people without light or [air conditioning](#). The blackout triggered mass looting and arson across much of the city.
- **The Northwestern Blackout of 1996**: Transmission lines sagged into some trees, causing an electrical short that knocked out power to more than 4 million people in Oregon, California and other western states.
- **The Blackout of 2003**: Cities across the Midwestern United States, northeastern United States and southern Canada lost power, apparently due to a problem with a series of transmission lines known as "The Lake Erie Loop." Roughly 50 million people lost power.

Be Prepared, Be Smart, and Be Informed

Be prepared. Always keep a flashlight and batteries on hand.

- Always keep these items on hand and easily accessible:
 - Flashlights and fresh batteries
 - Battery-powered radio
 - Battery-powered or wind-up clock
 - Emergency telephone numbers, including the number of your local electric company to report outages
 - Corded telephone to notify your local electric company of the outage
- Protect your appliances and electronic equipment. Purchase equipment with built-in surge protection or battery-powered back-up, or use electrical surge suppressors or arresters. Plug computers and other sensitive equipment into a separate, grounded circuit to isolate them from fluctuations caused when a major appliance restarts (such as your room air conditioner or refrigerator). Consider having a lightning arrester installed at your main circuit panel.

Be smart. Keep the refrigerator closed during a power outage.

- If an outage occurs, stay away from downed power lines, and warn others to do the same. Report downed lines to your local electric company.
- Turn off all appliances, including your furnace, air conditioner, water heater, and water pump. Leave on one lamp to know when power has been restored. That way, you can avoid a circuit overload and another outage that may result when power is restored to all appliances at once.
- Keep freezer and refrigerator doors closed. Food will stay frozen for 36 to 48 hours in a fully loaded freezer if you keep the door closed. A half-full freezer will generally keep food frozen for 24 hours.
- If it's hot outside, close drapes and blinds on the sunny side of your house, drink plenty of fluids, take your pets to a cool basement location, and go to an air-conditioned civic center, mall, or library if necessary to stay cool. Do not hesitate to contact a physician if you have any health-related questions.

Be informed. Electric companies work to restore power quickly.

- Every electric company has a detailed plan for restoring electrical service after a power outage. Typically, one of the first steps a company takes - to prevent injuries and fires - is to make sure that power is no longer flowing through downed lines. Restoration then proceeds based on established priorities:
 1. The first to be repaired are transmission lines and distribution substations, because they are the most important lines carrying power from generating plants to large numbers of customers over wide areas.
 2. Next, electric companies restore power to critical community services such as hospitals, police and fire protection, and communications facilities.
 3. The next priority is to restore service to the largest number of people as soon as possible. Service to neighborhoods, industries, and businesses is systematically restored, followed by single residences and small groups of customers, until restoration is complete.

Long Island Power Line Fails, Conservation Urged

Reuters, May 30 2002



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NEW YORK, May 29 (Reuters) - The failure of a second high voltage line to New York's Long Island prompted local officials on Wednesday to urge energy savings as they ordered in mobile generators to shore up the island's shaky power supply.

"Conservation will be essential ... especially if Long Island experiences a repeat of last year's record-breaking temperatures and humidity," Long Island Power Authority (LIPA) Chairman Richard Kessel said in a statement.

Last summer, the Island came within a couple hundred megawatts of blacking out during a long heat wave, when air conditioners push power demand to its annual peak.

To ease concerns among Long Island's 1.1 million electric customers, Kessel pointed out that LIPA has "sufficient electricity supplies available to meet normal summer demand" following an aggressive program to upgrade transmission lines and build more power plants.

But much of the hard work has been jeopardized by the loss since mid-May of two of the main undersea cables linking Long Island to the rest of the New York power system.

"The cable problems demonstrate how vulnerable we are to power shortages due to mechanical failures and not necessarily a resource shortfall. Additional on-island generation is critical if we want to keep the lights on," said Kessel.

THE CABLES

Both cables, which supply almost 1,000 megawatts of power to Long Island -- enough to light about a million homes -- run under the Long Island Sound between Westchester County, just north of New York City, and Nassau County on Long Island.

The 400 MW Y-50 cable, owned by LIPA and Consolidated Edison Inc. , New York City's main utility, was shut in mid-May and is likely to be down for several weeks.

"If the Y-50 cable is lost for the summer, the Island's electricity supply could be stressed to its limits, even with the addition of 737 MW of new resources expected to go on line in the weeks ahead," said Kessel.

Those new resources include 10 turbines being developed at six sites around Long Island by energy companies from around the country and a new cable being installed by a Canadian company that will bring in electricity from New England.

The Y-49 cable, shut over the past weekend, brings some 600 MW of power to Long Island. It is owned by the New York Power Authority, the state-owned power generating company.

NYPA has already started repairing line Y-49, already restoring its to about 444 MW, and hopes to have it back at full service within a couple of weeks.

"We're taking every action possible to get Y-50 back as soon as possible, and to repair the Y-49

problem so we can meet the peak summer demand supply requirements," said Kessel.

CONSERVATION PLEA

"Conservation has to be the number one item on every customer's mind," said LIPA spokesman Michael Lowndes, sounding a note heard often last year in California, which also failed to expand its power system fast enough to keep up with demand.

An extreme heat wave could cause peak electricity demand on Long Island to exceed 5,200 MW. LIPA has access to 5,917 MW of energy including its 10 new turbines, the new cross sound cable, and the Y-49 and Y-50 tie lines.

Without line Y-50, LIPA has access to just 5,517 MW.

To make up for the possible long-term loss of Y-50, LIPA said it will add 200 MW of generation, provided by 10 22 MW generators mounted on flatbed truck trailers parked at substations around the Island by July. The mobile generators would be switched on only during an extreme heat wave.

The 10 new turbines are being installed by Florida's FPL Group Inc., New York's KeySpan Corp, California's Calpine Corp. and Pennsylvania's PPL Corp. .

TransEnergie U.S., a unit of Canadian energy giant Hydro-Quebec, is installing the 330 MW cross-sound cable between Connecticut and Long Island. The transmission company expects the line to be in service by the end of June.

"While the new resources will help us meet demand, we urge customers, both residential and commercial, to conserve as much electricity as possible all summer long, especially during extreme heat waves," Kessel said.

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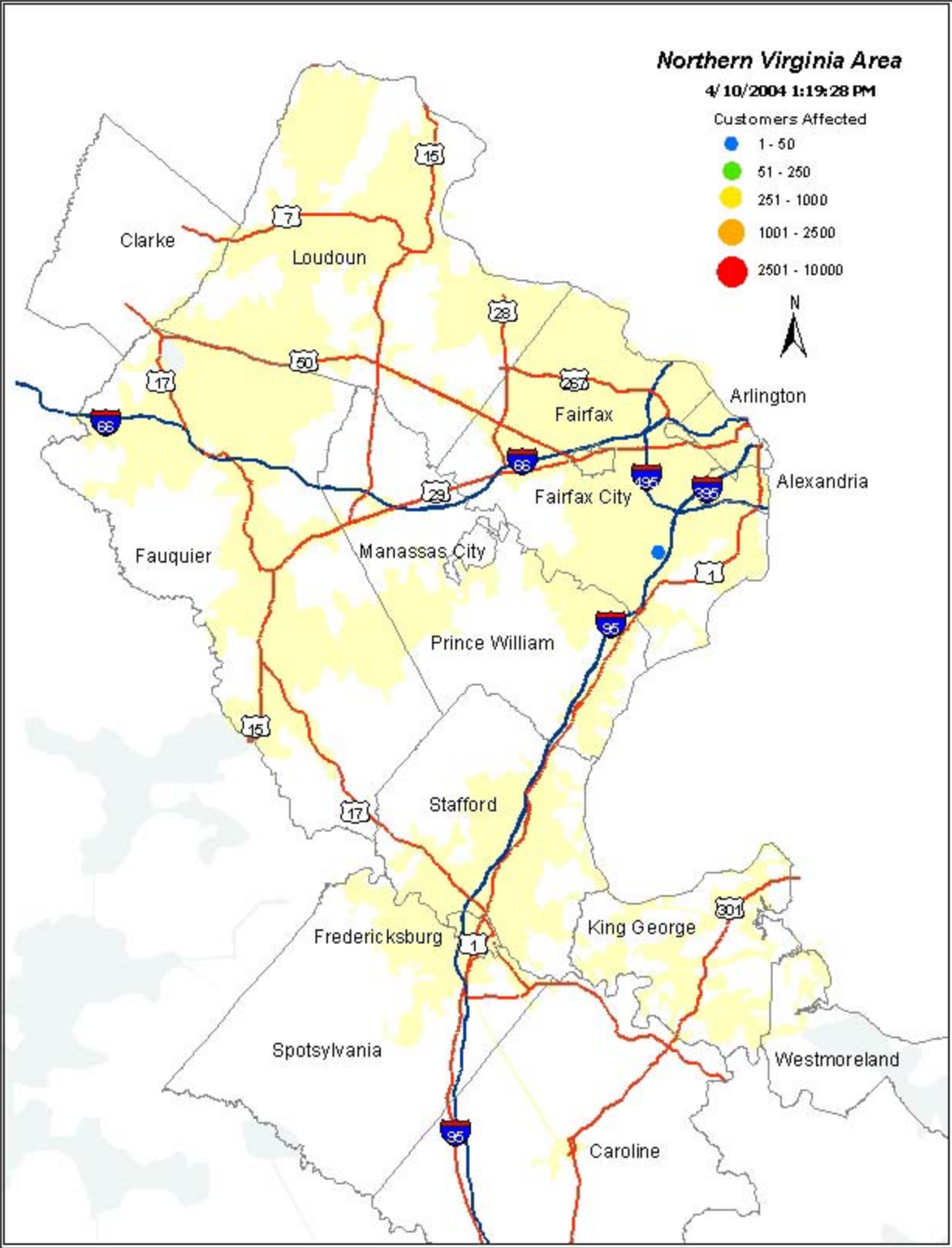
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Northern Virginia Area

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Customers Affected

- 1 - 50
- 51 - 250
- 251 - 1000
- 1001 - 2500
- 2501 - 10000



Emergency Standby Generators Frequently Asked Questions.

1. How long does it take to install an Emergency Standby Generator?

The air-cooled 7 kW, 12 kW and 15 kW, which comes equipped with a comprehensive installation kit, can take as little as 4 hours to install. The liquid-cooled 15 kW to 45 kW generators will normally take up to 14 hours over 2 days. Air-cooled units are typically installed on a composite mounting pad. Liquid-cooled units, because of their additional weight, must be installed on a stronger mounting surface. The increased installation time is necessary to pour a concrete slab and allow for it to set properly. If the installer can source a prefabricated mounting pad that will meet the increased weight requirements of a liquid-cooled unit, the installation time will be reduced accordingly. The length of time is based on a typical application. It does not apply to applications that require extended runs of conduit or gas piping or the placement of a unit far from the incoming gas or electrical service.

2. How do you size a generator?

[Click Here for our automatic wattage calculator.](#)

The only completely accurate way is to have an electrician apply an amp meter to the circuits or appliances that are being chosen to operate under emergency backup power. It is recommended that the amp draw be measured as the appliance "starts up" when that appliance used an inductive or resistive motor. You may also refer to our air-cooled models that offer 8, 10 or 12 circuits.

3. How much fuel does an Emergency Standby Generator use?

	7 KW Air- Cooled	12 KW Air-Cooled	15 KW Air-Cooled	15 KW Liquid- Cooled	20 KW Liquid- Cooled	25 KW Liquid- Cooled	40 KW Liquid- Cooled
Nat. Gas cu ft/hr	105	185	240	277	369	441	735
Lp Gas cu ft/hr (gal/hr)	44.1 (1.2)	79.0(2.17)	102.3 (2.8)	110 (3.1)	143 (4.0)	175 (4.8)	310 (8.8)

Figures are fuel consumption values at 100% (full) load. It is unlikely that the generator would run at full load for an extended period of time. Therefore, your consumption would decrease accordingly.

4. The generator that I've chosen has a 100-amp automatic transfer switch. What if I have 200-amp service in my home?

It is always recommended that emergency circuits be isolated by the emergency load center. An isolated sub-panel will prevent the possibility of the generator becoming overloaded. Thus, the system will respond automatically.

5. Will 200-amp automatic transfer switches be available for the air-cooled models, and the 15 kW and 20 kW liquid-cooled Residential Emergency Home Standby generators?

No. It is not electrically necessary. The outputs of these generators are safely carried with the 100-amp automatic transfer switch.

6. What is the expected life of the engine?

A properly maintained engine should provide over 20 years of operation under emergency standby conditions. Keep in mind that the units are not intended to provide continuous power (24 hours a day, 365 days a year).

7. Where can I purchase parts?

Parts may be obtained through any Authorized Guardian Dealer. Part numbers are located in the

owner's manual.

8. What is the cost of a service/maintenance contract?

The cost will be determined by the installing dealer, based upon what service the customer requires for the system. Further, the cost will vary based on hourly labor rates in different parts of the country.

9. How much oil does the engine crankcase hold?

Air-cooled: 7 kW, 12 kW and 15 kW – 1.7 qt. Liquid-cooled: 15 kW, 20 kW and 25 kW – 4.0 qt. Liquid-cooled: 45 kW – 4.5 qt.

10. What type of oil is recommended?

The recommended oil for the 7 kW, 12 kW and 15 kW air-cooled units is 10W-30 temperatures above 20° F. Use 5W-20 or 5W-30 for temperatures below 20° F. After the first oil change, all-season 5W-30 synthetic oil may be used. API Service Class SG, SH or SJ should be used in all cases. The recommended oil for the liquid-cooled units is 15W-40. All oil should be SAE rated high detergent oil that meets API Service Class SF requirements for gasoline engines.

11. Propane tanks are usually rated by pounds. Is there a conversion that can be applied to the fuel consumption numbers?

Yes. For general conversion, propane weighs 4.24 pounds per gallon. 1 lb. = 8.58 cu. ft.. 1 gallon = 36.39 cu. ft..