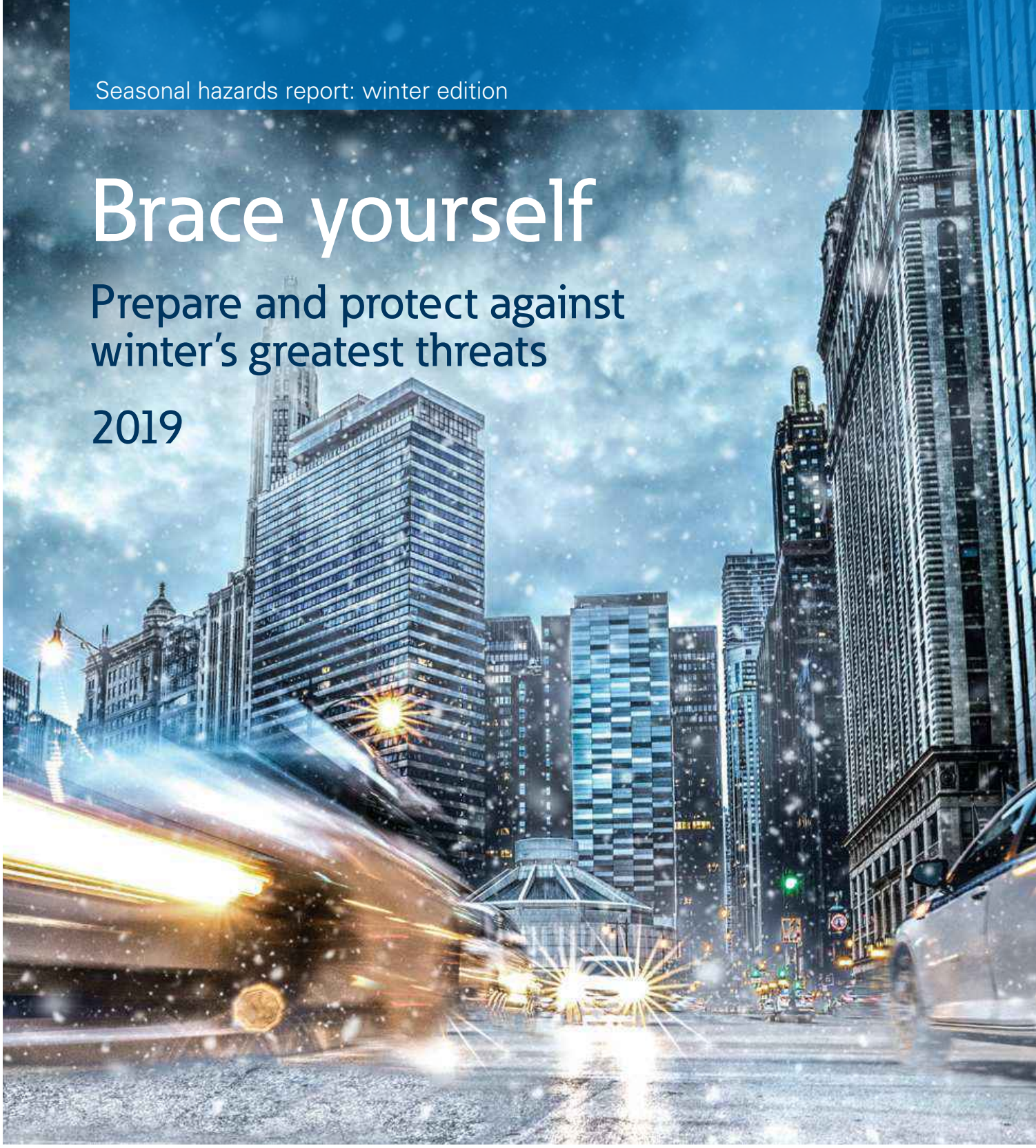
Seasonal hazards report: winter edition

Brace yourself

Prepare and protect against winter's greatest threats

2019



Powering Business Worldwide

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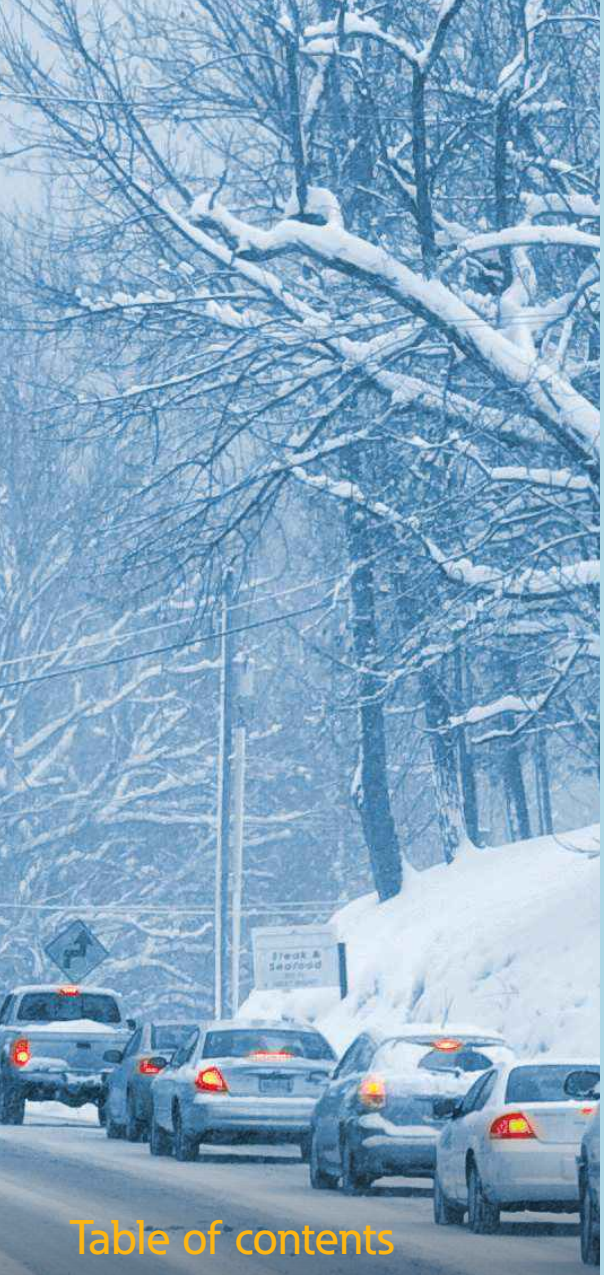

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Winter weather weighs heavily on the availability of electricity—literally.

The buildup of ice or snow can prompt sturdy power lines to snap, representing one of the many seasonal extremes that results in power outages. Indeed, the months of December, January and February bring a wide variety of adverse conditions, from snow squalls to blizzards to bone-chilling winds. In fact, January ranked as the snowfall leader, followed by December and February, when climatologists examined monthly snowfall data from 4,218 observation sites across the U.S. Additionally, plunging temperatures alone can impact power lines, increasing the amount of heat that is dissipated from the conductors, which in turn lowers conductor temperature and causes power lines to tighten.

As if battling the freezing winter conditions isn't enough to keep you busy, there are additional hazards that can cause power outages and leave your organization out in the cold, such as falling trees, grid vulnerabilities and overdemand, often triggered by the spike in runtime of heating systems.

One thing is certain: an unexpected power outage can turn a winter wonderland into a whopping winter woe. Between 2009 and 2017, Eaton's Blackout Tracker logged 7,260 winter outages that affected more than 14 million customers over a collective 122 days. Not surprisingly, more than one-third of these outages were attributed to Mother Nature.

While knowledge is power, it can also be cold comfort if best practices are not applied to an uptime strategy. With that in mind, Eaton is committed to helping you optimally prepare for the multitude of seasonal risks. It is our hope that this information will not only provide a wealth of valuable insight, but that it will prompt you to take appropriate action to prepare for winter power outages that could adversely affect you or your business.

By the numbers

Outages captured by Eaton's Blackout Tracker during the months of December, January and February from 2009-2017

Total # of outages:
7,260

# of people effected:
14 million+

Amount of downtime:
2,925 hours (122 days)

Are utility companies doing enough to prepare for storms?

More than ever, utility companies are experiencing increasing pressure to confront the effects of severe winter weather. And this is no small feat, considering that major U.S. outages have increased six-fold in the past 20 years, according to IDC Energy Insights Business Strategy: Facing Down Extreme Weather.

Amplified customer expectations and mounting regulatory scrutiny are driving utility companies' efforts to better prepare for storms and improve their power restoration response time. Impending weather preparation ranges from determining the number of employees to have on call the night of a storm to requesting assistance from other agencies days ahead of an event.

Yet, there is room for improvement. New Jersey's Board of Public Utilities, for instance, ordered the state's four main utility companies to better prepare for future storms likely to result in major power failures. The directive came in a 71-page report that investigated how the agencies dealt with significant outages during three major 2017 snowstorms.

Ordered by the governor, the study was the result of an internal review and five public hearings held by the BPU to gather feedback on the winter events, which affected 1.2 million customers, some of whom were without power for up to 11 days. Noting that the prolonged service interruptions were, in many cases, preventable, New Jersey's governor emphasized that "processes leading up to, during and following major weather events must be under constant evaluation to ensure that our residents are safe."

Artificial intelligence

A promising new preparation approach relies on artificial intelligence (AI), also known as machine learning, to identify patterns that will enable future prediction of outages. Because every utility has specific designs, ages of equipment, maintenance practices and other variances, the same storm can impact them in dramatically different manners. AI seeks to customize the best approach for each individual entity.

Already deployed successfully in many business applications, AI can transform weather forecasts into much more actionable information, in turn enabling more effective results. When quantitative predictions—such as an estimate of projected outages in a utility's service territory—are provided to the operations team well before a storm's arrival, it can lead to faster restoration times.

High-quality data is required to train the machine learning models that complete the prediction, such as three to five years of historical outage incident information that is both time-stamped and geo-located; a utility's overhead distribution system data in geospatial form; and a tree trimming history to understand where the utility is in its cycle.

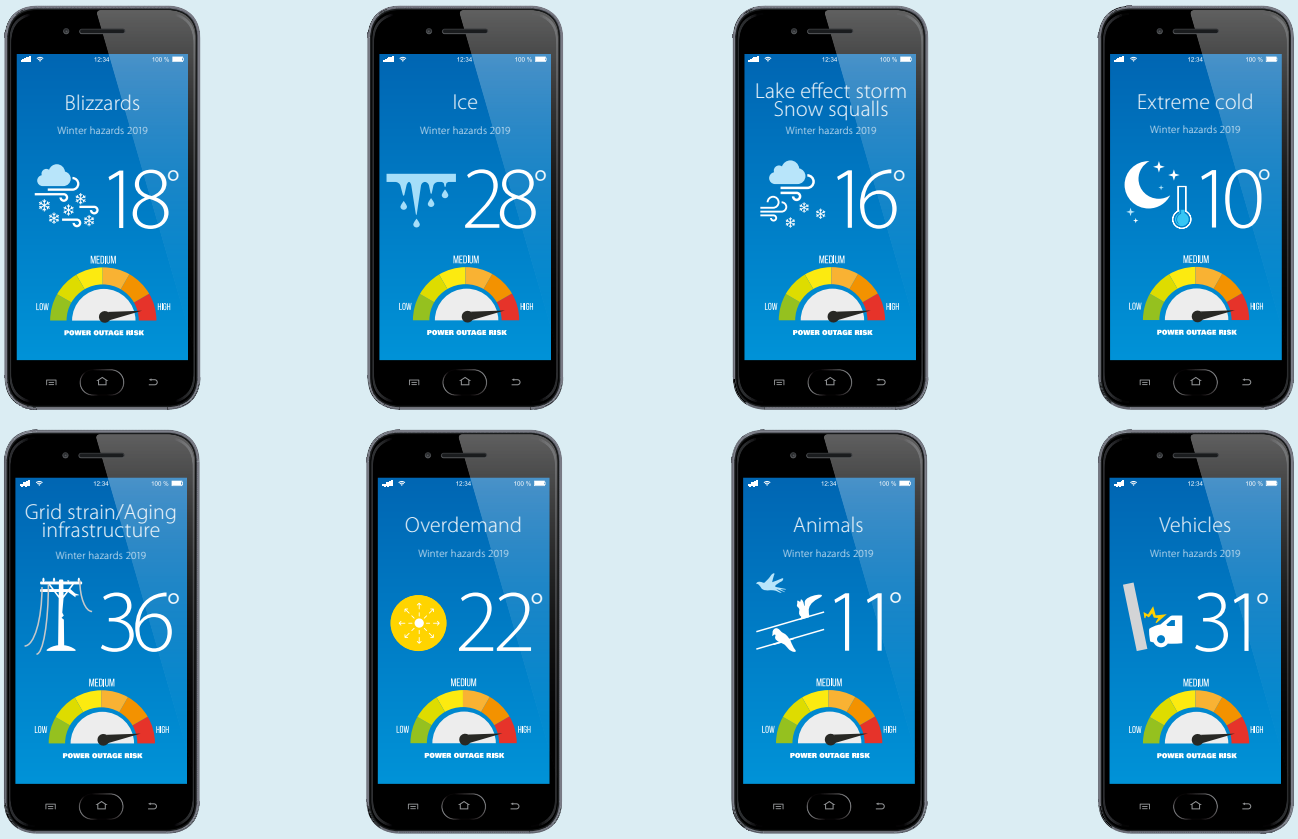
This data is then leveraged to build predictive damage models specific to various types of weather events, which are utilized to calculate the impact of future storms based on weather forecasts. Different machine learning algorithms can then be aggregated together to obtain a broad range of potential incidents on a utility's territory, with reliability increasing as additional data volumes are collected.

Between 2003 and 2012, weather-related outages, coupled with aging infrastructure, are estimated to have cost the U.S. economy an inflation-adjusted annual average of

$18 billion to $33 billion.

(ASCE)

Winter: a cast of main characters



Blizzards

Defined as a combination of blowing snow and sustained winds of at least 35 mph, a blizzard is a dangerous winter storm that results in visibility of one-quarter mile or less. One study found that over the past two decades, **the number of blizzards in the U.S. has doubled,** with a current average of 19 blizzards per year.

The same study, published in January 2017 and based on 55 years of data, also identified distinct blizzard zones. Although the Northeast receives much media attention regarding blizzard activity, the largest and most consistent area of higher annual blizzard activity actually occurs in the northern Great Plains, the study concluded. North Dakota, parts of northern South Dakota and northwestern Minnesota have at least a 61 percent chance of experiencing at least one blizzard per year, while four North Dakota counties in particular—Barnes, Benson, Cass and Traill—have a likelihood of just over 76 percent.

Representing the remainder of the Plains' blizzard alley is the rest of Minnesota, much of Iowa, Nebraska, northwest Kansas, eastern Colorado, far eastern Wyoming and parts of eastern Montana. This region has at least a one-in-three chance of a blizzard each year. Meanwhile, along the east coast, the highest probabilities exist in New England, as well as in four counties in northern Maine, all of which have a 40 percent likelihood. The rest of Maine, southern New Hampshire, eastern Massachusetts and Rhode Island had a roughly 20 percent chance of experiencing at least one blizzard each year.

Ice

This formidable winter foe can quickly leave your organization skating on thin ice. Not only does it have the ability to increase the weight of tree branches by 30 times, but just a 1/2-inch accumulation of ice on power lines can add 500 pounds of extra weight. This explains why branches and power lines routinely snap during an ice event, resulting in outages.

An ice storm is characterized by freezing rain that forms when raindrops move into a thin layer of below-freezing air near the surface of the earth, freezing on contact with the ground, trees, power lines and other objects. Throughout the U.S., ice storms occur most often during the months of December and January. Between 1982 and 1994, ice storms were more common than blizzards in the U.S., **averaging 16 per year.**

Climatologists have identified several freezing rain corridors in the U.S., most notably the Midwest, the Northeast (experiencing an average of 5–7 freezing rain days per year), and parts of the South and Northwest. Least susceptible to an ice storm are the Rockies, the Southwest and near the Gulf Coast.

Ice storms are dangerous and destructive winter weather events; the national loss total between 1949-2000 from all freezing rain events **was estimated at $18 billion, with an annual average of $187 million.** Furthermore, the ice storm that struck the Northeast in December 2008—described as the worst storm of the decade—left 1.25 million homes and businesses without power.

Lake effect storms and snow squalls

Some of winter's menaces occur predominantly in one region, as is the case with lake effect storms and snow squalls. As a cold, dry air mass moves over the Great Lakes regions, the air picks up moisture from the lakes and dumps it as snow in areas generally to the south and east of the lakes. This is known as a lake effect storm. Snow squalls, on the other hand, are brief but intense snow showers accompanied by strong, gusty winds. They also occur most often in the Great Lakes region.

Extreme cold

In recent years, winter's biting cold temperatures have underscored the vulnerability of utility equipment. The electric system—consisting of thousands of components with many moving parts—performs best when it operates in moderate temperature and humidity ranges. Most of the time, equipment will perform sufficiently when subjected to intensely hot or cold weather, provided it is not subjected to additional stress. However, under extreme temperature changes, many devices operate slower, faster or less predictably than they normally would—especially when required to work overtime, such as the need to quickly open a circuit breaker or switch to safeguard the system from a short circuit when a tree branch falls on a line.

Additionally, cold temperatures make power lines stiffer than usual, increasing their susceptibility to fail. Furthermore, even in the absence of snow and ice, tree roots can cause problems by providing a pathway for ice to build up around underground lines.

Grid strain/aging infrastructure

There is no downplaying the significant challenges faced by the U.S. energy sector as a result of aging grid infrastructure. Breakdowns in supply, security, reliability and resiliency issues all pose significant threats in the face of severe weather events, jeopardizing public safety and the national economy. While blackouts induced by America's aging power grid can occur during any season, winter is a prime contender. In fact, the first week of 2018 brought record low temperatures to 28 major cities across the East, taking the title for the coldest first week of January ever and reigniting grid availability concerns.

The apprehension is not without justification; America's power grid received a "D+" on its 2017 **report card from the American Society of Civil Engineers (ASCE).** The unimpressive mark signifies that "the more than 640,000 miles of high-voltage transmission lines in the lower 48 states' power grids are at full capacity." The report further emphasizes that "without greater attention to aging equipment, capacity bottlenecks, and increased demand along with increased storm and climate impacts, Americans will likely experience longer and more frequent power interruptions."

So what exactly is hindering the indisputably necessary overhaul of the nation's aging systems, some of which originated in the 1880s? For starters, there's a hefty price tag associated with upgrading approximately 5 million miles of electrical transmission lines—at an estimated cost of $56 billion to $100 billion. The expense is largely associated with the age and intricacy of much of the grid, according to experts. While investment in power transmission has increased in recent years, the grid remains vulnerable due to ongoing permitting issues, weather events and limited maintenance, which the ASCE report attributed to causing an increasing number of failures and power interruptions.

Overdemand

In January 2018, Winter Storm Inga—which plunged overnight temperatures below freezing and dumped snow, sleet and ice on much of Texas—set a new record for electricity demand in the state. The Electric Reliability Council of Texas reported that on Jan. 17, a peak demand of 65,731 megawatts of electricity was reached, breaking the previous record set two weeks earlier during a similar cold snap, when 62,855 megawatts of electricity were consumed in one hour.

Thankfully, no issues were reported in Texas, a stark contrast to the Polar Vortex of 2014, which left power system operators from Washington, D.C. to Maine scrambling as customers' demand for power spiked. During that storm, the nation's largest power pool experienced generator outages of almost 24 percent of available generation at that time. In addition, a large nuclear plant tripped offline and could not generate power in the mid-Atlantic. Conditions were further complicated when several dual-fuel generation plants in New England were unable to switch from burning natural gas to oil because they either didn't have sufficient supply of back-up fuel, or had not sufficiently tested their equipment.

Following the Polar Vortex, the nation's grid operators identified and worked to implement the necessary changes. Adjustments included: the way generators are compensated for performance and dispatched during extreme weather events; assurance that adequate back-up fuel supplies are procured ahead of the winter season; and a revision of protocols planned for maintenance on key transmission lines. Yet until the overtaxed power grid is remedied, excessive consumer demand will remain an ongoing threat.

Animals

Not all four-legged creatures hibernate for the winter. As a result, your power supply is potential prey for a wide array of curious and wayward animals. Hundreds of blackouts each year are attributed to animal activity, from squirrels and birds to less-common instigators such as beavers and mountain lions.

Vehicles

Considering the treacherous driving conditions generated by winter weather, it's not surprising to see an increase in the number of vehicle-induced power outages. In fact, 32 percent of all vehicle-related outages logged by Eaton's Blackout Tracker occurred during the three winter months. From DUI crashes to big rigs snagging power lines, automobiles account for the majority of incidents. However, it's not always the sedans and SUVs to blame; Eaton captured winter outages caused by cranes, pay loaders, back hoes, salt trucks, fire trucks, police cars, ambulances and trash trucks, among others (even planes and trains!).

Expect the unexpected

Americans have come to expect some degree of power loss during the winter season, so news of another blizzard-induced outage is rarely a surprise. Yet Eaton has managed to unearth some far more obscure blackout-instigators, proving you can never let your guard down!

Consider 10 of the most unusual outages from past winters:

This little piggy

Swine activity was blamed for a Westport, Ind., outage that knocked out power for nearly 5 hours on Jan. 31, 2017. A semi-truck was transporting swine when the weight of the animals shifted during a turn and destabilized the vehicle. The trailer rolled, taking the cab with it and striking a power pole. Local farmers were contacted to assist with the pigs.

Don't count your chickens before they hatch

Not to be outdone by a bunch of swine, a chicken truck crashed and sparked a power outage on Dec. 12, 2017 in Felton, Del. The tractor-trailer was hauling the fowl when it crashed and lost its load, jamming traffic and leaving 60 customers in the dark for two hours.

Gunning for trouble

Teenagers shooting at a power pole were responsible for a Jan. 1, 2013 outage in Fresno, Calif. Fire officials reported that as many as 14 teens were shooting at power poles, which caused live power lines to fall onto the street and nearby homes, resulting in outages and even causing some plants to catch fire.

A losing battle

An apparent gun battle (yes, battle!) resulted in a Pittsburgh, Penn., outage Dec. 1, 2013. The shootout caused a transformer fire and power outage that affected parts of Route 51, the Liberty Tunnel, Beltz-hoover and Mt. Washington.

The ultimate irony

A blackout was blamed for, err … causing a blackout … in Rome, Ga., on Jan. 12, 2017. Yes, indeed. A paramedic blacked out while driving an ambulance, which led to his vehicle veering off the road, taking down several power lines and knocking out electricity to 150 customers.

Foggy foe

Dense fog freezing on power lines caused outages to 2,200 customers in northern Lincoln County, Wash., on Jan. 21, 2009. More than 50 utility crews were on duty for repairs and ice removal, which required plows and tracked vehicles in some of the more remote areas.

Blame it on the kids

A distracted driver was blamed for a Dec. 21, 2015 blackout in Leola, Penn. Apparently rendered unfocused by her children while she was driving, a mom crashed into a utility pole, leaving hundreds without power.

Swiping Santa

Vandals cut power to steal Santa and five reindeer from a Dayton, Ohio home on Dec. 3, 2010.

Must have been his ninth life

A cat was to blame for a Christmas outage that struck El Paso in 2012. The two-hour blackout left 760 residents opening presents in the dark on Christmas morning. Officials found the cat at rest on one of the power lines.

Abandon ship!

A large cargo ship transporting fertilizer to a Stockton, Calif., port caused a power outage when its attached crane hit a power line as it moved to a different dock. The Jan. 20, 2016 blackout left 5,000 customers without electricity.

The Blackout Tracker's top 10 worst winter storms

Over the course of tracking power outages for nearly a decade, Eaton has logged some monster blackouts at the hands of Mother Nature.

10 of the most significant storm-related outages during winter months:

Slow and steady does the damage

A slow-moving winter storm smacked the Northeast on Feb. 26, 2010, unleashing heavy snow, rain and hurricane-force winds as it knocked out power to more than a million homes and businesses.

Ice age 2

A Feb. 5, 2015 ice storm was blamed for causing the second most outages ever in Philadelphia. The 750,000 people left in the dark throughout the city was exceeded only by Superstorm Sandy on a list of weather-related power outage events.

One for the books

Kentucky residents made history on Jan. 29, 2009 when ice on power lines sparked the largest outage the state had ever experienced. With more than 607,000 customers left in the dark statewide, the Kentucky Public Service Commission warned it could take several days before power was completely restored.

Triple threat

A wicked combination of snow, sleet and ice blanketed the Washington D.C. area on Jan. 27, 2011, leaving more than 600,000 people without power in the District, Maryland and Northern Virginia.

Gone with the wind

Santa Ana winds of up to 80 miles per hour knocked out electricity to 400,000 Southern California customers on Dec. 1, 2011. At Los Angeles International Airport, 23 inbound flights were diverted during the night to other airports because of debris blown onto runways and an hour-long power failure.

Brutal blizzard

A deadly blizzard of historic proportions pounded Rhode Island on Feb. 8, 2013, dumping more than 3 feet of snow on some areas and cutting power to 650,000 homes and businesses across the Northeast, including 350,000 in Rhode Island alone.

Throwing caution to the wind

High winds across Centre County, Penn., knocked down trees and power lines on Feb. 11, 2009. Approximately 330,000 customers were without power at some point during the storm, making it the largest power outage event in the company's history.

Not out of the woods yet

Metro Detroit was struck by a weekend snowstorm on Dec. 21, 2013 that led to more than 300,000 power outages. Even after most of the weekend's severe weather passed, power outages remained a significant threat as ice-coated tree branches began to break and take down power lines.

On thin ice

Some 296,000 Arkansas customers were blacked out Jan. 28, 2009 by a combination of ice on power lines and falling tree limbs. Harrison was the hardest hit area, with 90 percent of customers left powerless.

Almost 1000 hours in the dark

In Meeteetse, Wyo., a Feb. 5, 2015 wind storm blew down 13 transmission poles, leaving 188 customers without any electricity for four full days. The area where the outage occurred was fairly remote, making it difficult for crews to access due to muddy conditions.

How downtime can freeze your entire operation

There's no denying that today's businesses are under increasing pressure to adequately protect against downtime—and that's no easy feat, considering the ever-escalating portfolio of threats.

Not only are the risks proliferating, but the scope and magnitude of outages continue to grow, as well; Eaton's Blackout Tracker logged 3,879 separate U.S. power outages in 2016, the greatest number since the company first began tracking in 2008. Furthermore, the number of people affected by power failures nearly doubled from 2016 to 2017, with more than 36.7 million impacted in 2017 alone.

Exacerbating the problem is the fact that modern IT equipment is even more sensitive to electrical disturbances than in the past—and at the same time, more important to the critical functions of many businesses than ever before. As a result, power quality problems have become an increasingly costly and complex issue, resulting in substantial losses for the companies affected.

Unexpected downtime can result in an interruption to your operations, lost or corrupted files, hardware malfunctions, the inability to access the critical systems, and more. When considering the fortitude of your power protection solution, ask yourself this question: Can your business afford to lose $100,000 per hour? That's the most recent price tag associated with just 60 minutes of downtime, according to a study by ITIC. Even more concerning, the average cost of a single hour of downtime has skyrocketed more than 25 percent over the past eight years. Meanwhile, Forsythe FOCUS magazine determined that North American businesses collectively lose $26.5 billion each year due to IT downtime and data recovery.

Keep in mind these numbers represent only an average. For many organizations, the costs are significantly higher. Delta, for instance, estimated that the December 2017 power outage at Hartsfield-Jackson Atlanta International cost the airline up to $50 million in revenue. It's important to remember that downtime isn't only about dollars; a negative experience can significantly damage your organization's reputation and cause customers to flee to competitors. Data and monetary losses from unplanned outages can even cause a company to go out of business.

While the industry downtime average is dependent on many factors, and monetary losses vary based on a broad range of elements—including revenue, business type, outage duration, the number of people affected and the time of day an outage strikes—it's safe to say that downtime is a demon to be avoided at all costs.

After a power outage disrupts IT systems:

- >33% of companies take more than a day to recover
- 10% of companies take more than a week to recover
- It can take up to 48 hours to reconfigure a network
- It can take days or weeks to re-enter lost data
- 90% of companies without a survival plan go out of business within 18 months

Price Waterhouse

From a monetary standpoint:

- 33% of companies lose $20,000–$500,000
- 20% lose $500,000 to $2 million
- 15% lose more than $2 million

U.S. Department of Energy

Don't get left out in the cold: steps to prepare and protect

Despite the potential perils of winter, there are steps you can take to prevent your organization from getting snowed under. Here's a starting point:

Assess your overall power protection solution.

If your facility isn't already protected, determine the type of UPS you need, the best deployment strategy and how much capacity is required to support your business. Eaton's **UPS and Power Management Fundamentals Handbook** is an excellent resource to help you get started. For organizations with UPSs already in place, winter is a perfect time to reevaluate your overall environment and ensure the existing UPS solution meets your current needs.

Consider the factors that contribute to your organization's resiliency. For instance, how much battery power is needed to shut down systems or switch to backup generators in case of an emergency? Redundancy is another important consideration in your power protection strategy. This added safeguard helps ensure your UPS is always available; if a single module fails or needs to be taken offline for service, the UPS system will still be able to provide adequate power.

Monitor, optimize, visualize and predict.

A lot can be said for power insight and intelligence that resolves problems as they happen. But a solution should be flexible enough to proactively address issues with the right data at the right time, such as the Eaton Intelligence Platform, which works to monitor, optimize, visualize and predict these problems before they strike.

This solution is ready to take on the unique challenges you face within your environment, by empowering you to make tasks simpler via advance alerts and automated resolution, make data actionable through faster interpretation and analysis, see beyond power consumption via 3D infrastructure visualizations, and monitor all infrastructure devices--no matter the vendor--from one location.

It's versatile enough to change with your environment, whether it's a small deployment of UPS units and rack PDUs, a sophisticated data center housing thousands of servers and millions of datasets, or anything in between.

Implement remote management.

From powering cycle servers and devices to troubleshooting problems, remote management eliminates unnecessary service trips to isolated locations. By allowing administrators to securely control the power to every piece of equipment in the data center, remote management facilitates more efficient server management and reduces equipment downtime by giving administrators direct access to power control

Schedule a checkup for your UPS.

Your UPS is the first line of defense against the many hazards of the season, so make sure it's in optimal health. One of the best ways to protect your investment is by engaging in a service contract that includes regularly scheduled preventive maintenance (PM). These visits can help detect a wide range of ailments before they become serious and costly issues. During a PM service call, a trained technician will inspect your system, test the batteries and examine key components such as fans, capacitors and internal connections.

Also, consider bolstering your level of security by pairing an optimal UPS with a standby generator—an ideal complement to deliver power indefinitely. Be sure to test your generator regularly as well, to ensure you have emergency power in the event an outage occurs.

Based on a study of Eaton's service records of UPSs that experienced load loss, customers who had two preventive maintenance visits per year were four times less likely to have a load loss event, resulting in unplanned downtime.

Review your disaster recovery plan.

Every change that has taken place within your organization since you first compiled your DR strategy—from adjustments in employees to new hardware and software implementations—makes your plan that much less effective. **Be sure to update it on a regular basis.**

Always be prepared.

Anything that disrupts power has the potential to bring your business to a halt. Although UPSs offer an excellent line of defense against dirty power, data loss and equipment damage—as well as provide backup during short-term blackouts–they are not designed to deliver power indefinitely. By pairing a UPS with a standby generator, the harmonization is ideal for applications that must remain online 24/7 without interruption.

Choose your site carefully.

When selecting a spot for your data center, it's wise to consider the site's ability to withstand severe weather and disasters, as opposed to simply choosing the facility with the lowest cost. Avoid a single point-of-failure by maintaining multiple active sites in diverse locations (preparing for a local or regional disaster). Organizations that cannot afford downtime should not store data in only one location—or even in two locations susceptible to the same disaster. Also keep in mind room selection for your IT equipment. Seek higher (centralized) ground whenever possible to avoid flood damage. Variety is key, and when the time strikes, you will be happy all your eggs aren't in just one basement-level basket.

Communicate with your customers.

If your organization does fall prey to downtime, customers will be more forgiving if you communicate with them. While 100% uptime is expected on a daily basis, it's human nature to forgive, especially businesses that are transparent.

To learn more, visit
Eaton.com/BlackoutTracker

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