From managing risk to building resilience

The increasing number of natural disasters is causing irreversible societal damage to communities, and creating extremely high costs for utilities companies. Industry leaders are looking for ways to pro-actively invest in infrastructure to minimize exposure to threats while enhancing long term value to communities and shareholders. By following a 5 step approach, companies are able to align resources to effectively manage risks and build a resilient organization.

kpmg.com

Introduction

We have become all too familiar with natural disasters in the last few years. Whether they are the 2018 California wildfires that threaten the very existence of communities or the devastating hurricanes of 2017, such as Maria that killed nearly 3,000 people and caused about $80 billion in economic damage in Puerto Rico, such disasters pose a rising threat to the resilience of utility assets.

The rising occurrence and increasing intensity of these threats to reliability have made resilience a chief concern for communities and utilities across the country. While resilience may not be easy to define, an analytical approach can identify reliability threats by their impacts and sources. Among the most prominent in recent years are the varied effects of climate change, which have had some of the largest impacts on reliability and engendered some of the most vigorous utility responses. Analyzing those responses demonstrates the practices that leading organizations have employed and provides lessons that can provide valuable guidelines for all utilities striving to improve their resilience in the face of rising threats to reliability and safety.

Defining Resilience

Resilience has many definitions. Among the simplest is the ability to bounce back from disaster or misfortune. For a utility, a more specific definition could be applied, where resilience is the ability to reduce the likelihood and impact of severe events, and return to reliable service.

No single definition can apply to all contingencies, just as there is no single threat to resilience. The salient fact is that resilience should be a core competency for a utility. Resilience should be at the heart of a utility's mission. It enables or enhances the ability of a utility to provide reliable service.

Although resilience and reliability are distinct concepts, they are related. Reliability is being there when needed; it is the ability to provide uninterrupted electric, water or natural gas service. Resilience is the ability to prepare for severe events and to be able to quickly restore reliability. The distinction is particularly important when it comes to assessing the risks that threaten utilities.

KPMG's definition of resilience

Ability to reduce likelihood and mitigate impact of severe events, and return to reliable service

Being there when needed

> A quality within organizations [that] allows them to manage crises and disruption to operations, resist sudden shocks and adapt to changes
> ***The Business Continuity Institute***

> Ability of an organization to anticipate, prepare for, and respond and adapt to incremental change and sudden disruptions in order to survive and prosper
> ***ISO 22316***

> The ability of an organization to absorb and adapt in a changing environment
> ***British Standard***

Threats impacting reliability and safety

Threats to reliability and safety come from four different spheres: strategic threats such as technology disruption, operational threats such as asset failures, enterprise threats such as cyber-security, and climate threats such as extreme weather. All four are on the rise.

Strategic threats

Renders a company's business strategy ineffective and operating assumptions irrelevant (i.e. technology disruption, policy change, business model obsolescence)

Strategic threats come in many forms, one of the most potent and pervasive in the utility industry today is the threat of technology disruption. Investment banks ranging from Citigroup and Goldman Sachs to UBS have issued reports warning about possible power sector downgrades as a result of the threat posed by distributed energy resources (DERs), particularly from the rapidly falling costs of solar panels and battery storage devices.

Operational threats

Unexpected failure or under performance of an asset or disruption to the company's routine operations (i.e. major accidents, single points of failure)

A recent survey[1] found that nearly half of all utilities have identified threats and vulnerabilities to critical operational assets. One example is the threat that comes from underground electrical vaults. Underground vaults are pervasive. There are about 2 million in the United States, and every year there are about 2,000 events—fires or explosions—in underground vaults, resulting in property damage, injury and even fatalities.

Enterprise threats

Challenges to enabling functions that help the company execute its core business (i.e. cyber security, financial crises, workforce issues)

A report from the Department of Energy found the likelihood for cyber-attacks against utilities is increasing in frequency and severity with power companies and utilities around the world reporting a six-fold, year-over-year increase in detected cyber incidents.[2] A 2015 cyber-attack in Ukraine, for instance, knocked out power to about a quarter million customers for up to six hours.

Climate threats

Climate induced natural disasters that can disrupt a company's operations (i.e. wildfires, hurricanes and storms, earthquakes)

More recently, however, the most prevalent threats have come from natural causes such as extreme weather events. Weather statistics indicate[3] that the number of severe storms in the United States has risen dramatically, resulting in a steep increase in power outages. From the 1950s through the 1980s there was an average of five storms per year[4] that caused power outages. Over the past five years, that number has soared to between 70 and 130 storms per year that have caused outages. Federal data indicates that the U.S. electrical grid now loses power almost three times more often than in the 1980s. Those outages can not only disrupt a company's operations, they can cause economic damage and a rise in accidents and even mortality in local communities.

1 Utility Dive, The State of Physical Grid. (2015). Retrieved in 2018 from https://www.utilitydive.com/library/the-state-of-physical-grid-security-2015-report/

2 Cyber Threat and Vulnerability Analysis of the U.S. Electric Sector; Mission Support Center, Idaho National Laboratory, August 2016.

3 Inside Energy, Data: Explore 15 Years Of Power Outages (August 18, 2014). Retrieved in 2018 from http://insideenergy.org/2014/08/18/data-explore-15 years-of-power-outages/

4 Clifford Power, Trends in Power Outages (March 11, 2016). Retrieved in 2018 from http://www.cliffordpower.com/trends-in-power-outages

Assessing climate threats

The science is unclear on whether or not climate change will increase the number of hurricanes, but warmer ocean temperatures and higher sea levels are expected to make their impact more severe. Despite a possible decrease in the frequency of storms, one model projects[5] a 45% to 87% increase in the frequency of Category 4 and Category 5 hurricanes in the Atlantic Basin.

In 2017, the hurricane season was so damaging—it is estimated that Harvey, Irma, Maria and Nate caused as much $200 billion in damages—that those names[6] have been retired and will not be used again. When Hurricane Michael made landfall on Oct. 10, 2018 as a Category 4 hurricane, it was the strongest storm to ever hit the Florida Panhandle. The storm killed 39 people, caused as much as $5 billion in economic damages, and left about 2.5 million customers in the Southeast without electricity.

The Southeast and the Western parts of the U.S. and East and Southeast Asia are particularly vulnerable

2005

Indian Ocean Tsunami
Country most hit: India
Total damage: >$3 billion

Storm Gudrun
Country most hit: Sweden
Total damage: >$2.5 billion

2006

Katrina + Rita
State most hit: Louisiana
No. of customers affected: >1 million
Katrina + Rita: Total No. of customers impacted >11M
Natural Gas Production shut-in: >46B cf/d
Crude oil production shut-in: >9 cf/d

2007

Gustav
State most hit: Louisiana
No. of customers affected: >1 million

2008

Cyclone Nargis
Country most hit: Myanmar
Total damage: >$13 billion

Ike
State most hit: Texas
No. of customers affected: >2 million

2009–2011

Severe floods
Country most hit: Thailand
Total damage: >$45 billion

Station Wild Fire
State most hit: California
Total acreage burned: >160,000

2012

Tohoku Tsunami
Country most hit: Japan
Total damage: >$360B

2013–2014

Isaac & Sandy
State most hit: NE U.S., Louisiana
Total damage: >$73B

2015

South Indian floods
Country most hit: India
Total damage: >$14B

2016

Matthew
State most hit: SE U.S.
Total damage: >$10B

Harvey, Irma, & Maria
Areas most hit: Puerto Rico, Costa Rica
Total damage: >$270B

2017

Hurricane Maria
Maria led to the largest electricity blackout in the U.S., with 3.5B customer-hours of electricity service lost
No. of disasters: >300
State with highest no. of disasters: California

2018

Florence
State most hit: Carolinas
Total damage: >$22B

[5] Dynamical Downscaling Projections of Twenty-First-Century Atlantic Hurricane Activity: CMIP3 and CMIP5 Model-Based Scenarios, Thomas R. Knutson, Joseph J. Sirutis, Gabriel A. Vecchi, Stephen Garner, Ming Zhao, Hyeong-Seog Kim, Morris Bender, Robert E. Tuleya, Isaac M. Held, and Gabriele Villarini; Journal of Climate, September 2013.

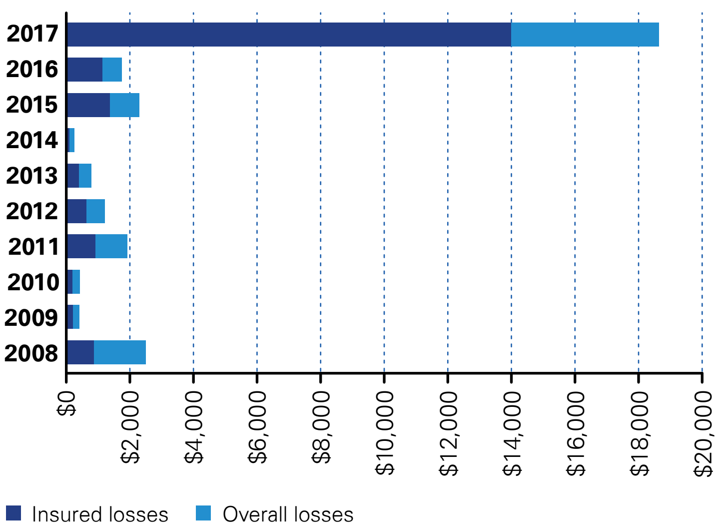
[6] The Washington Post, Hurricanes Harvey, Irma, Maria and Nate were so destructive, their names have been retired (April 12, 2018). Retrieved in 2018 from https://www.washingtonpost.com/news/capital-weather-gang/wp/2018/04/12/hurricanes-harvey-irma-maria-and-nate-were-so-destructive-their-names-have-been-retired/?noredirect=on&utm_term=.2f01b6d1b989

Climate change has also been implicated in the rise of wildfires. One recent scientific study[7] concluded that human-caused climate change nearly doubled the forest fire area in the western United States between 1984 and 2015. The tragic effects of greater fuel aridity caused by climate change have been particularly evident in recent years.

The 2017 wildfires were the most destructive and costly[8] in California's history, but they could be eclipsed by the wildfires of 2018. Estimates of the financial damages stemming from the Camp Fire alone run as high as $10 billion.

Wildfire losses in the U.S.

(2008 – 2017 in U.S. $ millions)



Recent storms and wildfires serve as warnings that as the effects of climate change intensify, the impact on energy infrastructure will be widely felt. Those effects range from physical damage and service disruptions to transmission equipment to lower water availability for thermoelectric generation sources, as well as lower efficiencies and generation service disruptions.

In most cases, the damage inflicted by hurricanes is caused by high winds and flooding from storm surges and heavy rains, however, storm damage can be compounded by the condition and age of the system. Most of the transmission and distribution lines in the United States were built in the 1950s and 1960s, putting them 10 or 20 years past their 50-year life expectancy. Seventy percent of power transformers and transmission lines are 25 years old or older. Sixty percent of circuit breakers are 30 years old or older.

The combination of aging infrastructure and more severe storms creates an enhanced threat to future reliability. Faced with these realities, many utilities have undertaken investments to upgrade their aging infrastructure. Those investments include making physical and structural improvements to harden system components, as well as planning and modifying operations to enhance resilience.

By one estimate[9], Texas utilities could spend as much as $520 million to repair damage for wires and equipment in the wake of Hurricane Harvey. In the wake of Superstorm Sandy in 2012, Public Service Electric & Gas in New Jersey launched Energy Strong I. The $1.2 billion program, approved by regulators in 2014, is designed to improve reliability and enhance resiliency by repairing or replacing 29 PSE&G switching stations and substations that were flooded by Sandy.

Sandy was a wake-up call for many MidAtlantic utilities on how vulnerable they are to the triple threat of more severe storms, rising sea levels and aging infrastructure. In its ongoing efforts, PSE&G is proposing to spend as much as $17 billion in the five-year period that ends in 2023 in what the company's CEO called, "the most significant investment program[10]" in PSE&G's history. The spending program includes $6 billion to upgrade aging transmission lines and $2.5 billion for its Energy Strong II program.

[7] PNAS, Impact of anthropogenic climate change on wildfire across western US forests (October 18, 2016). Retrieved in 2018 from https://www.pnas.org/content/113/42/11770

[8] The Sacramento Bee, Wine country wildfire costs now top $9 billion, costliest in California history (December 6, 2017). Retrieved in 2018 from https://www.sacbee.com/news/state/california/fires/article188377854.html

[9] S&P Global, Analysis: Utilities spending about $520 million to repair systems after Hurricane Harvey (August 29, 2018). Retrieved in 2018 from https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/082918-analysis-utilities-spending-about-520-million-to-repair-systems-after-hurricane-harvey

[10] PSEG, PSEG Announces Major Infrastructure Investment Program (May 31, 2018). Retrieved in 2018 from https://investor.pseg.com/press-release/featured/pseg-announces-major-infrastructure-investment-program

Utility spend on aging infrastructure

U.S. utilities have undertaken investments to combat aging infrastructure

The Consolidated Appropriations Act for 2019 (Public Law 116-6) included provisions to boost natural disaster premitigation programs. The legislation, which funds several agencies through FY 2019 including the Federal Emergency Management Agency (FEMA), builds upon Congressional efforts in the aftermath of the 2017 and 2018 hurricanes as well as the recent California wildfires. Specifically, the Disaster Recovery Reform Act of 2018 (PL 115-254) authorized the creation of a National Public Infrastructure Pre-Disaster Mitigation fund at FEMA. The FY 2019 funding bill provides $250 million for premitigation efforts, and once the new program is fully implemented, FEMA may use additional funds for it. In total, FEMA received $16.6 billion for FY 19, including $12.6 billion for disaster relief funding.

Texas utilities: **$520 million** for Hurricane Harvey

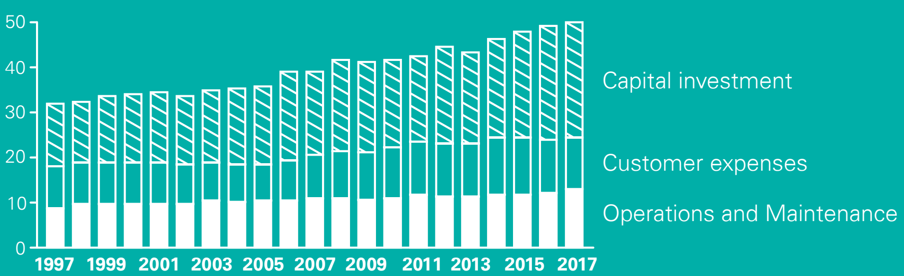
Public services electric and gas **$17 billion by 2023**

Energy strong I: **$1.2 billion** for Superstorm Sandy

First Energy: **$100 million** to replace aging transmission lines

Annual electric distribution system costs for major U.S. utilities

Billion dollars (2017)



Capital investment accounts for the largest share of distribution costs as utilities work to upgrade aging equipment

Average infrastructure life expectancy is **50 years**

Current distribution and transmission lines are **10–20 years** past their life expectancy

70%

Of power transformers and transmission lines are 25 years or older

60%

Of circuit breakers are 30 years old or older

The rationale behind PSE&G's Energy Strong II program is to have "the greatest impact on system-wide hardening and resiliency" while anticipating potential equipment failure rather than waiting for it to occur.[11]

So, while the Energy Strong I program addressed substations that were directly affected by Sandy, the Energy Strong II program is taking preemptive action by raising substations not directly affected by recent storm events that are at risk under flood elevations designated by the Federal Emergency Management Agency. Risk analysis performed for PSE&G estimates that the Energy Strong II program will reduce substation failure by more than 20%.[12]

In New York, Sandy was the largest storm ever to strike Consolidated Edison's service territory. It caused over 1 million customers to lose power. After Sandy, Con Ed invested about $1 billion from 2013 and 2016 to make its infrastructure more resilient. Con Ed estimates that its storm hardening investments prevented 370,000 customer outages.[13]

In Ohio, FirstEnergy spent about $100 million to replace and upgrade aging transmission lines and substations. The utility says its investment has resulted in a 37% reduction in equipment-related outages.

[11] Direct testimony of William D. Williams, associate vice president, asset management practice of Black & Veatch, for PSE&G before the New Jersey Board of Public Utilities, June 8, 2018.

[12] Direct testimony of Edward F. Gray, director of transmission and distribution engineering for PSE&G, before the New Jersey Board of Public Utilities, June 8, 2018.

[13] Consolidated Edison, Report on Preparation and System Restoration Performance, Winter Storms Riley and Quinn; March 2018.

Building resilience - improving reliability and safety

It is becoming clear that the combination of aging infrastructure and more severe storms could be more widespread, and severe damage and longer recovery times will require higher levels of investments for controls and mitigations. The collateral conclusion is that restoring operations to their prior state is not sufficient to ensure resilience given the greater threats utilities face.

For management faced with making these decisions, that raises questions about the correct level of investment needed to ensure resilience. With storm related damages in the hundreds of millions of dollars, one response could be to spend commensurate sums to protect against any and all contingencies. That approach is not likely to meet the metrics of effective or prudent investment.

It is important, nevertheless, that investment and budgetary considerations be included in any complete approach to risk and resilience. A risk-informed budget allocation should incorporate an assessment of funds to mitigate the impacts of events with a low probability of occurrence but a high potential for adverse consequences. That assessment should also be multi-dimensional and include scenarios in which risk compounds or cascades as a result of the confluence of multiple events as well as assess "single points of failure".

Attributes of resilience

The practices of leading organizations can provide a template for building resilience and improving reliability and safety. That template comprises the building blocks that any organization can use to manage risk more effectively and build resilience. The process starts by (1) aligning the preparations needed to respond to reliability events with a wider vision that encompasses the organization's strategy, mission and values. Those preparations can be put in place by (2) developing formal structures such as reporting lines and committees specifically charged with implementing resiliency strategies.

As part of the process of implementing their resiliency strategies, leading organizations (3) utilize data to identify and evaluate risks to reliability. Part of that process is to look outside the organization's immediate sphere of operations in order to (4) clearly understand operational risks that could impact the ability to produce a product or to get it to market. A wider view of resilience is one of essential building blocks in the crisis management practice, which identifies and analyzes risks before they occur.

The last key attribute that can be used to identify a resilient organization involves (5) investment planning. The ability to demonstrate the value of investments, including enhancements to operations and management, can ensure that capital can be deployed in a time sensitive manner that can reduce the frequency of reliability events and mitigate their effects when they do occur. Together, these five attributes are key to building a resilient organization.

The five key attributes of a resilient organization

1	2	3	4	5
Prepare	**Prevent**	**Protect**	**Practice**	**Pivot**
Strategy	Governance	Operations	Crises management	Investment planning
Create a strategy with a clear definition and alignment of mission, values, strategy and risk at corporate and business unit levels	**Integrate governance** (e.g., reporting lines, committees and governance models, titles and role descriptions, decision rights) with formal structures for all employees	**Understand operational risk** at various levels, frequency and velocity to develop operational mitigation without preventing the production or delivery of products/services to customers	**Implement crises management best practices** to effectively respond to risk by identifying, analyzing, and having a plan to address the risk before it occurs	**Actively monitor investment plans** to reduce the frequency of and to contain risk; and mitigations to enable long-term resilience through perceived value of capital and Operations & Maintenance investments

A call to action

Building these key resiliency attributes into an organization requires a process that begins with (1) a survey of the landscape to identify critical short- and long-term risks to resilience. Mapping out that landscape allows (2) a strategy to be put in place that identifies key collaborators and partnerships that can aid in execution. The process of creating a resilient organization is not complete, however, until (3) metrics to assess performance are put in place. It is critical that those metrics (4) take into consideration the long-term value to stakeholders in multiple spheres, from the world of finance, investment and politics to the worlds of government and regulatory stakeholders, and the customer.

All utilities face rising threat levels, but the threats are specific and unique for each utility. There are, however, common principles that can help guide investments in more resilient systems. Resilient infrastructure, for instance, does more than one thing well. Likewise, a resilience investment should pay for itself and create value for ratepayers, even when it is not being used. When in place, the practices and procedures that build resilience, allow an organization to better withstand the rising threats of the 21st Century.

The threats to utility resilience are real. They are pervasive, and they are on the rise. Utilities that do not act now will most likely have to react later, after the fact. Experience shows that being prepared by building a resilient organization not only mitigates the severity when disaster strikes, but over the longer term, improves utility performance.

KPMG can help

KPMG has an established track record of helping energy companies and utilities face from threats ranging from cyber-attacks to the increasing risks from climate change and more severe storms.

KPMG works with a Company's operations and management teams to build resilience into an organization from the ground up, from initial assessments and preparations to tailored responses and proven recovery procedures.

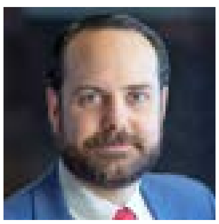
KPMG's took kit includes the ability to:

- Deploy market leading tools to help clients assess risks and opportunities
- Demonstrate tangible and measurable improvement for clients on long term value creation actions
- Help management become thought leaders on resilience issues
- Work with industry partners to develop resilience definitions and strategies and drive wider industry progress
- Produce results that enable enhancing revenues by reducing risk within a five-year time frame

About the authors

Arun Mani

A principal in KPMG's Advisory group, Arun is the U.S. Power and Utilities strategy and transformation leader in KPMG's Strategy practice. Arun operates at the intersection of risk, regulation, and response in the power and utilities sector to advise industry leaders worldwide on a variety of topics. With more than two decades of experience, he has helped numerous power and utilities organizations transform their risk management practices and become resilient. Most recently Arun has been advising utilities on some of the largest "extreme risks" that the industry has seen in a long time ranging from wildfires to natural gas incidents.



Jonathan White

Jonathan is a Managing Director in KPMG's U.S. Power and Utilities Strategy Practice. He has over 15 years of experience in strategy consulting and across the P&U industry. Jonathan has focused on business and operating model strategies and has recently leveraged this experience to help utilities to understand their reliance risks and translate those into operational improvements. Specifically Jonathan has been working with West Coast utilities on Enterprise Risk Management (ERM) assessments and design, enhanced vegetation management design, system hardening prioritization, and enhanced asset inspection and repair design.

Paul McGregor

Paul is a Manager in KPMG's Strategy Practice based in Southern California. He is an accomplished senior leader and management consultant with 25 years of experience in the Power and Utilities industry across Generation (Fossil, Nuclear, Hydro and Renewable), Transmission, Distribution, Energy Marketing, and corporate support functions. He has demonstrated expertise in the project management and delivery of Strategic Planning, Regulatory Strategy, and Risk Management initiatives.

For more information, contact:

Arun Mani
Principal, Corporate Strategy
832-648-8513
arunmani@kpmg.com

Jonathan White
Managing Director, Corporate Strategy
415-635-5149
jdwhite@kpmg.com

Paul McGregor
Manager, Corporate Strategy
949-885-5444
paulmcgregor@kpmg.com

Some of the services described herein may not be permissible for KPMG audit clients and their affiliates or related entities.

kpmg.com/socialmedia

About KPMG's Global Strategy Group

KPMG's Global Strategy Group works with private, public and not-for-profit organizations to develop and implement strategy from "innovation to results" helping clients achieve their goals and objectives. KPMG Global Strategy professionals develop insights and ideas to address organizational challenges such as growth, operating strategy, cost, deals and transformation.

About the KPMG Global Energy Institute

Launched in 2007, the KPMG Global Energy Institute (GEI) is a worldwide knowledge-sharing forum on current issues and emerging trends within the Power & Utilities and Oil & Gas industries. GEI membership is free and an effective way for energy executives to gather the latest information on trends affecting the industry as well as meet their continuing education requirements. Members receive early alerts and invitations to valuable thought leadership, studies, events and webcasts about key industry topic. Register today. To become a member, visit **kpmgglobalenergyinstitute.com** and register today.