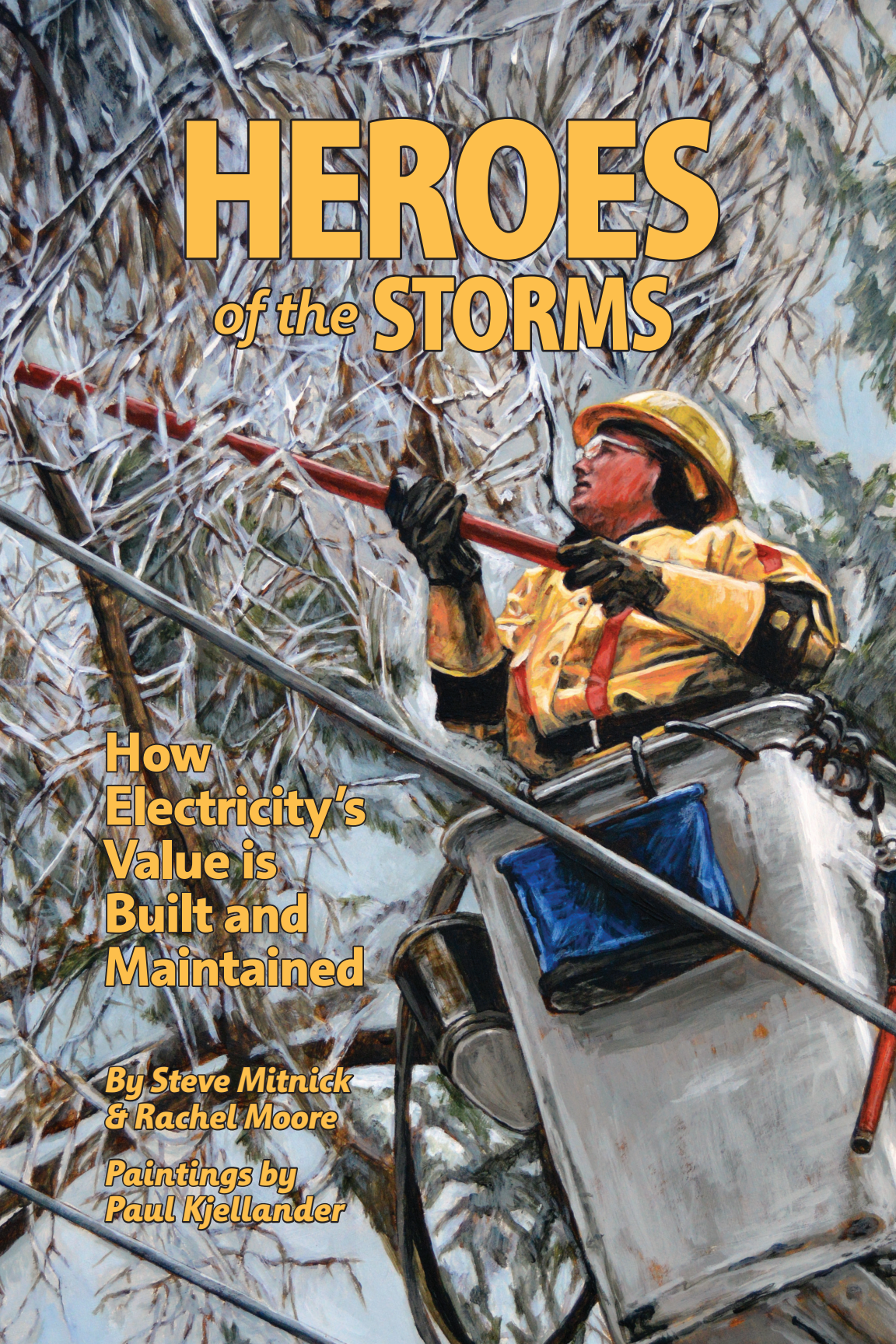
HEROES
of the STORMS
How Electricity's Value is Built and Maintained
By Steve Mitnick & Rachel Moore
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Sponsoring This Book

Rather than for sale, this book is being distributed freely throughout the Public Utilities Fortnightly community due to the generous support of some highly respected organizations of our community. They include Ameren, the American Public Power Association, the Edison Electric Institute, and Dentons. These organizations believe, as do the authors, that the men and women committed to maintaining and restoring our power truly deserve the title of heroes. It is the hope of the authors that this book will raise awareness of their tremendous dedication and the constant innovation that goes into utility restorations year after year. Please see the moving statements by the sponsoring organizations on the following pages.

Moving Statements by the Sponsoring Organizations

It takes a special individual to put the needs of others before their own. That's why being a part of this industry is so inspiring when you see daily the team of people who come together to ensure their friends, neighbors and community have the critical energy they need and rely on.

No matter the weather, the time of day, or any obstacles that are laid before them, our team is there to ensure unwavering commitment to providing safe, affordable, and reliable energy. It is a special bond we share not only at Ameren, but with others throughout our industry. From line workers battling the elements to restore service, to those working around the clock at our energy centers, we are committed to keeping the lights on and our communities energized, powering the quality of life for our customers.

It's not just a job, it's a calling, and the stories documented here help celebrate and recognize all the heroes who give so much of themselves and put the needs of our customers first.

—Martin J. Lyons Jr., President and CEO,
Ameren

For as long as our modern society has benefited from the magnificent ubiquity of electric power, we have also seen the flipside of the coin: the frustration, annoyance, and fear that can come along with power outages of any duration. These negative emotions all too often overshadow the amazing, dedicated, and sometimes harrowing work of the electric utility personnel who get the power back on as quickly and safely as possible. Whether they are working in their own community or travelling to help a neighbor in need, these skilled men and women deserve to be celebrated and treasured.

—Joy Ditto, President and CEO,
American Public Power Association

EEI's member companies – America's investor-owned electric companies – and our industry's extraordinary workforce prepare year-round to ensure they are ready to respond to any challenges they face. Our industry has some of the most dedicated, talented workers anywhere. This latest book by Steve Mitnick and Public Utilities Fortnightly tells the story of these heroes of our industry, and rightly pays them tribute for their dedication, talent, and sacrifice.

Our industry is proud to be leading the transformation of energy. Even more than investments and technologies, our companies' workforce is at the center of this transformation. Thanks to our workers, we are able to fulfill our commitment to deliver America's resilient clean energy to the customers and communities we proudly serve.

—Tom Kuhn, President
Edison Electric Institute

Heroes of the Storms is an inspiring new book that celebrates the men and women who restore and reinforce our electric systems. In addition to showcasing many of the individuals and organizations whose hard work and dedication are essential to keeping the lights on, authors Steven Mitnick and Rachel Moore explore the many ways investor-owned, public power and cooperative utilities are deploying more durable systems and investing for a future when outages will no longer be tolerated. Dentons is honored to celebrate the heroism of responders and the companies investing in the future of our critical infrastructure.

—Clinton A. Vince, Chair, Energy
Dentons

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Thank you all for your invaluable contributions to this book. We could never have done it without you.

Foreword

When the storms come, and our electricity shuts off, it sometimes seems like a perfectly normal progression. What can you do? Nature's fury takes on the constructions of man. Guess who wins that match.

It all starts with a path of destruction. After a while, once the winds die down, the devastation is apparent. Now anybody can see that the power isn't coming back anytime soon. It is then when we recalculate things. How are we actually going to get through this, however long this is?

That's when our heroes of the storms show up, from around here, and from around the state. From several states over, they come. With their gear and trucks, they come. They form up, much like an army. They come here, from their hometowns to ours, to reassemble what's been so thoroughly dissembled by the weather's tantrum. They come, so we can plug back into our lives.

The electric utility industry is a great one for several reasons. But one of the best reasons is this – the dedication, the courage, the sheer persistence of the heroes of storm recovery. This book is for all of us, but for them especially.

There is so much to tell. These are the chapters that are rarely written, and the stories rarely told. Recounted here are the sacrifices of the heroes' families left behind to cope alone, and the essential efforts behind the scenes to ensure the heroes are safe, well-fed, and have a clean bed for a precious few hours.

There is more. There are years of planning and drills, so that when the battle is joined, the crews work as if they were choreographed for the stage. There are additionally the engineers constantly innovating, honing the equipment and processes, to cut five-day outages down to four days, down to three days, down to, well…

Then there are the utilities themselves, stretching to harden the systems we all so depend on, make long outages shorter, and make outages of any duration, ultimately, a scarce occurrence – rather than the norm after the fiercest of storms, fires, and floods.

It will be an arduous quest to zero outages, now hastened by ever growing concerns about a changing and ever more challenging climate. A noble quest it is – one replete with heroes.

Introduction

For as long as we have had electricity, for a hundred and forty years, this much has been true. Like the air we breathe, we're completely dependent on it. At the same time, we're curiously complacent about this reliance and implicitly our vulnerability.

You could say we're more oblivious than complacent. You could say we're taking for granted that this invisible force animating our world, electricity, will absolutely always be there for us. Nowadays we might say that this delicate confidence is seldom "on our radar screen."

That is, right up until the instant of time when that force of ours is wrested away. That complacency then vanishes without a trace, as if it was never there.

It takes but a moment for our consciousness to turn on, about how reliant we are on the constancy of electricity. It's somewhat like switching on bright lights in a dark room.

This happens when the havoc wreaked by a fierce storm tears apart electricity's wiring – when the force that's always there isn't. It's then that we remember electricity's essentialness and rue its loss.

Look, everyone will say if asked that electricity is indispensable. But the topic rarely comes up, excepting those times when the power goes down. The topic then trends to number one.

Whenever the supply of electricity is interrupted, how do we react? Many of us become practically apoplectic. Only then do we think about how truly disabling is the deadening of our machines, appliances, and devices.

One moment it is like we're daydreaming during a pleasant ocean swim. There is the warmth of the sun above, and the contrasting cool of the water below. We're dreaming about what we'll do later perhaps or tomorrow. Then, in the very next moment, we're swept up by an undertow. We are now single-mindedly searching for the surface and for a breath of air.

It is said that we are highly adaptable creatures of nature. That's generally the case. If you're old enough, you'll recall when we couldn't easily fill er' up, when gas was in short supply during the shocks of the seventies. Tempers flared, for sure. But most adjusted their routines quite effortlessly until the flow of gas reverted to normal.

But what about when electricity becomes unavailable for a week or more from a storm's destruction? How do we adjust to those circumstances? We handle it not all that well. On the first day of powerlessness, most of us are stunned as the pace of our lives comes to a screeching halt. That second day, it's like, where the heck is the power company? As for the third and fourth and fifth days, our moods bounce up and down between desperation and downright anger.

There are no easy analogues. Losing access to cell phone service from some technical glitch in provider networks drives people temporarily insane too, though telecom outages have been very few and very far between, particularly an outage of a long enough duration that blows past inconvenient all the way to disruptive.

Take a look at the other societal services that rival electricity in their essentiality, such as water, natural gas, health care, public safety, and transportation. They tend to be there pretty much whenever we have wanted them. Even the largest-scale natural disasters – superstorms in the gulf and along the east coast, or wildfires in the west – don't typically sideline these services for very long. Electricity, however, is different.

In comparison to the other most critical services, electricity is admittedly relatively fragile. Our exceptional dependance on electricity together with its vulnerability is a repeated theme in dystopian films. Alien invaders, with the advantage of their advanced intelligence of course, know to take out our electricity first.

It's this peculiar combination of electricity's characteristics, and how we think about electricity, and how we don't think about it, that makes it unique. Consider the celebration and adulation that surrounds the restoration of electric service. The courageous linemen climbing poles in our neighborhoods, restringing our connections to the larger grid, become instant heroes for a time.

Alas, soon they too are forgotten, as is the way with electricity's value, as are all those other heroes behind the scenes who labor throughout the year to lessen the likelihood that restorations of electric service will be required. As well as to lessen their ramifications when restorations are required – notwithstanding the ferocity of the attacks on power lines by nature and man.

The chapters that make up this book's core are about the heroes. They are those who, in the past, have kept electricity available almost always, even after the storms, when electricity became unavailable for a time. They are those who are doing this in the present, and those who are coming into the industry's ranks and will do this in the future.

The chapters surrounding the book's core are about what the heroics of those heroes mean to our communities. These address three questions: what the value of electricity really is, how that value is transforming before our eyes, and what that value will be and will mean in the decades ahead.

There have been, are, and will be many heroes for us to discuss herein – a sizable number you should expect. Indeed, that number is even now growing into the future, as we increasingly rely on electricity that is not subject to interruption hardly at all, and ultimately, not at all.

CHAPTER 1

Values of Electricity

From the earliest days of the electricity industry, of course there were storms. Hurricanes battered the southeast and Gulf coasts. Snowstorms slammed the Great Lakes states and the northeast. Tornados terrorized the midwest. River communities along the Mississippi and elsewhere were ravaged by floods.

No matter how devastating these storms were, however, their upending of local electric systems was typically not much more than an afterthought in those days. Contemporaneous reports, while detailing the catastrophic effects on buildings and people, oftentimes neglected entirely the impact on poles and power.

Why was this? Well, in the last two decades of the nineteenth century and first two of the twentieth century, most homes and many businesses hadn't yet been connected to an electric system. They didn't have electric lighting, let alone any other electric machines and appliances. Storms could tear through infrastructure and private property but in doing so couldn't steal those conveniences from those not-yet-connected.

Electrification accelerated in the twentieth century's third decade, during the roaring twenties. Though rural America was largely left out of the picture until well into the thirties and forties.

This really mattered since no more than half the population lived in cities of any size, or in the larger towns, prior to the second world war.

When a tornado came through, taking down power lines (if there were any situated in the tornado's path), chances are that not many homes and businesses would suffer an interruption in electric service.

Even for those that were interrupted, the effect on daily routines was limited. Because, for many of those families and workplaces that had been connected, their dependence on electricity extended to just lighting and a few other conveniences. In households, irons, toasters, and radios were becoming common.

Also, until the second half of the twentieth century, local electric systems were usually just that – local. Effectively electric islands, a utility's system generally had a weak interconnection to neighboring systems, for wheeling power from one system to another when economical, and little or nothing more. So, if a

system was hit by a blackout, homes and businesses served by neighboring systems were unaffected.

This was the case until the northeast blackouts made it clear that, along with the benefits of an interconnected grid, came the risk that many millions across several states could be affected by a single storm, disruptive equipment, or operator error.

Contemplating Value

Feelings About Value

Step back for a minute. What is value, whether for electricity or anything else? The answer is more complicated than you might think.

Someone might say, for example, "yes, this is a good value" – whatever "this" is. But why would they or you or I say that? In other words, what makes something a good value?

But don't answer that question just yet. Value can mean different things to different people and in different situations.

Let's first try this one on for size. Someone might say, "I do value this," as if they think highly of a particular good or service, or if they feel that way regardless of its cost.

Now let's look at another variation on the meaning of value. Someone might say, "Hey, I want value for my money." They could very well be at that classic crossroads of the consumer. To buy, or not to buy – that is the question.

There's a demand on the part of the consumer that's implicit in there as well. They expect to come away satisfied, if when coming to that fork in the road they take the branch with the big buy sign.

Now, after all this pondering about value, we're ready to return to the original question. What is it actually?

When value is thought up and brought up, oftentimes there's a direct comparison made to cost. Yes, a consumer might like a particular good or service. Its qualities – such as convenience, appearance, efficacy – suit them. But after assessing its qualities, the consumer then typically considers the fine balance between value and cost. Based on how that calculation comes out, they may conclude that they fancy the total package, or that they do not.

But wait. She or he might feel it is a good value if the purchase price is, say, ten dollars. Alternatively, they might feel it is a bad value if the price is greater, say twenty dollars.

At twenty dollars, the consumer may still go ahead with the purchase, perhaps begrudgingly. This is all too common. Consumers are resentful about many of their expenditures. Do you see a lot of smiles at the gas stations these days?

At ten dollars, rather than twenty, the consumer is more likely to proceed with the purchase. With the price being ten, they might even experience a moment or two of gratification and pat themselves on the back. They might think, "I sure got that bargain," or, coupled with a half-smile, "it was worth it."

Whether the consumer is pleased with the purchase, or peeved, can be dependent not only on the price level but on the price trajectory: Has the good or service's cost been increasing or decreasing? And, has its cost been increasing or decreasing gradually or steeply?

Price changes naturally get our attention – disproportionately we would assert. It's as if people become somewhat complacent about something's cost if they keep paying the same amount or nearly so over an extended period of time. But watch out. If the price noticeably rises, or even if it noticeably falls, our eyes bug out. This human response must be a primal instinct of our species. It works both ways. We're suckers for sales, and we scream about price hikes.

There's no doubt that the slope, a mathematical term for the rate of change, matters much. Every utility commissioner knows this fact all too well. If a utility rate increase is a couple of percent, the temperature of the public inevitably rises. Whereas, if the rate increase is several percent – and certainly whenever an increase approaches double digits – public anger can explode.

At what point does resentment among the public – which almost any significant rate increase can inspire – morph into public anger? A good predictor of where the fuse is lit is the general rate of inflation. The media regularly reports the federal government's Consumer Price Index, the CPI. The latest number gets embedded in the public mind.

A rate increase roughly in line with the latest CPI increase can raise hackles. A rate increase that considerably exceeds the latest CPI increase can provoke ever more heated responses.

Cost a Riddle, Mystery, Enigma

Did you notice how, in talking about value, our discussion here has concentrated on cost instead? That's because of a stark difference between how the public perceives value and cost.

The cost of utilities, which is determined by utility rate applications and utility commission rate orders, is tangible and easily understood by the public. Cost comes with little complication if all you see is the bottom line, in terms of cents per kilowatt hour. It can seem straightforward when the many thorough analyses of the underlying cost components are rarely, if ever, reported. Ditto as to the purpose of each in serving the public interest.

In contrast, value is complication itself. Paraphrasing what Winston Churchill once said about the Soviet Union, the value of a utility service is to most consumers a riddle wrapped in a mystery inside an enigma.

Because electric, natural gas, and water utility services are in-service virtually always. When these services are on, which again is virtually always, they're on with no discernable variability.

Indeed, the services themselves are not discernable, quite intentionally in their design. No one ever says, "Look, there's electricity in this room."

So, how would a consumer know if their electric service is lessening its vulnerability to storms and wildfires, whether their natural gas service is lowering methane emissions, or if their water service is reducing impurities? The fact is, a consumer cannot know about utility service value as they can about its cost.

It means that utility rates cases are, in the public mind, all about an additional cost that members of the public would be compelled to pay. And it means they know nearly nothing about the additional value that would be provided.

This reality automatically tilts our system for utility regulation toward lesser cost and hence lesser value. Yes, regulation has performed magnificently in the public interest for a long while, ever since the days when George M. Cohan made a sensation on Broadway with his hit song, "You're a Grand Old Flag." But …

Value is as invisible to utility consumers as cost is visible. So, utility commissioners who are able to evaluate the value and cost of a utility rate application aren't able to defend the full range of value/cost tradeoffs, in the public arena. This is a fundamental paradox of regulation.

A utility proposal may promise enormous value to consumers. But unless the cost is moderate, oftentimes the proposal may as well be dead on arrival. The same result will likely unfold unless there's something super special and

pronounced about the value that is under consideration by the commissioners, and/or unless the promised value is many times greater than the associated cost – in other words, a slam dunk.

Cost Confusions

Tens of Millions, Tens of Cents

The public becomes alarmed. Some are downright angry. Why is this so?

Look to the reports in the local media. In a dramatic tone they describe the filing of a huge application by the utility to the utility commission. Rates would rise by millions of dollars, tens of millions, or hundreds of millions. For what reason? So the utility can make more money?

What's left unsaid, or may have been said but buried within the media report, is that the utility serves hundreds of thousands of customers, or perhaps millions. All of those families and businesses would share the costs as well as the value of what the utility proposes, of what the commission is considering.

Do the math. Suppose the commission accepts the proposal in its entirety. This would be a true rarity. Anybody who works in utility regulation knows this. It's far more likely that the proposal will be halved, plus or minus, should it survive the ratemaking process at all.

That cost, however finalized, will be shared by the hundreds of thousands or millions of utility customers. So, it will be spread thinly among them. A huge cost divided by a huge number of customers equals, well, a relatively modest amount.

If the utility commission does accept the proposal, at least in part, all of the consumers will receive the resulting value, such as less of a chance of blackouts, or shorter blackouts. Now you're talking about something entirely different than what was shouted from the rafters by the reporters.

Rather than a massive burden that the utility commission was allegedly going to rubber stamp, it's a proposed value that would come with a proposed cost. Indeed, this may end up as a barely noticeable cost for most consumers, though not for those hard-pressed financially.

The Gold Plating Myth

Investor-owned utilities are in one respect the simplest of companies in our economy. They make money for their shareholders in a single way for the most part, by investing capital in utility infrastructure.

This was actually the intended result of a brilliant idea that is literally the foundation of utility regulation. It was first conceived by Samuel Insull in the eighteen nineties to spur investment in utility infrastructure. Insull's idea was finally instituted by the states starting in the year of the Panic of 1907. It is largely responsible for the remarkable development of the nation's infrastructure over the succeeding hundred fifteen years to today.

However, the potent medicine of investment-based regulation has a serious side effect. This cure has saddled us with a constant stream of controversies and litigation.

A century-plus of arguments all stem from one pesky premise. This is the assumption that utilities needlessly over-invest capital in the infrastructure beyond what is beneficial to utility consumers.

Why is that so? This gold plating takes place, it is supposed, so utilities can make more money. Since in accordance with Insull's idea, the more utilities invest, the more they earn.

The academic theory underlying this assumption is known as the Averch-Johnson Effect. A couple of economists came up with this in the nineteen sixties. You don't need to be an economist to comprehend the A-J Effect. It is not that complex. That it is relatively straightforward explains the theory's big effect on utility regulation.

Many an academic paper has been published with the assertion that utilities over-invest capital, and that commissions allow this bias in Insull's regulatory system to a considerable extent. But the A-J Effect bias cuts both ways. Many of the parties in commission proceedings believe that there's this inherent bias. As a direct consequence, utility proposals face an inherent pushback.

It is commonly said that "The utility just wants its proposed investment approved so it can make more money." We could call these arguments, which are ubiquitous in commission proceedings, the J-A Effect.

Resilience? Prove It

Rate case proceedings historically compel utilities to present ironclad proof. Proposals to invest in resilience can be and have been subjected to withering opposition. The proposed investment in the end faces a high hurdle. It must be shown that it will almost certainly have greater benefits for consumers than costs by a comfortable margin. Only then will a project or set or projects be approved and allowed to proceed.

That works very well for, say, investment in the building of a powerplant. A utility knows exactly how to provide evidence quantifying a powerplant's benefits. Ever-more precise capacity expansion, production cost and load flow models have been deployed time and time again to make the case for powerplant benefits.

The benefit-cost principle of utility regulation doesn't work nearly as well for proposed investments with highly probabilistic benefits – that is, benefits that are hardly assured in time and effect. Particularly those investments meant to address black swan events of nature, whose occurrence is fundamentally sporadic.

When will a terrible storm occur? When it does occur, where will it impact, and with what ferocity? No one can say for sure, to say the least. What can be said with certainty is this. When a terrible storm does occur, and where it does occur, the effect on consumers can be manifestly catastrophic.

Take for example an investment in the undergrounding of a particular power line, or just replacing its wood poles with steel ones, while leaving the line overhead. In either case, the goal is to make the line less prone to falling to the ground from a fierce storm or wildfire.

No one is smart enough to predict with any accuracy whatsoever if and how often a storm or fire will threaten that line in the future, let alone the impact each time. Will it take down the line, or just short of that effect? The manifold uncertainties are a real problem in utility regulation.

Projecting how a particular element of the existing infrastructure will hold up over the next several decades, if it is not hardened in specific ways, simply cannot be done – at least with anything close to complete confidence. The very best you can do is roughly estimate the probabilities of black swan events of nature, of how often, where, and what ferocity.

But probabilities aren't certainties. A utility's proposal can therefore seem subjective, speculative, and vulnerable to the opposition's charge that

the utility is naturally biased, wanting to make more investment in order to make more money.

Resilience and Safety Converging

We have been discussing investing in resilience, of the electricity system specifically. But consider for a moment the why behind all of this. That is, why exactly do we invest in resilience? Indeed, why do we care about this as much as we do?

You are probably thinking, that's an easy one. The obvious answer is, we simply want to reduce electric service outages, with whatever metric of their incidence that you care to use. The goal is, ultimately, to lessen customers' inconvenience from outages lasting minutes, hours, and days.

This is unquestionably desirable whether you're at a utility, a utility regulator, or work elsewhere in the industry. None of us want an outage of electric service.

Yet, our industry fully accepts that outages will and do take place, and occur rather frequently over the course of a year. We accept this as a painful reality. But accept it we do. Outages are going to happen from time to time, like it or not.

The industry can make the grid more resilient upfront, to lessen the occurrence and extent of outages, and it endeavors to do just that. It can improve recovery after the fact, once an outage is underway, to lessen the duration and severity of the effect on customers. Notwithstanding these meritorious efforts, given the vagaries of Mother Nature, and given the limits of how much we can spend of customer monies on resilience and recovery, outages are going to happen.

The larger question from time immemorial has been, what's the tradeoff between customers' costs and outage inconvenience? Our industry has always aimed to find the sweet spot of this tradeoff. We don't want customers to experience too many outages. But we also don't want them to feel their costs for electric service are too high. Many customers will however feel this notwithstanding how much we work at moderating their rates and bills.

The implication is, in order to keep rate and bill levels reasonable (however "reasonable" is defined), we must all tolerate a frequency and duration of outages. In other words, we'll always have some outages of some seriousness no matter what we do.

That's one tradeoff. It has governed the extent to which we invest in resilience, and thereby why we accept the electric service outages that would cost customers too much to prevent.

There's a second tradeoff that works in tandem with the first. That's the tradeoff between investment in resilience to prevent outages from occurring in the first place, and investment in recovery to lessen the impact on customers of outages once they occur.

This book celebrates the heroes of outage recovery, as well it should. Their courageous work in the roving armies of recovery crews that assemble for storms of all kinds make every outage more bearable for customers.

In a sense, we spend customer monies on some resilience, but not too much, and spend customer monies on some recovery, but again not too much. We do this so that overall customer rates and bills are restrained and so that it's fairly rare that customers are harshly harmed by region-wide long-duration outages.

Now, consider the contrast of how differently we look at investing in resilience and recovery on the one hand, and investing in safety on the other hand. The differences are like night and day.

When it comes to safety, to preventing death and injury, society spends with abandon. The restraint and tradeoffs characteristic of resilience spending are largely absent even when the amount of safety being purchased is unknown. Even when how much safety we're buying is not susceptible to quantification, we do it anyway.

It's a deeply ingrained cultural response. In our culture, we put a very high premium on the value of life. We go to great lengths consequently and make great sacrifices to protect people.

Consider the many billions spent on reducing the risks of airplane travel. Though it cannot be known how many plane crashes are prevented by a particular expenditure, there is little hesitation in, for instance, requiring flotation devices on every plane notwithstanding that the number of landings in water are miniscule (even allowing for the heroic 2009 landing in the Hudson River).

Any crash is considered unacceptable. We therefore copiously invest in plane safety, pilot safety, air traffic control safety, and airport safety. In the hard-to-imagine scenario in which we did not invest to that degree, airplane travel costs would be considerably less. Airfares would presumably be considerably less accordingly.

Everyone wishes airfares would be cheaper. But no one favors cheaper airfares if that would come with reduced safety and greater risk of deaths and injuries even though the correlation between fares and safety is unknown and unknowable.

What's the relevance of airplane travel safety, what we spend for safety from plane crashes, and what we spend on resilience of the electricity system? The two situations may seem very different. When we spend for safety from plane crashes, we're reducing the deaths and injuries from crashes. We're literally saving lives, even though we don't know how many lives are saved by this specific safety investment or that one.

But when we spend on electricity system resilience, we're not saving lives at all – or are we? That's the relevance of what we spend on airplane travel safety to what we spend on resilience in our industry. Electricity system resilience is rather rapidly becoming a matter of public safety.

Consider as one poignant example what happened when the electricity system failed from Winter Storm Uri in February of 2022. The Texas Department of State Health Services has reported that two hundred and forty-six Texans died from that terrible event. Other sources, using different analytic methods, estimated the number of deaths in the range of four hundred and twenty-six, all the way up to nine hundred and seventy-eight.

Now, many of these tragedies were unrelated to the loss of electric and natural gas utility services, but apparently many others were. Close to two-thirds of the deaths counted by the Department of State Health Services were due to hypothermia. As has been said by many commentators, notwithstanding the exact death count, each and every loss was tragic.

In this example at least, electric system resilience was indeed a matter of public safety. Just as society's investment in air travel safety saves lives, albeit an indeterminate number, so too does society's investment in electric system resilience. Investment in resilience now saves lives too.

Just as in the case of air travel, or for that matter many other sectors of the economy where we quite intentionally invest in safety, substantially, the payoff in lives saved is indeterminate. But that fact doesn't hold us back from trading the good of lower costs for the good of greater safety.

If you think about it, in the electric and natural gas utility industries, we already do this. In particular, we invest heavily in the safety of nuclear powerplants and natural gas distribution pipelines. These commitments to public safety have required little persuading in order to secure regulatory permission to proceed.

We don't know if any specific safety investment will forestall an accident at a particular nuclear plant or along a particular gas pipeline. But we sure don't want to skip over such an investment and risk finding out.

Electric utility service especially has taken on such a critical role in our lives. Its interruption in today's world, particularly a region-wide long-duration interruption, can actually threaten public safety. One result of this trend was perhaps predictable. Resilience investment has now converged with safety investment.

That's today. What about the future? Where is all of this going?

In coming decades, electricity's role will further expand. So, its interruption in tomorrow's world can be expected to threaten public safety even more extensively.

At one time, it is true, an electric service outage was considered an inevitable occurrence that caused inconveniences, like compelling customers to throw out the spoiled milk in their refrigerators. That time has passed, for good. Now and into the foreseeable future, an outage will have greater import. It will compromise public safety. It might even endanger lives. Shouldn't we then treat investment in resilience similar to the way we treat investment in safety?

CHAPTER 2

Value Trends

One of this book's authors, as was said above, was a child in the nineteen fifties, born during the second Harry Truman Administration, fourteen Presidents ago. His co-author, on the other hand, was born during the second Bill Clinton Administration in the late nineteen nineties.

During the intervening forty-five years a whole lot happened, politically, socially, culturally, technologically, economically. Including most certainly to the role of electricity in people's lives.

Accordingly, how people value electricity. How they value electricity most of the time, subconsciously, and how they value electricity during and in the aftermath of a serious storm, quite consciously.

Just look at the reaction of people when power is restored after it goes out. How they value electricity is evidenced both by their desperation during an outage and their euphoria when it ends.

Since the fifties, and since the nineties, how people react to electric service outages and restorations has changed. Our response has clearly become more visceral, which makes sense given how we have immersed ourselves more and more in an electrified environment.

Consider a typical American home of the early fifties. Electricity powered a ceiling light in most rooms, and any table and floor lamps throughout. And a modestly sized refrigerator with an even more modestly sized freezer within. And a fan, radio, record player, vacuum cleaner, washing machine, sewing machine, iron, toaster – maybe a couple more appliances as well. Increasingly it powered a black-and-white television to watch Dragnet, I Love Lucy, and Arthur Godfrey's Talent Scouts.

Now consider a typical American home of the late nineties. By then, electricity powered many more appliances. Some hadn't even existed in the early fifties. Some had, but were out of reach financially for most mid-century families.

In the home of the late nineties were, for example, one or more color televisions, computers, video games, rechargeable devices. And there were now air conditioners, very possibly central air. As well as a dishwasher, microwave oven, and clothes dryer.

Gone were the days of the laundromat or clotheslines for households across the country. A late nineties refrigerator was there too. It was far larger than its fifties predecessor, most especially the capacity of the freezer.

An early fifties blackout was an inconvenience, no doubt about it. But something must be said first, before going on further about this period seventy years ago, when the U.S. population was less than half of what it is presently.

Major blackouts as we think of them today were almost unheard of, at least those affecting hundreds of thousands or millions of Americans for periods of twelve hours or more. Prior to the extensive outages in Manhattan on August 3, 1959, darkening upper Manhattan at 3 p.m. in the middle of a sweltering summer day.

And on June 13, 1961, darkening midtown Manhattan at 5:05 p.m. amid the afternoon rush hour of another scorcher. The next day's edition of The New York Times captured the impact of the '61 blackout with these words by the great writer Gay Talese:

"Pool-players scratched in the dark; men left barbershops in a half-shaved state and otherwise fashionable women swept through Park Avenue with their hair in curlers and pink nets over their ears.

Nearly everybody in the blackout area felt the effects yesterday. The beer was warm, the butter soft, the taxis hard to get. Even a Forty-eighth Street fortune teller, Mme. Fatima, was temporarily out of business … and went outside, shouting: 'Hey, when they going to fix the lights?' forgetting momentarily her billing as a prognosticator."

Then came the historic northeast blackout of November 9, 1965. Taking out the grid for thirty million Americans and Canadians for as long as thirteen hours, after the lights first went out at 5:27 p.m., the northeast blackout shattered all the records.

The resulting Congressional investigation eventually led to the founding of the Electric Power Research Institute in 1972 by UCLA's Dean of Engineering and Applied Science, Dr. Chauncey Starr. A new era of concern for grid reliability was ushered in.

When the lights went out in the fifties, candles were handy and lit in minutes. The milk was poured down the drain once the outage extended to a couple of hours. The fan was sorely missed if it was a steamy summer day, or night. But at least the windows could be thrown open, unlike many contemporary ones.

The reader might not recall those days, and how it was when "the lights went out" seventy years ago. Only fourteen percent of the country's current population, as this book is being written, was around back then.

A late nineties blackout was much more than an inconvenience, if only because of the sheer number and range of appliances that populated a typical home. Americans had grown, in the forty-five years of 1952 to 1997, ever more dependent upon air conditioning on demand, and on the equipment formerly in the office only, but now in the home too – computers, monitors, printers, fax machines, etc.

You might not even recall those days, and how it was when the lights went out twenty-five years ago. Only seventy-two percent of the country's current population was around back then.

Let's think harder for a minute about how things have changed since and are changing still. Compare the role of electricity and the impacts of a blackout – particularly a prolonged outage – that took place in the early fifties, to one that took place in the late nineties, to one that would take place today here in the early twenty twenties. Look ahead, for that matter, to one that will take place twenty years hence, in the early twenty forties.

Which is important for us to be thinking about now. The power grid we shall have twenty years hence is the grid we must plan, engineer, finance, and construct today, or not long from today.

Many in the present day have come to expect their fancy coffees served by an electric appliance, their family's safety secured by an electric system, their floors tidied by an electric roving robot, their air customized by an electric humidifier, dehumidifier or purifier or some combination of them, and their fitness kept up by an electric treadmill, Peloton, etc.

Increasingly, cars won't be able to drive far from home if the garage's charger can't draw power. How's that supposed to work if there's a prolonged outage throughout the region? It is said that twenty years from today, most cars will be electric. This makes you think that prolonged regional outages better be as rare as baseball's unassisted triple play by then, when the early twenty forties arrive.

Ok, in case you were wondering, there have been only fifteen unassisted triple plays in all of baseball history. That certainly is rare. A Philadelphia Phillies second baseman completed the most recent one in the ninth inning of a 2009 game against the New York Mets.

Increasingly our lives are centered around our smart phones. Finding our way to a destination is often done nowadays with a phone guiding us. Baby

boomers may still be able to get through a day or two or more, fine enough, sans their screens. But that's less true for Gen Xers, less true again for Millennials, and still less true for Gen Zers.

Imagine how totally dependent on electric machines, appliances and devices shall be those born after 2010, those of Gen Alpha. They'll be as old as thirty in the early twenty forties, and they'll be almost forty percent of the U.S. population including the younger members of Gen Beta.

Get the picture? There's a clear trend going on here. Electricity, as essential as it was to us seventy years ago, was more essential twenty-five years ago, and is more essential now. It shall be even more essential twenty years hence.

If you can say that a lengthy and widespread outage in the nineteen fifties was disruptive, that such an outage in the nineteen nineties was much more difficult, and that any outage of this magnitude in the twenty twenties would be simply dreadful, then an outage in the twenty forties shall be nothing less than devastating. There is some time for us to prepare for this future, though realistically not that much.

Reliability to Resilience

Hardening Harder

We asserted above that the northeast blackout of 1965, and the subsequent Congressional investigation and founding of the Electric Power Research Institute, ushered in the era of heightened concern for grid reliability. That period could be said to have lasted nearly a half-century, up to the early twenty teens.

Then something happened. One era came to an end and another era began.

This clean break with the past wasn't quite as breathtaking as when the Visigoths sacked the eternal city of Rome for three days in the year 410. But nonetheless it was transformational for our industry.

Let us call this new period since the early twenty teens, "the era of grid resilience." And let's look at how differently we now think about the mission of the electric utilities industry.

This is quite unlike the preceding period. We'll similarly name that timeframe as, "the era of grid reliability."

The central concern for the last ten years and counting is no longer on minimizing the frequency and duration of outages. Don't get us wrong. That concern

is surely still important. The focus however has clearly shifted from the familiar triad of SAIDI, SAIFI and CAIDI stats that are most sensitive to the common minutes-long and hours-long interruptions of electric service to the uncommon interruptions that are days-long.

Maintaining a fairly high standard of reliability on so-called blue-sky days is still a thing, subject of course to a careful balancing act between maintaining reliability and the costs of doing so, and thereby customer affordability. Although now not the main thing.

Because of this. The recognition that, notwithstanding the (sometimes quite serious) inconvenience of minutes-long and hours-long interruptions, utility customers are much more disrupted and distressed by days-long events, even if these events come not more often than years apart.

So, in this new era of grid resilience, a central concern is on making the availability of electricity as uninterruptible as is feasible to the multitude of threats and attacks of nature and man. Hence, we have a now popular buzzword that has emerged over the last ten years, "hardening." That comes along with a second central concern; reducing by days the duration of those longer interruptions when they do occur.

Think of this as less focus on the all too frequent outages from squirrels chewing wires and cars hitting poles. There's in its place more focus on the far less frequent outages from the devastating damage to poles, lines, transformers and substations from wild winds, waters, snows, and fires.

Ten Years Ago

Why did this happen? Why did our industry make this dramatic change a dozen years ago – and why so decisively – to put the emphasis on resilience rather than reliability?

As often occurs in historical transformations, there was a confluence of economic and social forces. For one, there was the Barack Obama Administration's rhetoric and programs aimed at making the so-called dumb grid a smart grid.

The American Recovery and Reinvestment Act of 2009 launched unprecedented innovation and investment in the nation's transmission and distribution systems. Before the 2009 Act, it can be argued that transmission and distribution systems didn't command the greatest attention of our scientists, engineers, corporate leaders, entrepreneurs, and financial investors.

Since that point in time, let's face it, there's been a complete reversal. Some of the most creative minds and some of the most impressive technological innovations across any field or sector of the economy are in the smartening of T&D.

Another force that combined with this one to usher in the era of grid resilience in the early twenty teens was itself a prolonged outage. What Superstorm Sandy did to the northeast grid in late October of 2012 shook the utilities industry. The chaotic effects on subways, substations, and seashore infrastructure generally caused a major rethink of how "hard" to make the new equipment replacing the damaged equipment.

You might ask, what was so special about Superstorm Sandy that so dramatically changed industry thinking? After all, storms elsewhere around the country have been equally or more devastating to life, property, and the grid.

The answer may not be any more complex than the fact that Superstorm Sandy rocked the northeast. That's still the region where national media is based, and population density is highest.

It seems unfair of course that a natural disaster in the northeast moves the needle more than one in the other regions, though consider this. The northeast blackouts of 1965, 1977, 2003 and Sandy in 2012 have unquestionably precipitated the most far-reaching regulatory, political, operational, and technological developments.

There are only a few exceptions. There's California's electricity crisis of 2000-2001. Then there're the biggest of the Florida hurricanes, like Andrew in 1992, Wilma in 2005, and Irma in 2017.

Other factors combined with these to usher in the era of grid resilience in the early twenty teens. One worth mentioning is the increased push to decarbonize the economy, to slow climate change. The campaign to electrify is a natural outgrowth of the decarb push, including the electrification of transportation. From there it's easy for anyone to conclude, if we're going to electric cars, the grid better be able to supply electricity on demand anytime.

Prolonged outages are bad enough when they cripple daily activity in homes and workplaces. But they're too terrible to imagine if they cripple our ability to drive around, especially if an outage of days and days takes out a large area of the country for that duration.

Climate Consequences

Fewer Snowmen

Hurricanes, wildfires, tornadoes, floods are becoming more ferocious. Take it from one of the co-authors of this book. He has the perspective of someone who grew up in the nineteen fifties. Or take it from the climate science. The case is getting stronger by the day practically. Our weather is unquestionably warmer on average, with more extremes, more volatility, and more destructive effects.

Our co-author recalls, as do most of his age group, that there were more snowmen made in wintertime in the parks and front yards of the nineteen fifties and sixties. There were longer ski and ice-skating seasons across the nation.

The science bears this out. For instance, since 1955, the American West's mountain snowpacks have shrunk by twenty-three percent. The snowpacks could shrink further, by as much as seventy-nine percent, by this century's end.

The U.S. Department of Agriculture has found that April snowpack declined at ninety three percent of its measurement sites throughout the twelve western states. Peak snowpacks are now generally earlier in the year, and snowpack season is shorter.

Changes to our climate like less snow are presenting challenges to the electricity system. We're seeing more frequent and more ferocious wildfires in the west. More derechos are tearing through hundreds of miles of the midwest. As are flash floods too, and tornadoes. In the east, there are more snow and ice storms, and hurricanes. All of this suggests that, however we anticipated an investment in resilience and recovery would perform when implemented, their beneficial effects may now be more than we had projected.

But it also suggests that, even so, the overall risk for customers is growing. More of the public is now vulnerable to electric service outages from a riled Mother Nature. Not only more vulnerable to outages, but more frequently vulnerable to outages, and to outages that are longer in duration, and more widespread across their region.

This isn't where we want to be as the public is increasing its dependence on electricity. And this certainly is not where we want to be considering our low- and moderate-income households who, when a prolonged regional outage hits, have fewer resources and options for getting through it.

One only need look at those most impacted by Winter Storm Uri in February of 2022. They were disproportionately the LMI households of the Lone Star State.

Lines Down

It's natural for us to think of a courageous lineman when we consider our heroes of the storms. Ever since the 1934 novel "Slim" captured the nation's imagination and then the 1937 blockbuster by the same name starring Henry Fonda and Pat O'Brien, the crews that run toward restoration work have been the electric industry's strongest symbol of dedication to service.

Although the lineman is the tip of the spear to combat the destruction of storms there's a massive machine behind them that makes their work possible. This is the system the industry has developed that dispatches them, keeps them safe, hastens their work, supplies, feeds, and houses them.

Those heroes are all around us. They man the control centers. They're engineers and scientists pushing the envelope on new innovations to make the system's equipment more resilient. They're logistical geniuses making it possible for the service restoration armies to keep at their work dawn to dusk, and before dawn, and after dusk, often far from home, often in adverse working conditions.

The next three chapters of this book are all about the heroes that build and maintain electricity's value. Based on around fifty conversations with them, their experiences in their words express better than anyone else what the phrase "utility service" truly means.

Everything Keeps Going Up and Up

One of this book's authors was a child in the nineteen fifties. He can testify that the cost of living was far lower then. He recalls for instance that his parents bought a brick house at the beginning of 1959 on Brooklyn's southern shore. It came with a rental unit downstairs. They paid a total of nineteen thousand dollars.

A new car could be had for twenty-two hundred. Most families in his neighborhood though bought used. When you filled up, a gallon of gas cost a quarter. A loaf of bread was twenty cents, and a movie ticket a dollar. You did get a double feature for your money.

Prices have increased by a lot for practically everything since the mid-twentieth century. Just look at the Consumer Price Index. The CPI is the federal government's measure of inflation for all of the goods and services that Americans buy. According to the CPI, consumer prices are on average about eleven times higher than seventy years ago, when our co-author was born.

Seven decades have passed by. Still, eleven times higher is quite an increase in price levels.

You can no longer buy a tuna salad sandwich or a slice of apple pie from a small window at the Horn & Hardart Automat. But if you could, it would cost much more than the handful of nickels you were required to place into the coin slot in the fifties.

Electric utility service is not immune to this general trend in consumer prices. According to the CPI, electricity prices are about nine and a half times higher than seventy years ago. That includes the recent runup in prices precipitated by the spike in natural gas commodity markets.

If electricity was, say, a penny and a half a kilowatt-hour when our co-author was born, and it is fourteen and a quarter cent a kilowatt-hour today, then clearly power's price has gone way up – by nine and a half times to be specific.

It's nonsense though to look in isolation at the price trend of any good or service including electricity. To meaningfully evaluate a trend in prices you need to fold in the trend in the prices of other goods and services, and while you're at it, the trend in income too.

For example, Americans' median income is thirty-three times higher than seventy years ago. Prices of the things Americans purchase overall are eleven times higher. This means that Americans generally can afford to buy more stuff now than in 1952. The statistics show they do. And since the electricity Americans purchase is nine and a half times higher, they can afford to buy more power now than then, so they do.

It's not easy to explain this to the public. Increases in the price of electric service, through ratemaking decisions by commissions, are very visible to the public and can provoke outrage. But perhaps there is a way.

Suppose electricity's price increases by five percent, and that prices overall for all goods and services increase by five percent. Suppose also, that incomes increase by five percent on average.

In these circumstances, with prices of electricity and everything and incomes increasing at the same rate, it really is as if nothing has changed. Electricity's affordability, at least on average, would be the same as before.

This is like a variation of Albert Einstein's famous thought experiment which the great scientist used to explain his general theory of relativity. Imagine a car driving at sixty miles per hour on a road alongside train tracks. Then imagine you're standing in a train that's also travelling at sixty miles per hour. Looking out at that car from the train window, the car appears to be standing still.

That's the way it is when a price of something and prices of everything and incomes are increasing at the same rate. Affordability is standing still in that case. Assuming you don't raise or lower your electricity usage, electricity will remain at the same percentage of your expenditures on all goods and services, and at the same percentage of your income. Your ability to buy goods and services has been unaffected notwithstanding the rise in electricity's price.

Everything's relative, in homage to Einstein.


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CHAPTER 3

Heroic

We've given the incredible individuals we showcase in this book the title of heroes. Why is that word significant? We could easily describe them as individuals qualified simply by a variety of applicable adjectives – brave, dedicated, noble, to name just a few. And we do use those words, and many others, to describe our heroes here. But it's the heroism they display in the face of their unique experiences that makes these stories so special. Each of their inspiring stories is unique to their individual experiences, but at the same time, they are often so much the same. Someone working on a restoration project after a spontaneous wildfire in Oregon is dealing with many of the same problems as someone in Florida restoring power following a well-forecasted hurricane.

They play a variety of roles in the everyday work of restoration. That's work that gets done well in advance of the work itself. But their roles also pivot when the storm and later, the restoration, is upon them. However, some of the most inspiring points in these stories have very little to do with utilities. The human element is what makes this industry special. Even more so than electricity itself.

These are the moments where the dedication of these heroes shines. The hours logged during some sort of an emergency. When the weather is such that neither man or beast will go outside, they get a phone call and head out into some pretty extreme conditions. In conditions that often have everyone else leaving the area, they're just rolling out.

Storms in the Sunshine State

There is a huge variety of storms that challenge our systems across the country. It's an impossible task to choose where to begin. So, perhaps we should begin with the place that often comes to mind the moment we think of storms. Florida. So many of the storms that hit American soil make landfall in the Sunshine State. But the folks down there have a long and practiced history of preparedness and restoration. Because it's never a matter of if the storm comes, but rather when.

Manny Miranda has been with Florida Power & Light (FPL) for more than forty years. He's been directly involved with every hurricane restoration during

those forty years, either as an incident commander or in an operational role. Now serving as the company's Executive Vice President of Power Delivery, he carries a tremendous amount of hurricane response experience, including leading restoration efforts outside of FPL's service territory.

In 1982, Miranda joined FPL as a young engineer. With time, he worked his way up through the company's engineering ranks. By the time Hurricane Andrew struck in August of 1992, he had been serving as a superintendent of the West Dade Service Center, where he led crews. When the storm approached, he was abruptly pulled from that role to become an incident commander.

At the time, Miranda was in Hialeah, Florida just north of where Andrew ultimately made landfall. While the hurricane had been forecasted to directly impact Hialeah, its path veered south just hours before landfall, hitting the city of Homestead instead. FPL had been expecting a bad storm to affect its service territory, but not the level of devastation that the storm delivered.

The next day, Miranda was able to get in contact with the superintendent that ran the local area to learn more about the damage they were facing. The superintendent had no words to describe the obliteration. Miranda hardly believed him when he said that every pole was down. Convinced that his local counterpart was simply in shock, Miranda made his way there to survey the damage himself.

As he got closer and closer to where the eye of the storm had been, the devastation was beyond comprehension – everything was simply leveled. The radio system was destroyed, a major problem during a time where mobile phones hadn't yet become as common as they are today. Every street or building sign and landmark had been completely blown away. They had no idea where they were standing as they looked out at the wreckage.

As they recovered and restored service following the devastation, Hurricane Andrew brought many processes that had not existed previously. With every restaurant in the area out of commission, FPL secured on-site caterers to provide food for the restoration workforce on the third day of restoration. That restoration effort was also the foundation for a key piece of FPL's hurricane preparation today: staging sites. Work bases designed to house, feed, and manage the restoration workforce in the affected area. Each site was assigned to a different geographic area.

Many of the prominent concepts that we see used by utilities across the nation today came out of the restoration of Hurricane Andrew – staging sites, on-site caterers, on-site material, and on-site fueling to name a few. To this day, Miranda and the FPL team continue to refine these processes as well. FPL staging

sites, which were once nonexistent, are now widely identified for use throughout its service territory, all laid out so they can be up and running within 24 hours. It was a strategy FPL would come to employ regularly in the future.

A pivotal moment in FPL history was the 2004-05 hurricane season, where the state of Florida was hit with seven storms, four of them being major, in an eighteen-month period. It started with Hurricane Charley in August of 2004. The storm had been forecasted to go up the west coast and hit Tampa, but at the last moment, the category four hurricane took a sharp turn and made landfall in FPL's southwest territory. The restoration after Charley was a bit of a rebuild, lasting roughly thirteen days. More storms quickly followed, with Hurricanes Frances, Ivan, and Jeanne each making landfall in FPL's service territory in September.

The 2004 hurricane season was just the primer for what the FPL team saw in 2005. The season started early with Hurricane Dennis hitting in July, followed by Hurricane Katrina nearly making landfall near Aventura, Florida in August before eventually devastating New Orleans. Hurricane Rita hit in September, but it was the final storm of that eighteen-month stretch that was the real turning point.

In late October of 2005, Hurricane Wilma came along. While the storm eventually rose to category five status, Wilma hit Florida as a category three storm, causing outages for more than three million FPL customers and knocking down more than twelve thousand poles.

FPL needed eighteen days to restore service following Wilma's devastation. From an operations perspective, current Executive Vice President of Power Delivery Manny Miranda was responsible for the entire restoration during Wilma. It was still the culmination of the seven storms, though, that had taken its toll and led political leaders, regulators, and customers to become upset with the utility. Media coverage took aim at FPL, customers were tired of experiencing outages, and employees were exhausted following the lengthy restoration efforts. Under all of that pressure, FPL knew it had to change.

Miranda, FPL teams and others worked to identify solutions, leading them to establish the company's Storm Secure program. Through Storm Secure, FPL has improved its vegetation cycle, introduced a pole inspection program, begun undergrounding portions of its grid, and continued to strengthen, or harden, its grid. FPL expects to completely eliminate wood poles from its transmission system by the end of 2022, replacing them with steel or concrete poles. By the end of 2025, all of its feeder main power lines will have been placed underground or hardened to withstand winds up to one hundred forty-five miles per hour – a dramatic change for FPL's grid. Not only has Storm Secure made a huge difference

during hurricanes and the restorations that follow, but the team has also seen daily reliability improve by forty-five percent.

But let's go back a couple of years again. More than a decade after Wilma, Mother Nature had another attack in store for the state of Florida. It was early September of 2017 when Hurricane Irma began coming up from Cuba toward the continental United States. Many Floridians were hoping its path would swing out toward the Atlantic Ocean. Unfortunately for Lynne Tejeda, General Manager at Keys Energy Services, the storm hit directly in her service area in Cudjoe Key. From there, it shot almost straight north through the entire Florida peninsula. About three days before the storm was going to hit, they started evacuations throughout the entire state. This later created a panic of gas shortages. It was chaos; people couldn't get where they were going and were having issues getting the gas to do so. While it didn't affect the utility getting power back on, it made things more complicated in the aftermath when all the folks who had evacuated were trying to make their way back home. Keys Energy Services is rather isolated, about one hundred sixty-five miles southwest of greater Miami. It's one lane in, one lane out, for most of the way.

For this storm, there was quite a bit of lead up. Tejeda was having regular calls with the Emergency Operations Center (EOC) for the county. Meanwhile, the utility was filling up with their employees. Keys Energy has a policy that first responders stay and ride out storms at the utility in specific buildings that have been fortified to withstand category five storms. So, they require employees to stay, but they also allow them to bring in their families and even their pets. Because if the utility says you can't evacuate, they still want to provide for you as an employee.

As the weekend approached, Tejeda had her last EOC call very late that Friday night. The city manager had informed those on the call that the city itself had decided to evacuate. At 5:00 AM Saturday morning, they were going to caravan both the police and the fire trucks out and take them up to Homestead. To this day, that gives Tejeda goosebumps. The idea that all the city's emergency responders would leave was just incredible.

But Keys Energy had its plan in place. People were going to move into their buildings until the storm passed. Tejeda reached out to all the department directors and all the supervisors to let them know. And there was stunned silence on the call. People were suddenly scared. At that point, they were not going to hold anybody. If anyone wanted to evacuate, they could. Some employees made the

decision very late in the game to leave, but the entire line department, the line workers themselves, made the decision to stay.

Then, that weekend they lost all communications with the mainland. Everything from cell phones to email went down. And that Sunday, they also lost water, which they had never lost in all the years that Keys Energy has had storm restorations. It was different than any other storm had ever been. Just the magnitude of it. But they were able to make it through the storm itself. Surprisingly, there was no damage to speak of to any of the storm buildings they had taken shelter in. When the storm had finally subsided, Tejeda went out on the third-floor balcony and looked out at Key West to see roofs on every house.

However, as they started doing damage assessments moving further north up the Keys, it was nowhere near as good. In the northernmost area of Keys Energy's service territory, there was significant damage: lots of lines and towers down, houses knocked off their foundations, roofs torn off. Many employees who had taken shelter with the utility went home to discover severe structural damage and a lot of water damage too. It was tough for employees to manage what was happening at their homes, many relying on their spouses to take on the bulk of those projects, while they were doing the job that they were committed to doing. But they felt responsible for helping the community. Everyone was ready to take on the restoration and get the whole city back on its feet.

They brought in a helicopter to do assessments and different teams went up during the day to get a visual for planning the restoration. Tejeda was on one of those rides and seeing the total devastation in the upper part of her service territory gave her a sense of the storm's true scale. And it just so happened that the day she went up, she saw the first caravan of line trucks coming down the Keys. They had called for mutual aid, and she could now see the contractors and mutual aid workers coming down to their assistance.

Typically, mutual aid is handled through the Florida Municipal Electric Association out of Tallahassee, as the state association director matches utilities up. Keys Energy usually gets a lot of help from other utilities in the state of Florida, but Irma's path had gone straight upstate. So, there was no help coming from other Floridian utilities. But the American Public Power Association reached out to other states so that they could start bringing people in. Keys Energy also had several private contractors on standby. A very large group came all the way from Wisconsin. Then, as the cities sort of cleared themselves out, they were able to start getting additional people from within the state.

The evacuation was a real benefit to the restoration at first. In the first week, the city and state were still closed with roadblocks. People couldn't return to their homes because they still didn't have water. The city had decided that until they had water back for the hospital, which was dependent on water, it did not want to have an influx of people returning. This meant that in the first seven days, the utility workers had the island to themselves. No fighting traffic, corralling people out of work zones. They were able to get in and get work done. Some of the police and fire department personnel who hadn't left, and eventually some who came back, also helped with road clean up. Roads were impassable after the storm because of felled trees and canopy. Even though there were no people to get in their way, it was a task to clear the way for work vehicles.

For the restoration, the utility had milestones with which to track progress. First, it was the goal to get all the transmission lines fixed. Then, it was moving on to getting the backbone of distribution fixed, leading to the laterals, the smaller, secondary lines. All that was done in about two weeks, but they still had several weeks thereafter of constant calls as people made home repairs, and got weatherheads, and meter centers back up. Keys Energy was still responding to damage for some time. For several months, it was street lighting that was a priority. The recovery lasted into the holidays before things felt back to normal.

With that overview, consider now the emotions of the boots on the ground in this situation. Paul Sanchez works as a lineman for Keys Energy. His day-to-day work on the job can be fairly redundant: his crew assembles, gathers their work tickets, tailgates to discuss the work to be done and its hazards, and starts their tasks. Sometimes it's two to three different work tickets. Sometimes they'll be working on the same tickets throughout the whole week. Like any weather pattern might, it varies.

And variable weather patterns lead to some of Sanchez's more exciting work. There are a lot of emotions setting in prior to the initial moment he's called for a hurricane restoration. Keys Energy is watching the weather as storms are rising, so he is informed in a sense. When a storm impacts Key West, Paul knows he'll be weathering the storm then going straight to restoration work. But when a storm impacts another area, he's not only watching the weather, he's also waiting in anticipation of the phone call, of being put on notice that he'll be needed for mutual aid in another community. When the call does come, it's a little bit of an adrenaline rush.

Leaving his family for an indeterminate period is emotional in another way. But it's part of his job; he signed up for it. He knows the risks he is taking and the

sacrifices that he has to make as well. And everybody is onboard. Most families are onboard with it because they understand. There might be some separation anxiety at times, but they understand the ultimate goal, and that's to get everybody's lights back on. It's Sanchez' World Series, where he gets to put all his skills to the test and the stakes are high. It's what he works for. And it's exciting.

The adrenaline rush helps keep him going too. The whole team is pumped up. It's a hectic environment, and you have a lot to do. But you don't like people out of power, and you want to get power back for them and help them out as much as you can. In fact, most people Sanchez works with feel that way. Recall that the entire line department at Keys Energy made its own choice not to evacuate during Irma. The community among linemen is tight knit. You could go anywhere and all the linemen across the state and the nation share similar sentiments. So, everybody is very close. But it's also very competitive. Everybody's trying to get as many customers back on as they can. To Sanchez, that environment is encouraging, even fun. It's rewarding for him to see them get a subdivision or a good portion of the city back on. He looks back on it knowing he played a role in making that happen.

For Sanchez, Irma was different. The category five storm was almost a direct hit to Key West. Even though Keys Energy Services had been working on the storm hardening project for over a decade, improving the system and strengthening poles and hardware, Sanchez encountered a lot of damage. Even some damages at his own home. Having to deal with his own house repairs and also working to restore power for his city was hard. It was like being stuck. He was thankful that his family was safe, but he had to focus on the job at hand: getting the lights back on.

Luckily, it's a close community down there. Keys Energy provided some people to help get employees' homes secured, making repairs and adjustments to protect from further damage. So much was out of Sanchez' control and that simple aid was a substantial help to him. It's little things like that in his community that hit home. It's a good feeling to know that you have backup like that.

Irma was an eye-opener for everybody. From the very top to the very bottom. But they came together as a crew, as one cohesive unit, to tackle it. The brotherhood among his crew members and his work family at Keys Energy are some of the greatest aspects of this work for Sanchez. They're all trying to do the same thing, reach the same goals.

Since Hurricane Irma, the five-member Utility Board of the City of Key West, who is elected by the citizens from Key West to the Seven Mile Bridge in

Monroe County, asked Keys Energy to amass an emergency reserve. That way, they can better financially handle another storm like Irma. Irma's recovery cost about forty million dollars for Keys Energy. They didn't have that kind of money upfront, so they had to get a line of credit. And then it was a very, very long wait to get partial reimbursement from the Federal Emergency Management Agency.

The utility is now in the process of building up its war chest so that when another storm comes, they won't have to get a loan. The Utility Board is very supportive of intense capital improvement projects so that they are always storm hardening. During Irma, no storm-hardened poles came down. All the ones that came down were wood. They're now more aggressively replacing wood poles with ductile iron poles because the more poles replaced, the faster later recoveries will be. With an aging infrastructure on the transmission side, these improvements can do a lot to try and save time. Storms will always wreak havoc on an electrical infrastructure, but there are certainly things that we can do that make our system stronger and more resilient to hurricanes. And that's what Keys Energy does all year, working on those different capital projects to try and prepare for the next one.

And that preparation isn't unique to the Florida Keys. Like everyone else in the industry, every utility, cooperative, and support organization stays ready in Florida. This isn't even a new phenomenon. It's a strategy that's been refined over decades. A man familiar with that evolution is John Hill of Tampa Electric.

Hill has been with Tampa Electric for thirty-nine years. Starting as a line worker, he came to know what it was really like working such a crucial job. It's a twenty-four-seven job. You never know when you're going to get called to help, whether it's in your hometown or states away. But no matter who's out of power, you're ready to get it back for them. And you're dedicated to getting it done.

Although, even as the goals have not changed in his years in the industry, Hill notes that a lot has changed about the way that work gets done. The industry has always believed in safety, but the safety culture has gotten stronger and better from when Hill first started. Now, when working in a manhole, there are flare guns. They check the temperature of the cable to make sure it's stable for anybody to go down and work. We now have battery-operated spiking tools with remote control. Workers don't even always have to go down into the manhole these days. Now, when climbing poles, there are Buck squeeze belts that prevent workers from falling, so they're not solely relying on their own strength. All these innovations keep workers safer than ever before, with the added benefit of helping them to provide better and more efficient service to customers.

Today, Hill serves as Manager of Distribution Operations at Tampa Electric, managing his supervisors and line workers, and heading both a joint departmental committee and a safe work practice committee. The latter is working to rewrite and condense safe work practice texts, so the literature is more accessible.

During a local storm event, Hill becomes an incident-based leader, running the base out of the Tampa dog track. They set up tents for eating. There's a fuel truck for fueling all vehicles and security lights for trucks and material. Hill can be found in what they call FORTS (Fold-out Rigid Temporary Shelter), a closed-in building with air conditioning where he helps distribute jobs to crews during the restoration. The first priority is getting the main circuit done first, getting the feeder back up as quickly as possible. If there are laterals that they can leave in to pick up, they're left in. Their biggest concern is getting power to the hospitals, schools, fire departments, and police stations first.

Hill's most memorable storm restoration was years before that of Tejeda or Sanchez. In 1992, the aftermath of Hurricane Andrew saw Hill spend seventeen days working down in Miami on the restoration. For him, the most rewarding part of the job was seeing the smiles on people's face once they could turn their lights on again. That feeling is something that no one can ever take away from him. It's a feeling of accomplishment, of giving people their lives back.

Tornadoes Next Door

You will find that Hill's methodical approach is echoed in many of the other stories in this book. One of these is the story of Steve Kirkham. When he began his career as an engineer at Alabama Power Company, his primary responsibility after a storm was evaluating the damage and reporting back his assessments. A few years later, he gained added responsibility as a crew leader. In this role, he was not only responsible for assessing damage, but for leading crews during the restoration effort.

While every restoration effort has its own hurdles, one common goal is to remain focused on safety. Everyone leading the effort understands the challenges and hazards that are present during a major storm restoration event. Even though the conditions may be harsh, and many hazards are present in the work areas, major storm restoration work is most often performed in a very safe manner. This is due to the heightened awareness of all involved.

The most impactful storm Kirkham worked was in April of 2011. The 2011 Super Outbreak saw over one hundred seventy-five tornadoes that ravaged much of Alabama, Mississippi, and Tennessee. For Alabama, it was the second worst tornado outbreak in the state's history. The catastrophic destruction resulted in the most significant infrastructure damage that Alabama Power Company's electric grid had ever sustained.

Kirkham had moved to Mobile at the time and was serving as General Manager of Power Delivery. Danny Glover, Vice President of Distribution, requested Kirkham return to his former work location in Tuscaloosa to assist with the recovery effort. Kirkham worked in the Tuscaloosa storm center for three to four days and when he finally had a chance to drive through the city, the place he once was so familiar with was unrecognizable. He remembers how surreal it was not knowing the streets he was on due to the missing landmarks he once knew.

In addition, being just next door to the panhandle throughout his career, Kirkham has also seen the destruction caused by major hurricanes like Ivan and Katrina in the early 2000s. While he knows there are always things to be improved from an industry response, the key to a successful restoration effort is to have a robust storm plan in place that can withstand the unexpected. For example, in 2020 when Hurricane Sally hit the state, Alabama Power put together guidelines to revise storm plans based on the pandemic effort. The reality of these changes made the restoration efforts more difficult. To meet social distancing requirements, sleeper trailers were brought in to accommodate three thousand restoration workers at one staging site. However, the pandemic plan ultimately only allowed for fifteen hundred workers to be staged at this site to meet spacing requirements.

To Kirkham, making sure that your plans are dynamic and adaptable can help eliminate the unexpected and being prepared on the front end is crucial. Prior to Hurricane Sally in 2020, it had been almost a decade since a significant hurricane had made landfall in Alabama. That is why it is so important to be prepared and it is essential that every employee know and fully understand their assigned storm roles. Kirkham has led numerous storm restoration efforts and he knows that advanced planning is essential to success. Clearly communicating roles and responsibilities on the front end and ensuring that employees are prepared to competently perform their storm assignments is key.

Kirkham's Western Alabama counterpart knows this as well. After thirty-four years with Alabama Power, Harry Gabriel now works as General Manager of Power Delivery for Alabama Power's Western Division, serving Tuscaloosa and

its surrounding areas. Over the course of his career, he's seen plenty of outages, but his worst storm restoration is the same as Kirkham's.

One of the Super Outbreak tornadoes, a category four, carved through the city of Tuscaloosa. In fact, nearly a dozen tornadoes had touched down in the area, leaving destruction in their path. Gabriel helped to lead the week-long service recovery in his division.

In Tuscaloosa, Gabriel enlisted the support of Kirkham, his Alabama Power support manager at the time, and the local leadership team. The latter of which had actually been out of town for a leadership course when the storm hit. They all convened at the storm center in the basement of the division office. As the storm came through, they simply had to watch it unfold before they could take action. Everybody had to be in a safe spot to wait it out, so they watched the destruction of their city on the news in real time.

They were responding to restore electricity the moment the storm passed, first teaming up with local authorities. They had to get roads cleared and intersections opened for first responders to come and help recovery efforts. Homes were devastated, but they had to see what life was there. Second, they had to determine what kind of lights they could turn back on. How could they isolate the damage, make the area safe? All of this was aided by their corporate storm center providing logistical help and support.

The team was constantly organizing, starting with determining how many outside resources were needed. Then, they had to consider where to house this outside support, often setting up staging areas locally. During large restoration projects such as this, they've often used space at local community colleges and even parking lots outside of a Tuscaloosa mall.

In another instance, just north of Tuscaloosa into the Hamilton-Haleyville area, a tornado touched down and destroyed a local high school. Alabama Power happened to have a crew up there just as the tornado was coming through. They had to park their vehicles and take refuge in a local home's underground tornado shelter to let the storm pass. At the time, another group of employees had left to go on vacation in the Midwest. When they found out what was happening, they turned around and came back to work in the restoration.

To Gabriel, stories like this simply prove the dedication that the men and women working in his power delivery group have for the communities that they live in. Particularly in smaller areas, when these folks go to church or a ball game or the park or wherever, people know them as the power company. And so, they

have a vested interest in supporting the communities that they interact with every day of their lives.

But that commitment is constantly tested by rigorous work. For instance, this restoration was a seven-day operation. Obviously, people can't simply work nonstop for a whole week. However, they can still work sixteen-hour shifts. They had sleeper trailers for their eight-hours of off time and the National Guard even allowed them to stock a local armory with cots for additional sleeping arrangements.

The way Gabriel puts it, any restoration is like eating an elephant. You take the situation one bite at a time. Because it can be overwhelming to look at all the moving parts.

How many people do I have? Where are they? Are they being adequately supported? How many broken poles do we have? What resources do I need to send? All you can do is take things one day at a time. Gabriel's team does it by breaking down the storm areas into smaller pieces. They aim to decentralize control so that each piece can manage a storm's impact locally. Then at the end of the day, they can all regroup on what everyone was able to accomplish.

There are also partnerships formed with local contractors, city electrical inspectors, and many others. They also had regular help from local police. Many not affected by the outages traveled around town taking pictures of the damage. There's a sensationalist factor to a big storm. So, they had to bring in policemen to help block off roads, keep people out of work zones, and even escort crews through traffic.

On top of all of that, during the restoration in question, the president was coming to make a visit. While he was landing at the local airport, Gabriel and his team couldn't have any buckets in the air because of security. And the president's security team was there in advance to be sure that they had stopped their work.

Unforeseen events like that are one of the things that throw a wrench in your plans. You're shutting down work for half a day in some areas. And that time is valuable. But in each case, you improvise, adapt, and overcome those obstacles.

Boots on the Ground in the Bayou State

While Steve Kirkham saw Hurricane Katrina's damage in Florida, the state of Louisiana was feeling its wrath as well. Louisiana, like nearby Florida, is especially acquainted with just how heavy a hurricane can hit. And one of the

things the state does well as far as utilities is its network of electric cooperatives across the state.

Mike Heinen has served as General Manager for Jeff Davis Electric Cooperative since 1999. Running the general operations of the cooperative has changed drastically through the years, especially with hurricane events. He had just entered his current position when Hurricane Rita hit in 2005, destroying a great deal of Jeff Davis Electric's system. It knocked out about half of all the cooperative's transmission. At the time, Heinen and others from his cooperative were on the east side of Louisiana, helping with the recovery from Katrina, which had hit just three weeks earlier. Not only did Heinen and his crew need to return home, but they needed resources. All the people and materials were on the east side for the Katrina restoration efforts.

Heinen initiated Louisiana's statewide association to start pulling in lineman from all over the United States. They were making calls as far as Indiana, Kentucky, the Carolinas, even as far away as California, to get linemen to come help them. Not to mention, they were still desperately searching for materials. All in all, they were recuperating eighty-five million dollars' worth of damage.

Given all that, Heinen thought that was going to be his worst one. Then in 2007, he dealt with Hurricane Ike. It didn't do as much damage as Rita had, but it still damaged the transmission system. And for a small cooperative of ten thousand meters and seventy-five hundred members, it was significant. Over a hundred miles of transmission system were devastated.

Yet again, Heinen thought that he had put the worst behind him. Then in 2020, Hurricane Laura hit, with Hurricane Delta following just six weeks later along nearly the exact same path. It affected Heinen's entire service area. It knocked out his entire transmission system, including towers over the intercostal waterway.

At that point, it was time to do something different. So, Heinen petitioned for mitigation funds from the Federal Emergency Management Agency (FEMA) to rebuild a transmission system that would withstand winds up to one hundred sixty miles per hour. In fact, he's still in that process today. Today, Jeff Davis Electric is still generating electricity along the coast with generators sitting in what were previously substations, waiting to get approval to build a transmission system that goes to the coast. That's at a substantial cost, but FEMA is helping throughout the process.

As each storm comes through, resources are taken up by everyone. There were the multiple cooperatives as well as investor-owned utilities that were

devastated by Hurricanes Laura and Delta. Even when the industry itself is doing everything it can to try and get the materials that everyone needs, it's only one piece. It's also manpower. Returning to Rita as an example, Heinen used the cooperative network across the nation to get that manpower. But you also have to put that manpower somewhere. For Hurricane Laura, Heinen was running a tent city of around eight hundred linemen. Because of pandemic guidelines for social distancing, he had to prepare a tent city big enough for sixteen hundred linemen. It was a huge challenge in logistics and materials and getting everything working, but it was finally over after four months of sixteen-hour shifts.

Except, it wasn't really over. Instead of doing what Jeff Davis Electric had always done and put back a system of wooden poles, Heinen and his contractors went to FEMA and proposed they build a hardened, upgraded system that would last through the next storm. Heinen didn't want to keep rebuilding after the fact. He wanted to put a system back that would stay there.

Jeff Davis Electric is currently in the middle of trying to build that system with steel-elevated substations, along the coast. With everything in the works, it'll be probably several more years before everything gets back to whatever Heinen once called normal. But that's the process of getting things done. In that process, Heinen's heroes of the storm are really his employees; the people who work those sixteen-hour days, seven days a week, trying to get electricity back for people in the middle of summer amid harsh working conditions set before them.

To Heinen, the most rewarding thing about the work that he does is the people. While not always as General Manager, he's been working at the cooperative for over thirty-seven years. And throughout storms big and small, he gets to see the people who have come through the experience realize that they matter – and their job matters. Everybody wants to have a job helping people.

The people in this industry bring life to people, not just electricity. Heinen sees it out there when tragedy happens. The first thing we all need to rebuild our lives is electricity. And when the people at his cooperative can provide that, and they see what a difference they make in the community, it's the most rewarding part.

And speaking of rebuilding, there are others in Louisiana working on their own rebuilds. Take the South Louisiana Electric Cooperative Association (SLECA), for instance. According to its General Manager, Joe Ticheli, work is usually pretty much on automatic on a regular basis. In non-hurricane times, they have the typical things that utilities deal with, whether it's personnel or payroll issues, organization, or operation concerns. However, ever since 2021's Hurricane Ida, SLECA

is still very much in hurricane mode. Daily workloads for Ticheli and the entire SLECA employee workforce have at least doubled since the hurricane.

Ticheli has been in the electric co-op world since the mid-eighties. Although he's currently a GM, he considers himself a public relations communicator at his core. He started out at the Association of Louisiana Electric Cooperatives (ALEC), initially with little experience working hurricanes from both the statewide level and an operations point of view. Back in those days, he would send news releases out about storm restorations, and talk with reporters on progress. He didn't have a cell phone; he was sending press releases via the U.S. mail because he had no email. Everything is so much more instantaneous now than it was then.

In the aftermath of Hurricane Andrew in 1992 and other storms following, Ticheli used to come to SLECA on behalf of ALEC to bring things like bottled water and canned goods to pass out to the members there. Twenty-two years ago, he then joined the SLECA staff as Member Services Manager, still doing public outreach communications. But by that time, email and cell phones were commonplace. So, he's seen two different worlds, from what it was then to today.

Hurricane season is paramount to Ticheli's world, like it is to our whole industry. In his locale, the season is almost half of the year. Most of the serious hurricanes occur late in the summer, even though some have come as early as the day after hurricane season begins on the first of June. During the season, SLECA is always in some type of emergency preparedness mode, because by the time one hurricane season ends, there are only six more months until the next season. The emergency work plan is analyzed by the staff at the end of the season, and every May it's updated and tested in a tabletop mock hurricane drill. Lessons learned from the previous year are incorporated into plans and strategies for the coming year.

Last year, when SLECA was getting ready for that hurricane season, they were coming off of a 2020 season that had them reeling. Not only was there the pandemic to speak of, but seven tropical storms or hurricanes had made landfall in and around Louisiana that year. At least five of them were aimed right at SLECA. Some went west, others east, and still others fizzled out. Fortunately, none of them hit the co-op. So, as they went into 2021's hurricane season they had a staff meeting much earlier than normal. They all agreed at some point, their number was going to come up, and they would be hit with a major storm.

March of 2021, months before hurricane season, Ticheli and his team met with another cooperative in West Louisiana, who got hit hard back-to-back the previous year with Hurricanes Laura and Delta. They had built a tent city and

SLECA wanted to learn from them what had worked, what hadn't, and what they would have done differently if they could have. Of course, they would need tents, cots, food, showers, and laundry. But there were also many things that some of us don't even think about. For example, where will people go if they need a prescription filled? How could they provide power for things like CPAP machines that people may need to sleep with? They also got the advice to fuel at night. Because fueling can take hours when there are so many pieces of equipment and trucks coming through.

These were problems SLECA had the opportunity to get right the first time. They got to work planning how to put a tent city in their service territory. Six months later, it paid off when Hurricane Ida hit. When SLECA pulled the trigger on its emergency protocols as the storm hit, the plan was already laid out and ready. All that was left was to start making phone calls. For the first time, SLECA hired help for the restoration. A professional disaster recovery consulting group not only helped erect the tent city, get caterers and showers, but they are also helping to get Federal Emergency Management Agency reimbursements as well.

Before Ida, SLECA's most destructive and costliest storm recovery on record was for Hurricane Gustav in 2008. For Gustav, they brought in almost four hundred people to assist in the restoration. For Ida, they brought over twelve hundred. Where Hurricane Gustav cost SLECA over nine million dollars, Hurricane Ida is costing one hundred twenty-five million and growing.

Ida was challenging for the co-op for a couple of reasons, but it was most challenging because when the storm was in the Gulf, it was aimed right at SLECA. The day the storm made landfall it destroyed their on-site main office building. The afternoon of the storm, Ticheli and a group of employees who had gathered to weather the storm in the building all heard a big roar on the roof. He thought it was a tornado, though he had never been in a tornado before. He looked out the window to see bricks and roof parts falling off the building. Parts of the roof had caved in. For some time, they didn't know whether the roof had fallen on any of the employees or whether they were dead if it had. They had to do a headcount to see if everybody was still there. Thankfully, they were, and nobody was injured, but for over five hours, hurricane rain and wind swept through the building. They had to decide, did they stay in the building and risk more of the roof falling in on them, or did they run out in one hundred fifty-five mile per hour winds, and in the dark? Neither option was good. But they decided to stay in the building. If they heard the roof continue to collapse, they would run out then. They had no other choice.

Ticheli still works and lives in a SLECA trailer right now, a year later. In fact, SLECA is working out of twelve trailers because the brick-and-mortar building office was so destroyed by the storm it had to be torn down. That alone complicated the restoration process, even though they had the tent city. And it still complicates things a year after the storm, because not only was the building lost, but everything in the building. Every piece of paper, every contract, everything. Customer files were either destroyed by the storm because the roof fell in or were sent off to be digitized and are currently in cold storage. No other electric utility in Louisiana has gone through a category five storm and lost their main headquarters. SLECA is the only one and is still feeling the effects of that unique and devastating loss today.

But to Ticheli, his work is still one of the most rewarding parts of his life. In or out of the storm, it's rewarding to keep the lights on for his members. He loves helping to provide, not just a service, but the power that gives quality of life to his community. SLECA has the third lowest rates in the state, so that gives him great satisfaction. But what gives him the greatest satisfaction every morning is seeing all his employees come to work and later seeing them go home at night to their families. To him, it gets no better than that.

Midwestern Winds

Bridging our way toward the West Coast, let's now consider how the Midwest fares when it comes to storms. A hurricane is unlikely to make it that far inland, but the region isn't immune to similar winds. Brian Slocum has taken on several roles from Vice President of Engineering to Vice President of Operations, but today he's risen to Senior Vice President and Chief Operating Officer of ITC Holdings Corp., the largest independent electricity transmission company in the U.S. And with all that experience at his disposal, he had a lot to share regarding Midwestern winds.

In any situation beyond normal day-to-day operations, ITC starts off with an incident command structure. Whether it is a minor or a major storm, Slocum and team take on a whole new job whenever an incident springs up. Today, he serves on a policy team, ensuring connections between people working in the field and organizing the response all the way up to management. Meanwhile, the emergency operations center sets priorities and organizes the response to storms, and

engineers and supply chain professionals make sure that they have all the equipment and materials needed to respond.

But what does that mean in context? Take this example from recent memory. Around two years ago, a derecho hit ITC Midwest's service territory. It was like a hurricane hit the corn fields of Iowa with the sustained winds they experienced. The storm had the effect of a forty-mile-wide tornado across two hundred miles, inflicting damage across eight thousand square miles. ITC deployed close to eight hundred field workers in the restoration, and it was one of the first times in ITC's history that they made use of utility mutual assistance. It was the biggest storm response Slocum had ever encountered, and in the middle of a pandemic.

So, the incident command structure kicked in. It was first time to organize around what damage had occurred. There were many questions to answer to begin with. How did they need to respond? With whom? What resources did they need?

Where would they come from? All these questions were answered and organized by multiple arms in the command structure. ITC connected with emergency response from the state of Iowa and other utilities in the area to coordinate priorities and a timeline for their joint response.

Just eight days after the massive storm hit, ITC restored the last of the lines and circuits needed to provide service to ITC Midwest distribution customers. Thanks to the hard work of its utility crews, ITC Midwest delivered on its commitment to safely restore the transmission system.

In a hurricane zone, you can often predict where the storm may hit and when, but a bad thunderstorm in the Midwest can change to something much worse surprisingly fast. While relatively rare, these derechos are unique in that they are difficult to predict.

ITC then needs to respond to the damage. For Slocum, it sharpens the focus on being prepared. No matter what, they have to be ready. At a moment's notice, ITC leaders have to press the button on their crisis communication and put incident response plans in place.

Of course, ITC has regular drills in addition to the real-life events that occur. And after any of these experiences, they're looking at lessons learned, from what went right to how they can improve their plans going forward. Another aspect is making sure that there is enough equipment and materials ready to respond to what seems to be more frequent and more severe storms. Part of that preparation is taking a look at how ITC designs and builds its existing systems to withstand such events. Many of their structures are in the air for several decades.

Substations are there for just as long, if not longer. So, what they build today and over the next few years might have new design standards that raise the bar. Many simply call it hardening, but Slocum considers it proactively looking at what changes in design standards are necessary for the future.

A lot of ITC's infrastructure is high-voltage transmission system, already built to higher codes than most distribution set ups. However, while there are often steel poles in use, they still have wood poles in the majority of the Midwest where some lines are at the 34.5-69 kilovolt level. The bigger issue is that when their systems have an issue and there's an outage, the impact on customers can be more widespread. They need to be responsive to get the system back in place. And they need to do it in such a way that is timed with distribution utilities who are ready to take power. So, that's where a lot of the coordination comes in, making sure that priorities are set for what order the loads are getting back onto the system. Working together with them is an important part, so that as a transmission company they're not just restoring randomly.

T&D in CA

So, as far as transmission and distribution goes, it takes a lot of planning and construction to stay ready for the threats that nature presents. One familiar with what it takes to protect California from unpredictable natural disasters like wildfires is Monica Curry. Trained as an electrical engineer, Curry has worked in San Diego Gas & Electric's (SDG&E) construction and operation yards for thirty years in both transmission and distribution. Today, her role as Construction Operations Manager is to support transmission construction supervisors and line crews.

Her mornings begin with assessing resources, looking at the work to be done, and briefing crews on safety precautions before they're sent out. Then, while the crews are out working, she performs crew visits or stays at the office following up on their needs to stay in compliance with SDG&E's inspection and maintenance program and stay ready to respond to trouble. The program helps with both taking care of crew and public safety and maintaining the reliability of the system, including mitigating fire risks.

Recently, Curry had a call about a pole-top fire in downtown San Diego at one of the transit stations, impacting rail and bus services. Upon arrival, she found the area surrounded by police and fire response, and the sixty-nine-kilovolt pole-top was still burning. She was among the first responders and began

feeding information to her construction supervisor, who was en route and calling out crews. The insulator wash crew responded and ultimately put out the pole-top fire. Then, the construction crew worked through the night and into the next day to replace the pole.

That was a more recent challenge, but Curry has also worked prior restorations following the 2003 and 2007 California wildfires. The devastating blazes wiped out entire sections of transmission and distribution infrastructure. She had crews working directly on restoration of facilities in her district and had mutual aid crews coming in to assist. Her challenge then was processing damage assessment reports, tracking crew assignments, and tracking completion.

Back in those days, they did have computers, but not real-time information dashboards that multiple users could simultaneously update. The new technologies for sharing damage reports and system assessment on dashboards and geospatially are a huge help today. Whereas in the past, when crews completed their sixteen-hour day, they would bring back paperwork for Curry to then manually compile later that night. With better tools for tracking damage and resources, it's much easier to work efficiently.

Although, even as Curry has learned and adapted to new technologies and procedures, it's the construction environment itself that she's always wanted to work in. Being able to support her linemen and their supervisors has been very rewarding. She knows and shares the pride they take in their work, and she's seen them work extremely hard, continuous hours to get a job done. And to get it done well, so the lights are back on for customers and the system is safe.

Another California transmission and distribution expert is Christy Fanous, Managing Director of Transmission and Substations for Southern California Edison (SCE). In her role, she is responsible for the construction and maintenance of transmission and substation facilities to safely deliver power to the distribution grid. On a typical day, most of her energy is spent on safety, keeping SCE employees, contractors, and the community safe. Additionally, even though supply chain issues are a concern in the pandemic age, Fanous and her colleagues at SCE work together to manage infrastructure replacement programs and equipment maintenance so that they can keep the lights on.

Over the past several years, wildfire mitigation has been at the forefront of SCE's activities as well, with extreme levels of heat growing each year. Moreover, there has been a significant increase in what fuels those fires due to a lack of rain and moisture. As a Southern California native, Fanous reports that rainfall has been increasingly sparse compared to years past. Coupled with a trend in dry

winds, these factors have led to an increase in wildfire risk across all of California and into the Pacific Northwest.

For SCE, reducing wildfire risk includes hardening the electric grid, bolstering situational awareness capabilities, and enhancing operational practices. One solution to provide increased situational awareness has been the installation of new weather stations. SCE has installed over fourteen hundred weather stations on its poles throughout high fire risk areas. As an incident commander, they give Fanous real-time information about what's going on with a particular circuit. So, when she's in the Emergency Operations Center, SCE's dashboard will tell her exactly what the wind speeds are, what the humidity is, and gusts taking place. Decisions can be made based on real-time information rather than a forecast of anticipated weather patterns. Over one hundred sixty high-definition cameras have been installed to provide visual coverage across ninety percent of these high fire risk areas. These tools help Fanous and her colleagues work with local officials and mitigate the severity or extent of wildfire damage. Early warning of a fire might be just a bit of smoke. If they can get to it quickly before the winds take off, that's a big help toward fire suppression.

In addition to these tools for boosting awareness, SCE is hardening the grid and has so far installed over three thousand miles of covered conductor in high fire areas, with more to come. Many ignitions in this region are caused by objects contacting power lines. Covering those lines now reduces the risk of a spark later if a tree branch or other object blows into the lines during a high-wind event. It's an expeditious way to reduce wildfire risk in a cost-effective manner. Many of the poles in high fire risk areas are either being replaced by composite poles or being covered with fire wraps to keep them standing should a wildfire come through.

As a last resort, SCE deploys a Public Safety Power Shutoff (PSPS). While all the new practices in place have actually helped reduce the number of PSPS events over the past couple of years, it is still an important strategy for reducing wildfire risk. As SCE's meteorologists are monitoring the weather around the clock, they may see that a windstorm is coming in. They're also measuring the moisture levels in the fuel.

So, seventy-two hours in advance, SCE can notify public agencies and government officials of a potential PSPS event. At forty-eight hours, they will notify customers that their circuit may be impacted. After another notification at twenty-four hours, they are deploying a PSPS if certain thresholds are met. Meanwhile, in addition to the weather cameras watching, field crews are deployed to do live field observations and witness the circuit or pole site of an anticipated

weather event. Once the wind stops, crews are redeployed to assess damage and debris. Because before they turn power back on, they must be sure that the line is clear to re-energize safely.

But regardless of best practices and new strategies, it's nearly impossible to completely rule out fire risk. Take 2020's Creek Fire near Shaver Lake, California, for instance. What started in September and burned across over three hundred thousand acres wasn't finally contained until December. Fanous and others were working hard for those several months. When the fire first broke out, it was not on SCE's property, but SCE's forest management team worked with local agencies to identify areas of risk from a forestry perspective. They identified access roads for their foresters and the Department of Forestry and Fire Protection to use. When that fire tragically took off, several other parts of the company were involved, from distribution to transmission, information technology and telecommunications, to vegetation management and generation. Meanwhile, the COVID-19 pandemic was in full swing. Before vaccines were publicly available, keeping up with COVID-19 precautions during the mitigation efforts was quite a task.

Fires and Freezes in the Northwest

Further north you might think wildfires may not be a problem, but California's bordering state of Oregon sees its fair share of flames as well. One of the cooperatives that deals with those disasters is Consumers Power Inc. (CPI). The cooperative's President and CEO Roman Gillen had plenty of stories to share regarding wildfires in his service territory. But let's focus in on one from recent memory.

Early September of 2020, Gillen got a call from his Chief Operating Officer, Billy Terry, saying that they were in for the storm of a lifetime. There was a perfect storm forecast for Labor Day. Of course, that's the last thing a utility wants to hear, because everybody's got a three-day weekend they're meant to be looking forward to.

They spent an hour on the phone talking about what was coming up. It had been a hot, dry summer, so humidity levels were very low. But they were expecting strong east winds, gusts up to sixty miles per hour. And when east winds come into western Oregon, that is what creates a dangerous situation amongst all the dry timber. The National Weather Service had issued a red flag event across all three thousand five hundred square miles of CPI's service territory.

Gillen was most concerned about the foothills of the Cascades, the most remote part of their service territory – the Santiam Canyon and the small communities of Detroit, Idanha, and Marion Forks. At least a month before this forecasted event, another fire had broken out in the Opal Wilderness just northwest of Detroit. That fire was not yet put out, although it had been contained at five hundred acres. The plan was to let it burn until the fall rains came as it was contained and there was no access. Local agencies kept an eye on it and fortunately, there was some rain. But that fire was still smoldering. And incoming were forecasted winds to stir it up again. But they had this early warning, which they quickly passed on to customers. Be prepared for an extraordinary weather event, possible power shutoffs, and risks of wildfires!

By Sunday, there was a schedule and a storm plan. By Monday at noon, everything was in place for the storm's arrival. Substation circuit breakers for the entire system were set on a very sensitive setting called hotline tag. If there was any disturbance at all, the substation breaker would open and kill power to the entire circuit. Hundreds of people would be out of power, but it would stay off until foot patrols patrolled every span, restoring power as they went along. That was the highest amount of protection that they could provide, so it was set.

When Labor Day came, Gillen's day was fairly routine, even into the afternoon. Then that evening, the first winds really hit. Trouble on a circuit opened a breaker which killed power to the Detroit, Idanha, and Marion Forks area. Gillen was getting field reports of terrible conditions. There were heavy winds, branches everywhere, and trees starting to go down. So, they made the decision to manually open the rest of the circuits out of the two substations primarily involved, deliberately killing power.

And the winds did what was dreadfully expected. That fire just north of Detroit became several fires culminating in what became known as the Beachie Creek Fire. The wildfire ravaged over four hundred thousand acres of northwestern Oregon. Gillen received reports that the fire was moving at eighty miles per hour. To put that in perspective, if you were in a race car on a straight stretch, it would be hard to outrace that fire. But these were curvy, mountainous roads with timber everywhere.

In the Santiam Canyon, around eight hundred fifty homes were lost, and so were several lives. The devastation was incredible. Terry was allowed in five days after the outbreak to assess damages, but the fire was still burning. And when crews eventually got there, they found over a thousand poles involved. It was time to gather intelligence and find out what they were looking at. Did they

need to bring in ten truckloads of poles? How many cross arms? How much wire? More importantly, they needed that information as quickly as possible.

So, they brought in the big guns. Or, the big tech, really. They used drones or unmanned aerial vehicles to rapidly collect data, using LIDAR for very accurate distances. They were working with a vendor, a subsidiary of Intel at the time, whose artificial intelligence software took in these massive amounts of data and identified facilities, poles, cross arms, wire, insulators, transformers, and more to give Gillen and his team critical information about the damage they were up against. Within two days, they had employees doing tallies using this information to come up with accurate estimates of what was damaged and what was needed. To Gillen, it was a good investment in technology that had really paid off in this instance.

Now that they had the information they needed to proceed, the plan for the restoration was to complete the minimum needed to get the overhead system back in operation as quickly as possible. The main line of the substation feeding power to Detroit, Idanha, and Marion Forks area was damaged and the whole area was without power. So, they hauled up a sizeable generator and the crews fashioned a microgrid to feed the fire department, the water plant, and the small communities of Detroit and Idanha until they could restore central station power. Then, the focus was getting the main line on to critical infrastructure and homes that survived. Meanwhile, they also had to remove over eighty thousand hazardous trees in the area while making as many temporary repairs as possible.

The restoration lasted weeks, even with all CPI crews, contractors, and multiple mutual aid crews from neighboring cooperatives working together to get the job done. It really didn't matter where you were coming from. Everyone had the same mission. Everyone was dedicated to communication, cooperation, and commitment even during these long, terrible workdays. And the conditions really were terrible. Even at Gillen's home, two hours away from the area, they couldn't go outside because the smoke was so thick. Everything outside – cars, barbecues, pet water dishes, the patio – was covered in a blanket of ash.

These guys were right in the middle of it. Meanwhile, the fires were still burning. They had slowed from eighty miles per hour, but there were still flames licking the hillsides as crews were driving by, thick smoke choking the air. All while crews carried materials and equipment up the steep hills. While hiking up those hills, their boots were sinking three or four inches into dust and throwing up clouds as they walked. Of course, they were worried about people being able to breathe as well. They had masks, but it was just a few months after the COVID-19 outbreak, and we all remember how difficult it was to get masks early on.

But these teams had work to do. And after the disaster event was declared a few weeks after the fires began, they had added two highly skilled and experienced Federal Emergency Management Agency (FEMA) experts to help the cooperative take advantage of all available mitigation programs. The resulting FEMA-approved wildfire mitigation projects will still take several years to complete.

So, all that heat in the summer naturally means a lot of cold in the winter. But what does that look like in Oregon? And what happens when snowfall starts impacting utilities just as much as flames? To answer that question, look no further than Douglas Electric Cooperative, based in Roseburg, Oregon.

Keith Brooks serves as General Manager at the co-op, where until recently, the biggest snowstorm in the area had been in 2013. The storm caused around three hundred fifty thousand dollars' worth of damage. That was blown out of the water in 2019 when what the locals call Snowmageddon came in, ringing up about ten million dollars' worth of damage. It was the first time in the cooperative's eighty-year history that every single one of its members was out of power. It took almost a month to restore service to every single meter. It was a traumatic event for the company. It broke almost five hundred poles and left one hundred miles of wire on the ground. The problem wasn't in one area, it was across the whole system. And Douglas Electric's service territory is fairly large, measuring twenty-five hundred miles. Sometimes just getting to the site where work needed to be done was a thousand-mile trek.

The cooperative typically only has around thirty-five employees. That means everybody wears multiple hats. People were working eighteen-hour shifts for the better part of a month. If there was any spare time, every member of the management staff was making sandwiches, running food out to crews out in the field, and trying to help with logistics. Logistically, it was a real challenge, particularly because their headquarters facility was built right after World War II. It just wasn't built to accommodate that many people. And this storm restoration saw their numbers go up to almost two hundred with the amount of help they received from the industry.

Whether it was other cooperatives, public power entities, or contractors that came to help fight the storm, they were going back to hotel rooms with no power themselves. Nor did they have the advantage of taking a hot shower after working out in a very cold environment for days and days. The Douglas Electric staff were focused on the little things they could do, like taking wet wipes, toothbrushes, and deodorant out to them, because they were working such long hours. Every day, they would basically empty out the entire warehouse inventory working

the restoration. But other cooperatives sent transformers, and General Pacific, a Portland supplier, made trips down to Douglas Electric every day to restock the whole warehouse. It was all a team effort.

They managed the restoration just about the same way they do any other outage, starting at the source of the power and working their way out. They tried to prioritize places that were important, like critical facilities, 911 operations, radios, and things of the like. Even cell phones weren't working. A lot of times Brooks felt he was sending folks out into an abyss where he couldn't talk to them until they came back. But they tried to have a plan. They would have daily meetings, and they were doing constant reassessments. Brooks and his staff worked very closely with the disaster preparedness personnel in their county to help identify critical infrastructure needed to help serve communities that they knew were going to be out of power for weeks. It was a team effort to evaluate those priorities.

It was satisfying when some things started coming back, whether it was a police station, a community center, or something similar. The frustrating part with this storm was that it hit across the whole county. So, a lot of times there weren't big pickups of one thousand homes. It was two, four, maybe six at a time, if they were lucky. It was a grind throughout the whole restoration.

However, the cooperative learned a lot through the Snowmageddon restoration. Brooks considers them very fortunate actually. Because they had no safety related incidents or accidents through the whole restoration. But they learned things that they could do better. They had an after-incident review, inviting the entire company and even some of the contractors that worked to come in and evaluate. They ended up with pages of notes of what worked well and what didn't. It's information they've used going forward in other large outages.

In addition, Douglas Electric will be moving into a new headquarters facility this year. The cooperative had already sort of planned to replace its facility because it's located in a Cascadia subduction zone, earthquake territory. And the building, built in 1948, was unreinforced masonry. A structural engineer reported to Brooks that it would shake apart if an earthquake ever did hit. So, the renovation had already been planned and was already in the works, but the storm transformed some opinions about what needed to be in the new building. For instance, they realized it might be good to have shower facilities, laundry machines, locker room facilities that could accommodate a larger workforce, and extra space for putting up cots so people could sleep in a warm room after working long shifts – all things that came from lessons learned during Snowmaggeddon.

East Coast Thrills

From the West Coast and now, swinging back to the East Coast. Starting with Santee Cooper in South Carolina. Andol Johnson has been with Santee Cooper for eight and a half years. He works as an A-class line technician in Myrtle Beach, South Carolina. He can often be found up high in a bucket, doing overhead primary work. He and his crew also do underground primary work. Every day, Johnson and his crew battle the elements from the hottest of the days of the year to the coldest. Regardless of the weather, they're wearing rubber gloves, rubber sleeves, and all their Personal Protective Equipment.

It's not unbearable, but it's pretty hard to deal with. All his work clothes are fire retardant, so they're extra thick. Then he's getting inside the bucket, with those rubber sleeves coming all the way from his shoulders down to his wrist. But then he still tops that with rubber gloves from his fingertips to his elbows. It's like he's in an extra thick rain suit in the hundred-degree South Carolina heat. When it's time for his break, he's practically pouring out his gloves.

When a storm is brewing, it can add a whole other set of things to consider. Everyone is on edge when a storm is on its way, watching the news restlessly. Meanwhile, Johnson's supervisors and upper management are at the storm center finding out all the information, like when the storm should hit, wind speeds, and all the basics. All of that is later relayed to the linemen, including Johnson.

He and his crew will start stocking up, putting extra wire on trucks, and making sure all the chainsaws and pieces of equipment are oiled and fueled up. They'll double check that they have all the material they may need so that they're ready for anything. Many times, hurricanes will catalyze tornadoes, which snap poles, fling broken tree limbs, and break cross arms. Johnson and his crew need a lot of material laid out days ahead of time, so they don't get caught up waiting on parts as they work to get the power restored.

The team usually works sixteen-hour shifts for the first few days. Then, if the restoration work is still on, they break down to twelve-hour shifts with a complete twenty-four-hour rotation. Somebody is always working around the clock to finish the job. It's consistent work, nonstop to make sure that everybody gets their power back on. Because the number one job is reliability and doing it safety. Making sure everyone has lights – that's what the linemen do.

However, in 2018 during Hurricane Michael, they were stuck in the office. The linemen work in up to thirty-five mile per hour winds when they deem it's safe to do so. They have to tie their hardhats to keep them from flying off. Michael

had intense gusts kicking up nearly two million cubic yards of debris, with a downpour of rain on top of that. So, they had to wait it out, fiercely anticipating the moment they could get to work.

Where Johnson anticipates the moment he can spring into action, further north, Dominion Energy has quite a few folks anticipating anything and everything that they can. If you delve into Dominion Energy's storm restoration history, Hurricane Isabel was really its seminal storm in September 2003. 1.8 million customers were out of power, a particularly significant number considering Dominion Energy only served two million customers at the time. That number has risen to 2.7 million in Virginia and northeast North Carolina today, and Dominion Energy has adjusted its storm restoration plans accordingly. Nonetheless, Isabel was unprecedented. Dominion Energy's processes and systems weren't set up to respond to an event of that magnitude. So, out of that experience came the utility's Restoration Tenets.

Alan Bradshaw, Dominion Energy's Vice President of Strategic Partnerships, gave us his own rundown of those tenets. The first is a relentless focus on safety. To Bradshaw, and to everyone else in our industry, safety is paramount. It's not only the safety of employees doing the often-dangerous work to get the power back on, but also the public who need to stay safe during and after the storms that cause power outages.

The next tenet ties in very well to that effort. It's a commitment to informative communications. Following most storms, what you see on TV is a lot of bucket trucks and line workers climbing poles. And Bradshaw believes that Dominion Energy does that work as well as anybody else in the country. He notes, you can be the best at setting poles, at pulling wire, and replacing crossarms, but if you don't communicate what's happening and what customers should expect, your restoration is going to be deemed a failure. It's being able to communicate throughout the event that is critical to customers. Utilities must be at their best when it matters most for customers.

And then there's the third tenet: assessment. Assessing damages promptly and continuously enables you to communicate to customers when their lights are going to come back on. Then you need to be able to collect and consolidate that information, so that the utility can quickly understand what kind of damages it's dealing with. In any restoration, there's a very big difference between dealing with broken poles and dealing with wire on the ground.

But once you have all the information you need, it leads you to another tenet, planning and executing that plan effectively. A hurricane that hits in September

will usually require a week to ten days of planning ahead of impact. Putting the plan in place early helps you to be as efficient as possible in the execution.

That brings us to the final tenet: remaining flexible always. In this dynamic industry, you must expect change. That includes both the changes that come with advances in technology and those thrown at us by nature. The plan must be both flexible and scalable.

At the end of the day, Bradshaw always thinks of any restoration effort as a big bucket of work that has to be accomplished. Obviously, a lot of that work is done by line crews in the field, but really his goal year-round is minimizing the size of that bucket of work. This includes doing things like tree trimming to mitigate complications caused by vegetation debris, or things like hardening the grid, putting in bigger poles and stronger crossarms, and undergrounding lines. But how can you be the most efficient? One tool Dominion Energy has created and worked on improving for the last three years is a set of dashboards that increase its situational awareness.

During storms, Dominion Energy's system storm center, based in Richmond, Virginia, is where all the activities taking place in the utility's thirty-four local offices are being orchestrated. Therefore, it becomes extremely important to get an operating picture of what's going on in all of those areas. There are a lot of systems used to get the information needed to obtain that picture. But sometimes in the past, someone's level of experience using those systems was directly proportional to the amount of data that he or she could utilize to make decisions.

These new dashboards give Dominion Energy one version of the truth. Part of damage assessment is people out in the field looking at the affected areas firsthand. Now, they simply take their phone out and have an app for taking pictures when they assess the damage. Those pictures are coming into Dominion Energy's system storm center in real time, giving coordinators a visual of the type of damage incurred. It helps show everyone not only what the problem is, but also what resources are needed. Those taking damage assessments now have a handheld device they can use to update how many poles or crossarms are needed, and where. It's a very strong tool that allows Dominion Energy to make better, more efficient decisions. To Bradshaw, it has been a game changer for Dominion Energy.

Operating All Over

So far, we've gone over a lot of examples of regional service territories being well taken care of. We've also covered communicating and coordinating with state and municipal entities, the public, and mutual assistance partners. You can all prepare together for a storm that's hitting your locale. What happens when you're handling operations all over the continent?

Gary Smith is the Executive Vice President of Operations and Innovation at Fortis, providing corporate-wide leadership in key areas including safety, reliability, capital investment, cybersecurity, and innovation. The Fortis group of companies operate in seventeen jurisdictions throughout North America, including Arizona, New York, Michigan, and six Midwest states; Canadian provinces including Alberta, British Columbia, Newfoundland and Labrador, Ontario, and Prince Edward Island. Fortis companies are also located in the Cayman Islands, Turks and Caicos, and Belize.

As the company has grown over the years to cover this substantial geographic footprint, the way Smith and his team respond to storms has matured. Across that footprint, Fortis utilities experience a lot of different storms, with one of the most common storms being hurricanes. Smith has also seen floods and fires in British Columbia, and monsoons in Arizona. He acknowledges that as utilities are experiencing harsher and more frequent weather events, the focus for him is on taking proactive steps to prepare and safely respond.

Fortis uses an emergency response platform across every subsidiary company to coordinate storm monitoring and response. With the aid of the platform, the instant a Fortis utility identifies a significant weather event developing in its service territory, a message is sent to all executives to put people on alert. Increased efforts in monitoring weather forecasts and preparing for possible system impacts are also initiated.

Preparations often involve having employees and contract personnel on the ground, ready to mobilize. Employee passports are secured in advance and supplies are packed, including food and essentials for the first few days of the restoration. Logistics teams are activated to ensure the tools and equipment needed are ready and prepared for transport. And, as part of its proactive planning, Fortis has charter flight arrangements with both American and Canadian commercial airlines so restoration teams can get where they need to go fast. Logistics teams also ensure food and accommodations arrangements are taken care of for arrival

crews so they can stay focused on the important task at hand: safely and quickly restoring power to customers.

These activities occur three to four days prior to the storm's arrival. Preparation is key to the Fortis storm response. The objective is to get boots on the ground on day one. Once a storm passes through a Fortis utility's service territory, the priority focus is on assessing damage to infrastructure. In the past, assessments were conducted only by helicopter. Today, a variety of technologies are used, including drones and satellite imaging, to identify early signals of damage.

In 2017, Fortis activated its emergency response program after Hurricane Irma made landfall on the Turks and Caicos Islands. It was a devastating category five hurricane that significantly damaged the country's major infrastructure. FortisTCI provides electricity to most of the country and maintains over three hundred seventy miles of transmission, distribution, and service lines on the islands.

After passing through Turks and Caicos, Hurricane Irma traveled across most of the Caribbean, with Florida also in its path. But it was near impossible then to get in or out of the state. With Florida being a key transportation location for personnel and restoration materials for Turks and Caicos, Smith pivoted to sending restoration crews out of Louisiana to the islands.

Part of these restorations is having plan A, but also plans B and C, Smith explains. Once you get past day one and the damage assessment, the focus is on restoration and the long-haul response. It's all about customers, getting the job done safely, and getting the lights back on quickly.

The initial restoration time after Hurricane Irma was estimated at one hundred days. The Fortis response to Hurricane Irma was significant, and it was complicated by international logistics and an island response. And, less than sixty days after Hurricane Irma made landfall on the Turks and Caicos Islands, restoration efforts were completed safely and efficiently.

According to Smith, the key to a successful storm response is a well-structured and organized network. He believes that wherever Fortis deploys storm response crews, it's critical to coordinate with the local team. He also believes experience plays an important role. During any given storm restoration, Smith has six to ten experienced storm response veterans on the ground who look after organizing, supervising, and sharing and applying knowledge from past experiences.

Everyone who works in the utility industry contributes to providing an essential service. When communities experience a terrible storm, having reliable electricity restored safely becomes even more critical. As the lights turn on in

one home, then another and another, the hard work pays off and the team feels that instant gratification. The satisfaction of a team coming together to throw the switch and get the power back on is powerful. It truly is a team effort.

Why They Do It

Everyone working these storm restorations in our industry shows steadfast dedication, the utmost resolve to get the job done quickly and safely. So many of them are motivated by the service they are doing for their communities. But while that may be what keeps them going, there are also a variety other reasons why they came to this field as well.

Rich Walje is perhaps one of the best stories we can tell of someone coming up through the industry. His career truly illustrates the answer to the question: why do people stay in this industry? It's an even more colorful story considering how it all began. According to Walje, he wound up being a lineman by accident. He happened to be going to college, studying chemical engineering. But during that bout, he found himself needing a summer job. The father of one of his high school friends was superintendent over a line construction company, and there was a shortage of linemen for a project hand painting lattice transmission towers. Walje thought it was the coolest summer job ever.

He showed up for work on the first day and met his new boss, Smiley Johnson, so named primarily because he didn't smile. Johnson handed him a lineman's belt, a pair of coveralls that were silver with galvanox paint, and a wire brush. Walje's marching orders were to wire brush the steel on his way climbing up the tower, and when he got to the top, Johnson would send up a bucket of paint and he would paint on the way down. That was Walje's first job doing line work. He drew his first paycheck in 1973, the same year the Occupational Safety and Health Administration was created.

The other thing he was always struck by, whether working as a lineman or in his career afterward, is that the safety record was usually better in a big storm than in day-to-day work. During storm work, people weren't complacent because things were atypical. It was more important in those moments to understand what was going on and have more focused communications. Without great communications you weren't sure whether somebody working one part of a line might accidentally energize a part of the line you thought was deenergized. So, it

surprised him that he saw very few serious incidents in any of the storm work he either participated in or later observed from a management position.

Walje was really getting in at the ground level of the industry. His second job was hand-digging pole holes. But it didn't quite matter what he was doing. What he liked initially was the camaraderie, being around other young men, who liked hard work. He later warmed to the work so much that he took on an apprenticeship. The thing he liked the most about it was at the end of the day, driving back from his work site, he could see what he'd done. And then during a storm, it was incredibly satisfying to help people get their electricity back on. Even back then, power was already critical to modern society. Practically every aspect that makes our lives livable is all dependent upon electricity. And it's only gotten more important today.

In any job he ever had in the industry, Walje always felt that one of the things driving him continued to be the camaraderie he had first fallen in love with. The kind of people who did line work liked to test themselves a little bit. It's not the easiest thing in the world to climb a pole, and pole climbing classes at the time had a pretty high washout rate. It takes a lot of getting used to, looking down at your feet and seeing just two little gaffes between you and falling off the pole. He felt a little bit like a daredevil doing that work.

However, while he was enjoying the IBEW construction lineman position that he had accidentally climbed into, as time went on, he recognized that it wasn't what he had chosen as a career. So, he went back to school to pursue an electrical engineering degree, and later an MBA. He went to work for General Electric as a field engineer, installing high voltage equipment. One of the jobs he had was at Utah Power & Light installing a phase shifting transformer down in Enterprise, Utah. He was the field representative for General Electric.

During the installation, he worked with a line crew that the power company had hired. And at that point in time, he was already aware that GE was doing away with his part of their operations. He approached the engineer from the power company and asked if they were hiring. They had a freeze on hiring linemen, but Walje was an engineer. So, he found his way in and somehow still found himself working with line crews. But he liked it. When he was on a good line crew, everything was so well synchronized. He felt almost artistic; climbing the pole was like an aerial dance. If he was working with someone who he was particularly compatible with, they knew all each other's moves.

But he still knew that line work wasn't his long-term career goal. Although, his coming up from there almost seemed fated. Every time he turned around,

someone was having an early retirement or a layoff, and he was the last man standing. So, he kept moving up the corporate ladder into management. At one point at the construction and substation department four of the five managers retired simultaneously and it was all left to him.

Starting in the field gave him a unique perspective when crafting his leadership strategies. He could relate to his people in all aspects, especially in restorations when they were challenged the most. His experiences also helped him to identify people who were superior managers and knew how to restore troubled places. He knew how important it was to be calm and have your wits about you to analyze the problems and solutions in this line of work. He knew to allow enough time for crews and management to get together, to deploy equipment appropriately. And being able to select knowledgeable, experienced individuals was valuable. After a while, you know which circuits are weak and which ones are prone to more trouble than others, so that all helps get the job done. Being able to hire people with known skill sets and experience in those management and supervisory positions was helpful to him.

Moreover, his experience working from the ground up helped him keep perspective during storm restorations. By the time he was President and CEO of Rocky Mountain Power, he had seen a lot of storms across his region. He experienced rain, sleet, and snowstorms in southeastern Idaho, out in the countryside, working through the worst parts of the weather. He would use a hot stick to restore a line while there was so much rain coming down that he could feel electricity bleeding over the sticks. He worked through ice storms in western Nebraska, again out in the country a long way, with no amenities whatsoever. These were jobs working five or six days, sleeping in a line truck, feeling ready to have someone conferred sainthood if they brought him a cup of hot coffee.

When it comes to storm restoration, everything is different. It's not simply different from your daily work but is different with each storm. The work being done in the industry is changeable, and those working in it need to be equally adaptable in that kind of environment. And that's why Walje loves being a part of it, has loved being a part of it all these years, and now finds himself CEO of RAW-Energy in the Salt Lake City area. He continues to admire the linemen of the industry, for what they do, and their dedication to getting the job done in any conditions.

Working Power Lines Today

There are fleets of men, and now women too, following in Walje's footsteps today. Linemen are the front men of these restorations, our first responders. During storm restorations, once they get the power back on, they're giving back hundreds, perhaps a thousand people, the ability to turn their lights back on. For many linemen, it's all worth it just to see the appreciation on their faces. It's a very rewarding job. After all, in today's society, you must have electricity to function. It's not an option in the modern world. Hospitals, police stations, fire stations, retail stores, schools, and homes; it doesn't matter. Everything is geared with electricity.

But though it's rewarding, it's never easy. An aforementioned lineman, Andol Johnson, acknowledges that you must have a lot of confidence in yourself to do this work. But that doesn't mean it can't still be fun. It's adventurous work. To Johnson, a little adventurousness is necessary to be a good lineman. Because you're going out there, sometimes in storm conditions. The power's out and you're in the bucket. That's an adrenaline rush. Some say, you have to be just a little crazy, a little off your rocker to do this job. It requires a lot of discipline and consistency to be successful. You're doing one of the most hazardous jobs in the world. So, remaining consistent as far as safety is paramount. Any mistake can take you, the guy next to you, or the guy down the line from you out of commission.

These are parts of the job known well by every lineman, like Matt Torres of San Diego Gas & Electric (SDG&E). As a Transmission Lineman, Torres works on maintaining SDG&E's system, from fixing flashed insulators and broken cross arms to regular maintenance on infrastructure around the county. When he first started as a groundman in distribution, a lot of it was wood pole hook climbing for restoration and maintenance. Due to high fire risk areas, those poles are now higher and made of steel, and the wires on them are higher strength. These days, he has been working on transmission undergrounding, undergrounding sixty-nine kilovolt splices and terminations in the substation and on cable poles out in the field.

Like everyone in the industry, Torres has seen his fair share of storm events. It's some of his most exciting work. It's all hands on deck; everybody comes in. He gets a briefing of where he's responding or patrolling and he's on the way. But there's a surprising amount of waiting between locales. Because in the case of a wildfire, he and his crewmembers have to let the fire roll through before they can

assess the damage. Even so, he's gotten to play the firefighter a few times in his career. Put up on a washer truck, he's put out pole fires all over the county and the back country. Being out in one-hundred-ten-degree heat and spraying flaming poles in real time was pretty crazy for him.

However, his most memorable restoration was in 2013, when wildfires broke out across the North County area in SDG&E's service territory. There were two pole structures off of Alga Road in La Costa Canyon. They were right in the middle of a suburban area, and the whole field behind the houses was on fire. Working jointly with the fire department, Torres and his crew replaced the two pole structures with thirty-foot cross arms, as well as insulators and everything else that was needed.

While they were doing that, the fire department had taken their trucks in, but they weren't four-wheel drive. Torres' team had to pull them out of a huge drift of ash, because they couldn't get out. The fire had created a barren wasteland. There was no traction. It's another good example of how those in our industry contribute so much to the community. The fire department gave them Subway sandwiches for their efforts. It was two in the morning, and everybody was hungry and little dehydrated, so the reward was not just kind, but needed.

Still, there are a lot of different rewarding aspects to the job for Torres such as working with the fire department, getting to engage with them and collaborate to keep the public safe, in addition to seeing the streetlights come on or people coming out to thank you because their refrigerators are back up and running. Torres has had kids bring his crew cards thanking the linemen for making repairs. He comes to work every day loving his job, being able to provide for his family, and the camaraderie and brotherhood he works with every day.

That brotherhood includes another individual from SDG&E: Shawn Hughes. Hughes is a Working Foreman for the utility in Ramona, California. He's been in his current role for four years, but he's been in this line of work since 2008. However, the work really hasn't changed that much for him. Of course, things like safety guidelines, company policies, and tools have changed – for the better. But in his day-to-day work, most of his work is pretty similar to the way it was when he started.

And a lot has happened since he's started, including the 2017 Tubbs Fire and the Mendocino Complex Fire in 2018 near Clear Lake. Hughes supported restoration efforts during both events and has also participated in mutual aid responses as well. After a large storm or other big weather event, companies put out their calls for help, trying to get everybody, anybody they can. When Hughes

comes in, it's a lot of tailgates, meetings, and executing different emergency preparedness plans. All at once, you're figuring out the scene. What's going on? Where are you needed? Literally, where is the fire? You get your job packets, head out with your team, and just start working on getting the backbone steady. The first priority is to build to where you can reenergize that area. And it's a grind day to day to day until it's done.

Additionally, working out of town with other utilities is unique in its own way. You're sleeping in trailers, working to stay in contact with your family, and learning new areas with new systems and standards. Every company has slightly different ways of doing things. You have to understand how they want things built before you start work. Then in the midst of undertaking that work, you have to simultaneously learn how to get around their terrain and use their materials. You're also working with many new people, from fire coordinators to company liaisons, to those leading and coordinating your work.

Perhaps Hughes's most challenging restoration experiences were during the 2007 California wildfires. This time was challenging, not just for him but for the whole company. He'd only been in the company four years at that point, and it was one of his earliest experiences with a big event like this. It was twenty-hour days, seven days a week, for almost a month. With limited sleep, Hughes and his team were working on rough terrain accessing poles to get power back online.

And after nearly twenty years in this trade, the most rewarding part for Hughes is still restoring power, whether it's a lightning storm, a wind event, you name it. When he knows that he's gotten the power back on for people who need it, that's the best part. People tend to dislike the power companies when the lights go out. Many don't really appreciate what happens when they flip the switch, how much work goes into making it just that easy. That makes the appreciation of the public following restorations, the people coming out to cheer or thank you for your work, extra special.

On the flip side, while it's always exciting to go out and work when there's trouble, he also sees all the destruction firsthand. There's a lot of grief to witness, and it can come to him on a delay. After the first day or two of excitement wears off, it can wear on him too. He starts to think about how many people lost everything. It's something he may not always think about until he's four, maybe five days into it, or maybe even until the whole restoration is finished. His work may be complete, and he's still wondering, why am I kind of bummed out? And then he realizes for the hundredth time the weight of the essential work he's doing.

Although it really is the trouble jobs that are the most fun in this work; Hughes still gets excited going out on jobs. It's the unknown. His everyday work is scheduled, planned. Restorations are dynamic. He has a blueprint of what the trouble is, where he gets to go, but then he's problem solving, focused on creating solutions rather than finishing a ticket.

Then there's Diane Bisesi, someone else who's intimately familiar with SDG&E transmission. For years, Bisesi worked as a transmission circuit breaker at the utility, doing maintenance in the field. She remembers lightning strikes hitting and blowing up circuit breaker bushings. The resulting faults are picked up by system relays and immediately trip the surrounding breakers.

The whole orchestrated reaction causing an outage protects the more valuable and crucial equipment in SDG&E's substations. Most of the breakers are filled with sulfur hexafluoride gas to snuff out the arc if they trip open. When the equipment sustains trauma from something like a lightning strike, the gas medium is released. If the affected breaker were to open without that medium, it would cause major explosive damage to the breaker itself and anything close to it. It was part of Bisesi's job in the maintenance program to routinely check the gas pressure switches that save the breaker, ensuring proper function during gas release.

After an earthquake on Easter Sunday of 2011, several bushings fell off of the five-hundred-kilovolt transformers out in Imperial Valley. Bisesi and everyone on her team pretty much spent the entire week functioning on about six hours of sleep per night. They had to restore the entire line in Imperial Valley, because it basically fell on the ground.

At the time, Bisesi was still relatively green, but she looks back on the incident as a learning experience. The valuable part of these incidents is that everybody learns from them. Even if you've been in the industry forever, you always learn something new with each event. The industry is changing constantly. Every year, there's something new and improved. It can be hard to keep up sometimes.

Presently, due to some injuries sustained during her career, Bisesi is learning new things as a Substation Electrician, maintaining and testing all the batteries on SDG&E's entire system. In a substation, it's a lot different than working in the field. There are more people working, but on a smaller scale of equipment. Regardless, the camaraderie is similar, and there's a good bit of bonding while everyone is working to get the service restored. And the linemen still sometimes work hand-in-hand with her and others at the substation. More recently, the substation was switching for the line crew. They were hanging static line out in

Imperial Valley, all night long for three or four nights in a row. So, the substation folks did all their switching and grounding for them so they could go up and do their work.

But Bisesi's passion will always be transmission circuit breakers. It was awesome to go out to a trouble job where someone couldn't get a breaker to close and to be able to troubleshoot it successfully. But also, because she often works alone now, she does miss the camaraderie. When you get a crew working together for a while it's almost like everyone knows what everyone else is thinking. That solidarity is incredibly fulfilling, and something she misses.

Getting into Management

Like Rich Walje, many in the industry start with something like line work. It's a good foothold to start your journey. Finding yourself in a leadership role can be either a professional goal or destiny. However, it's a substantial responsibility with its own trials in either case.

Tony Faison has been with Tampa Electric for thirty-two years. For the last two years, he has served as Manager of Distribution Operations, focusing on the utility's western service area. Prior to that, he was a Lead Line Supervisor for over a decade. And before that, he was a Distribution System Operator for three years. And even before that, he was a lineman for eight years. So clearly, he's been around for a bit.

The worst storm he was involved with was Hurricane Andrew back in 1990, a category five storm that made landfall in Florida after ripping through the Bahamas. Faison was only an apprentice at the time. When crews from Tampa Electric arrived in Miami, the local utility had them staged at a horse track. It was a scene to behold. There were boats abandoned in the middle of the road and bodies of horses who hadn't gotten to shelter in time. So many houses were left with just a frame or simply leveled.

Homestead looked like someone had dropped a nuclear bomb. Faison couldn't recognize his surroundings for miles. As a young apprentice, it was the most devastating thing he had ever seen. No storms Faison has gone to since have been as bad. But that was his introduction to storm restoration, and while it was horrible, it didn't scare him away from the industry.

While they were there restoring power, he got to see how grateful the locals were. When the lights turned on, he could hear the whole neighborhood

screaming. They came out into the streets dancing. Later, when the host utility was pulling Faison and his crew out of a section of town to send them elsewhere, the locals in the area blocked the road so they wouldn't leave. So, the host utility let them stay and finish the restoration there. The locals wanted Faison's crew to stay and see it through because of all the good work they were doing.

In the time since that restoration, Faison has seen quite a bit of change in the industry. He's seen substantial changes in just the equipment used to get the job done. When he first started, if he had an easement job, like a job in the back of someone's home, he would have to work manually with a hoist and winches. Now, they have easement machines with buckets on them. There are also augers for digging holes to set poles. They are a lot more efficient and a lot less taxing on the body. And many other formerly manual tools have been replaced by their battery-operated counterparts. It's been a lot of changes for the better, not only for line workers but also for customers, because these improvements have improved outage durations.

However, in Florida, it's uniquely challenging due to the weather. During nearly three quarters of the year, you can expect thunderstorms and lightning pretty much every afternoon. Then there are the much more complicated and often more dangerous tropical storms and hurricanes that come through. Faison and his crews are essentially constantly working overtime. They're working on weekends and nights, busy keeping the lights on.

And it's managing is largely the same in a different locale, even with different disasters to consider. Debi Wilson, for instance, is General Manager at Lane Electric Cooperative, serving ten thousand members across Western Oregon. She started at Lane Electric almost twenty-four years ago. So, she's certainly no stranger to storms today. Her cooperative has been experiencing large-scale weather events almost every other year. It seems sometimes that her team is always in a state of storm recovery.

As a result, she's always working with them on mitigation efforts as well. In fact, about fifty-three percent of Lane Electric's distribution system is underground, which is somewhat unusual for a rural electric cooperative. But you don't get to that statistic overnight. This has been a project underway over decades. The cooperative's commitment to reliability and resiliency strengthens Wilson's commitment to keep going with it.

But there are still challenges. In the beautiful forests of Pacific Northwest, when it comes to bad weather mixing trees and power lines, there tend to be problems. Whether it's wind, snow, or ice, the weather is constantly impacting

the power lines. The more undergrounding they can manage, the greater reduction there is in future recovery costs. But it also keeps the lights on in those areas more reliably.

However, recently, Wilson has been focused on mitigation in areas of her service territory prone to wildfires, whatever the cause may be. Labor Day of 2020, her area was experiencing unusually high winds from the east, notably unusual because the winds usually come from the North, or the ocean side, the West. It was a hot day, with high temperatures and low humidity to boot. Not to mention they were in the middle of a drought. There were dry, dead, and dying trees everywhere, providing plenty of fuel for a fire to feed on. And unfortunately, a wildfire sparked just outside the city of Blue River, taking off with the wind. Wilson's members lost about four hundred homes and businesses to the fire's devastating path.

In addition to those areas that burned, there were also areas affected only by the high winds. This added to the area that needed rebuilding. There was a waiting period needed before restorations could even begin. Winds had to die down, but so did the fire. Wilson and her team had to wait for firefighters and others to make it safe for workers to come in.

Meanwhile, since Lane Electric gets its power from the Bonneville Power Administration, and their transmission system was also destroyed by the fire, it presented another challenge. Wilson's team was able to get a diesel generator up to their substation to provide a power source for getting electricity to the nearby homes.

Lane Electric's service territory is also fortunate to include many rivers and dams, and many of those dams have electric generating capacity. The U.S. Army Corp of Engineers sprang into action, getting electric generating equipment at the Cougar Dam up and running. They were then able to replace the diesel generator with hydropower until the Bonneville Power Administration could rebuild their transmission system. That was supremely helpful, because then they also didn't have to worry about potential mechanical issues with the diesel generator. Instead, they could have good, reliable hydropower available to provide electricity to members. Even with mutual aid, it took Lane Electric over a month to rebuild the system and get the last member's power back on. Happily, they were able to restore everyone that needed power by Thanksgiving Day.

But for Wilson, the most amazing part of these restorations isn't even getting the lights back on. It's the amazing dedication of those who work to do it. The members of her team work long hours, away from their families. But they love

what they do. They love to see the lights come on. It's inspiring how tirelessly they work. It's part of what keeps her going, seeing that dedication. But more importantly perhaps, what keeps her going is serving the members. That's why she loves her job. She likes being able to make a difference, helping to improve her community. Because having reliable electricity is always going to help improve communities. It isn't just about electricity. It's also about caring for the communities. It's about providing the essential service that allows her members to work toward what they need or want in their everyday lives.

Keith Hull, Vice President of Distribution Operations for Oncor Electric Delivery has also witnessed this dedication from his teams. Over his forty-year career, he has led several different groups across the company and is no stranger to storm recovery. He experienced his first storm restoration event in his early twenties in Dallas-Fort Worth. Wind speeds reached a hundred miles per hour. He was handling a lot of different things as they kept the lights on as best as they could. The experience was a good learning start; a bit of a trial by storm, if you will. He later moved around with the company, to West Texas, where he grew up in Midland-Odessa, another good location for gathering experience with a lot of different types of storms. However, some of Hull's hardest storms have been relatively recent.

There was the North Texas Winter Storm December of 2013, where freezing rain, sleet, and snow encased most of North and Central Texas. Sleet and ice measured as deep as five inches in some areas. It impacted nearly half of Oncor's service area. Winter storms create not one, but two restoration opportunities. There is responding to power outages caused by the initial storm, and then repeating some of those restoration efforts when frozen limbs begin to thaw and spring back into electric equipment once again.

It was extensive work and speed was an issue. Of course, workers were freezing, even in coveralls and all their equipment. And the equipment that keeps workers safe can also make it difficult to get their work done quickly.

Just think of wearing rubber sleeves over coveralls and thermal gear while picking up a small bolt and getting it in place in icy conditions.

However, Hull says 2021's Winter Storm Uri was probably the most challenging. While the storm swept across most of North America, it hammered nearly the entire state of Texas. A short supply of generation also temporarily prevented Oncor from delivering power to customers, even as restoration efforts progressed. Once generation supply returned, workers strived to quickly get power back on for those areas hit most severely by multiple ice storms.

Although this work can be arduous, to Hull and many others it is incredibly rewarding work. The most rewarding part for him is knowing that they will persevere and succeed no matter the circumstances. In the electrical industry, it's not if we'll get the power back on, but rather when.

However, as mentioned of Wilson's crews, the people doing this work are often separated from others who need them too. Mother Nature isn't very cognizant of things like family calendars and holidays after all. Hull has worked lots of them. Father's Day was the big one he often missed. But that challenge too reminds him how amazing folks in our industry are. So many are deeply involved in this industry, but so are their families; husbands and fathers, wives and mothers, all missing holidays to help a stranger get their lights back on.

The interesting part is that's in the DNA of most people in electric utility work. They want to help somebody. Really, you have to want to go help. Because you might be there for two weeks, living in a sleeping trailer and eating a takeaway boxed lunch. You come back at night and use a portable shower. The people willing to do that are truly dedicated.

That dedication can show through in a lot of ways, one of which is time. Many in the industry have worked with utilities for decades or even their whole careers. Carlos Torres is an industry veteran, having worked at Con Edison for over thirty-two years. But he held a litany of positions right from the start after graduating college as a mechanical engineer. He's been a management intern, an engineer and operations manager for Manhattan's steam distribution system. He's worked for Manhattan's electric underground and in Westchester County's electric overhead. As Carlos held various positions within the industry he discovered a love for operations, so has worked as an incident commander for numerous emergency events. Eventually, he was asked by Con Edison's Vice President of Emergency Management if he was interested in coming to work there as a project manager. Torres accepted the position, and eighteen months later, was promoted to Director of Electric Operations Emergency Management. Then, after working as the director for eighteen months, Torres was promoted to General Manager of Construction Services, moving him back into operations.

Three years later, the Vice President of Emergency Management decided to retire, and Torres was named as his successor. He remained in this new position until 2007, when he eventually changed to the emergency preparedness and business resilience side. Torres held his new position for over ten years, and it was during this time that Superstorm Sandy struck the East Coast. During Superstorm Sandy, it was Torres' role to be the Incident Management Assist Team

member for the Incident Commander. So, he wasn't running the incident command operations, but rather he and his organization were supporting everyone in Con Edison's Corporate Emergency Response Center – their version of an Emergency Operations Center – as they implemented the company's Corporate Coastal Storm Plan (CCSP).

Following Hurricane Katrina, while he was the project manager in Emergency Management in the 2006-2007 timeframe, Torres was part of a corporate team creating and developing the CCSP. It was later exercised in 2010 when numerous modifications and improvements were made. Then the CCSP was put to the true test when it was utilized during Hurricane Irene in 2011. There were many opportunities for improvement that were identified and it was further updated. By the time Superstorm Sandy arrived, they had made numerous changes to the plan based on those experiences from the preceding two years.

In order to prepare for Superstorm Sandy, work started five days prior to the storm's arrival. The CCSP is designed to start immediately, working first in 24-hour blocks, and going down to 12-hour blocks. Once it's upon them, everyone comes in from the field to wait for the worst part to pass. (Those employees are called storm-riders.) Con Edison doesn't want anyone working outside during the storm, as safety is always the first priority. Once the storm passes and the sun appears, the real work begins, and the workers enter the field to begin repairs and assess the damage but do so in a safe and cautionary manner.

The damage was all over the place. Sandy impacted overhead lines as well as the underground transmission system, underground distribution system, steam, and gas systems. Luckily, the CCSP addresses everything. Everyone has a role in supporting the restoration before, during, and after the storm. Once the dust settled and Con Edison could see how many customers were impacted, the number was over 1.2 million.

So, Torres worked with the Con Edison incident command team, using their plan to restore power. Providing an estimated outage duration was key. They needed to set public expectations. The pre-storm prediction for outage duration was two-weeks and Con Edison came in with restoring the majority of the customers in nine-days. The only problem was that folks weren't used to having a nine-day restoration period. In New York City, residents could barely stand being out of power for two hours. Unfortunately, for many, though not all customers, they were without power for nine days. It was a shock when the company announced the estimate initially, and the customers were not pleased to hear

it. But Con Edison was already working hard to get everyone's power restored, regardless of the public's response.

The restoration was a largely successful production in the face of Superstorm Sandy's magnitude and the challenges presented by things like timing and coordinating industry collaboration. For one, Torres and the Con Edison team worked around the New York City Marathon that took up all the hotels in the area at that time. They set up staging areas to bed the over five thousand workers they were bringing in for mutual assistance. However, it was something they had to do on the fly, because they had never needed to do anything like that before.

The event taught them a lot and helped inform the creation of new plans for logistical staging site setups. One of the moments Torres is most proud of is the way he dealt with other agencies and his communications with them. He had contacts at the Federal Emergency Management Agency, New York State, the New York City Emergency Management, the fire department, and police departments. He contacted many folks in New York City, along with many others throughout his service territory.

After the Sandy restoration wrapped up, the experience inspired the electric industry with a new initiative. Torres became a part of the drafting team for the National Response Event (NRE) Framework, an effort involving many executives of the investor-owned utilities that are part of the Edison Electric Institute (EEI) family.

The framework was developed to meet new challenges like the aftermath from Superstorm Sandy, to support utilities' restoration efforts during major outages that have massive regional impacts. It's designed to provide the maximum support the industry possibly can, in situations where resource requirements are greater than what the industry has previously been equipped to handle. Fortunately, no event has yet necessitated the implementation of the plan, but it has been used in advance of other storms with potential implementation. With the support of the industry, and in order to stay in tune with the NRE Framework, EEI now hosts one tabletop and one functional exercise each year. It's a consistent drill for how we all might work together in the event of such a catastrophe.

CHAPTER 4

An Army of Aid

The story of Carlos Torres leads into another critical topic when it comes to storm restorations: mutual assistance. It's something that has developed immeasurably in the history of this industry. Steve Kirkham, who we met in chapter three, reflects that mutual assistance efforts have seen some incredible evolutions in past decades. He remembers hearing stories of the early 1940's and 1950's in Alabama, when customers would send a postcard in the mail to report an outage. Back then, customer expectations, demands, and needs were not as high. With the increased urbanization and reliance on modern technologies, it is now more critical than ever to have service restored in a timely manner. Today, the need for prompt restoration makes mutual assistance efforts imperative.

When the call comes up, everyone is quick to answer. A lot of folks in this industry are selfless. But that sacrifice is common in this line of work. Truly, it's more of a calling than a job, for some. They're missing anniversaries, birthdays, and dinners out with family when they're on call and it's time to work. No matter the time or place, crews come to work. They come from vacations, volunteer work, or even their daily roles the minute they find out there is a restoration that needs additional help. It's heartening to us all, knowing that help is just a phone call away.

We reach out to each other. We help each other during the hard times. We know the value of the product; everybody needs electricity. Then when the lights come back on, everyone knows they've helped restore something everyone needs, that's important to their everyday lives. It's that great sense of purpose and pride in what these teams do that propels them forward.

Alabama Assistance

These days at Alabama Power, they're way past sending postcards for outage reports. Storm restorations have become more and more about organization and planning, rather than repairing the odd fallen line. Chris Lucassen has been an Alabama Power company employee for his entire thirty-one-year career. Most of that time has been served in the Mobile, Alabama area. There, he started as an

engineer, spent time on the evaluation side, rode the lines out, and looked for trouble. But as far as storm restorations go, he's been in various places across the state. He spent a couple of years in the corporate office, worked in the southeast division of Alabama Power around the Montgomery area for a couple of years, then eventually came back to Mobile in 2007.

He's worn many hats since returning to Mobile. Right now, Lucassen serves as Distribution Manager, responsible for the distribution system that serves the southern half of the Mobile area. He's been in this role for about six years. But prior to this, he spent about seven years managing Alabama Power's control center, handling all the trouble dispatch for everything from a blown transformer fuse, a lightning strike, and a car hitting a pole, to a major restoration effort. He also spent three years as Distribution Support Manager where he had primary responsibility for coordinating and planning storm restoration and hurricane response for the whole division.

The storm that stands out the most to Lucassen is Hurricane Sally. The 2020 hurricane season in general was the busiest he had ever experienced. It seemed like for all of 2020, every couple of weeks they were preparing for a storm to potentially make landfall nearby or coordinating to send crews elsewhere to help. In addition, this was all happening during a pandemic that had everyone in flux.

This was the first big storm to hit Mobile since Katrina in 2005, and for many newer employees, it was their first time working a major restoration at home. While Lucassen and his team were constantly planning for those many years in between, Hurricane Sally provided the first real opportunity to test their plans and see how they worked.

With approximately one hundred fifty thousand customers in the area that he was responsible for, about two thirds of them experienced power outages during the storm. Meanwhile, a fair number of Alabama Power's folks were only just coming back from assisting with Hurricane Laura, which struck before Sally. Their storm contingency team had been working in Texas and Louisiana for nearly three weeks after Hurricane Laura. About two days after their return, Hurricane Sally struck. So, everyone was already running on very minimal rest.

While Lucassen's team didn't have any major safety incidents throughout Hurricane Sally, logistics was a big challenge. They have a new crew headquarters slated for construction over the next few years. Fortunately, the property was already purchased at the time. So, after some clearing, they basically had a site laid out for staging personnel. At that location, they eventually managed to house fifteen hundred people who were assisting with the restoration. Because of

the pandemic, it was actually set up with sleeper trailers to accommodate three thousand people in order to meet social distancing requirements.

It was a feat coordinating all the logistics of having that many people on one huge site, a site which Lucassen considered to be rather primitive as there was no power or water on it. They enlisted the help of vendors in managing logistics. Then there was just working through basic problems that he'd typically experience. A prime example was that the operating area that supported the staging site had no power. When people came in to operate computers and get everything to dispatch, their lights were out too. So, they had to scramble and get plans in place to determine how they would get folks rolling immediately.

Nevertheless, even though these restorations can be a stressful rigamarole, mutual assistance is something that we can count on in this industry. According to Lucassen, overall, the Sally restoration went very well. He spends a great deal of time planning for events like this one. Because the question isn't, will we be able to get people to help? The question is, where will we put them when they arrive?

However, when they do arrive, it's still so critical to get them organized. Then with the coordinated efforts of thousands of people, how do we manage to keep them organized with speed and efficiency – not to mention safety – in mind? Alabama Power's Scott Moore may have an answer.

Moore serves as Senior Vice President of Power Delivery at Alabama Power, managing seventy-five thousand miles of distribution lines. A lot of the system was built as many as a hundred years ago, so Moore and his team work to maintain and replace that infrastructure. It's constant work, and a considerable time commitment, but it keeps the system improving. It's part of the reason pretty much everyone across the industry is ready to help one another when restorations come along. However, across the industry, mutual assistance processes and procedures vary regionally. So, it can be complicated getting everyone on the same page when time is of the essence and people need power.

Alabama Power recently set out to improve mutual assistance response efforts with their Mutual Assistance Restoration Tool, or MART. Moore explains their main goal was to develop a tool that could streamline mutual aid response. The large contingencies of responders often needed to combat the frequent storms of the Southeast can include thousands traveling to and from other states to help during major events.

One of the key challenges in these efforts is simply managing the rosters. How many people are responding, and where? What are they assigned to do, and how do we put them to work efficiently and effectively? MART is designed to use

smartphones and computers to develop rosters more efficiently and communicate roles seamlessly. This way the host utility during recovery events isn't burdened with assigning roster management to their own personnel, who might be better utilized somewhere else.

Meanwhile, personnel helping the host utility with restoration may be unfamiliar with the local kit. Even though equipment is fairly standardized throughout the utility industry, it can still vary from state to state. As investment in the utility space and the power grid continues to mature, putting more standard equipment in place needs to be a priority. But there's still the challenge of different vendors, different providers of service, and different deployment schemes that utilities put on their systems. Things like insulators, transformers, and even wires on our grid are becoming more standardized across the country, though there remains a long way to go.

Moore hopes that MART will make a big difference in the industry and its use will spread throughout the country to create a more consistent process. Streamlining this whole process can help utilities manage the storm event overall and across entire regions, from the beginning of storm reports to end reviews with regulators.

Keeping everyone organized while they're working hard to get the lights back on can be a huge logistical hurdle, and Moore and his folks at Alabama Power are often practicing their strategies in real time. Every employee at the company has an assigned responsibility when it comes to storms. They know that when everything's broken and it's time for restoration work, they have a role to play.

Managing Mutual Aid from Florida

Rob Baker serves as the General Manager of Safety for Florida Power & Light's (FPL) power delivery organization. After being with the company for twenty-four years in a variety of roles, his current work deals with safety in power delivery, including their transmission, distribution, gas, and water teams. Baker also works hand-in-hand with the union and company management to establish safety rules and guidelines. It's a role that requires heavy collaboration, going out into the field and keeping employees accountable for following rules and working safely. He also supports his teams to be sure they have the best equipment and tools necessary to reduce injuries and continue to work safely. If incidents

do occur, he reviews injuries and conducts investigations so teams can better prevent them in the future.

When storms threaten the area, Baker serves as an incident commander, where his primary focus is safely restoring power to customers in his area of responsibility. For instance, the FPL team, led by Baker, responded by traveling to provide mutual assistance to multiple utilities that were impacted by Hurricane Michael in 2018. When the devastating Hurricane Wilma made landfall in 2005, Baker's team responded safely and as quickly as possible to restore service for customers throughout Palm Beach County.

While Baker's primary focus is keeping employees safe every day, he also plays a prominent role for FPL as they join others in the utility industry to continue to make improvements, including adapting to new safety precautions and procedures. Safety can be particularly challenging during storm restorations. Utility workers are faced with difficult field conditions, and leaders are challenged with coordinating a multi-faceted restoration effort, including managing field workers, logistics, and other resources. Meanwhile, the public is facing its own challenges following the devastation to their community. If Baker and his team are traveling to provide mutual assistance to another utility, there's additional onboarding needed to better understand how his team will safely operate on another utility's system.

Situational awareness must be heightened to identify off-normal hazardous work conditions. As Executive Director of Emergency Preparedness for Florida Power & Light (FPL), Tom Gwaltney knows this well. Gwaltney is responsible for all plans, processes, and coordination when responding to any event the company faces. This includes everything from opening the command center for a tropical storm or wildfire restoration project to coordinating responses to cyber threats. Whether the emergency is man-made or courtesy of Mother Nature, internal or external, Gwaltney helps lead FPL's response.

In this capacity, Gwaltney also works very closely with people outside of FPL. His team has strategic partnerships with other companies in the industry as well as federal, state, and local agencies and organizations. Restorations are always a team effort; no one utility can do it singlehandedly. In this industry, everyone relies on and supports each other regardless of where they're coming from or the company they work for.

When called upon, Gwaltney has also left his own service territory to help others in the industry. He spent a month and a half in Puerto Rico helping with the restoration efforts following Hurricane Maria in 2017, shortly after FPL

restored service to nearly four and half million customers following Hurricane Irma. He was part of the early stages, working with the Puerto Rico Electric Power Authority and Edison Electric Institute to bring in investor-owned utilities to support restoration.

In 2012, Gwaltney traveled to the Northeast during Superstorm Sandy, which caused tremendous vegetation damage and flooding due to storm surge. In Manhattan, water was flooding into substations. It posed an additional challenge for the restoration effort. New York City has a very complex network, a different type of system than most of FPL's. Not only was it different from most of their system, but it was also much larger than they were used to. It was a unique experience that taught them lessons they could take back to Florida. For example, that experience led FPL to add flood monitors and harden the structures to all their substations in areas that could be subject to a flood. The dual-flood monitoring system FPL now has provides another level of protection for the specialized equipment to prevent any catastrophic damage because losing a substation could mean losing part of the network for a significant period, depending on the damage.

These lessons learned and changes in preparedness helped during Hurricane Irma, which affected FPL's entire service territory in 2017, when a substation flooded with levels reaching up to four-feet high. The FPL team de-energized the substation and was able to clean, wash, and return it to normal operation within twenty-four hours.

But even so, Irma had its own unique challenges. Simultaneous logistics were required for multiple areas, as Gwaltney and the FPL team were running twenty-three staging sites at the same time. By then, he was overseeing the mutual assistance response, preparing crews, and helping develop the storm restoration plan. Although, once again, they were not alone. They brought in seven management teams from other utilities to help run these sites, something that most in the industry hadn't yet done to this extent. While that has become increasingly more common in the industry today, it was a new and substantial addition to the typical resources requested at the time.

Today, mutual assistance is essential in the industry. Gwaltney joins other utilities on mutual assistance committees twice a year. At each gathering, they share lessons learned, including those from every storm experience. They discussed what happened, what worked well, and what didn't work well. They're considering everything to implement and help the industry. For FPL, there are

always new ideas and strategies that can be brought back to their own systems so that if something similar ever happens, they are prepared to respond.

What's nice to Gwaltney is that it's not adversarial at all; everyone genuinely wants to help one another. Some utilities may be hit a little more often or a little harder than others, but no one is vying for all the resources. No one takes all the materials simply because they think that they'll be impacted the most. They share what's available. They may deal things out proportionately in some cases and work closely with available vendors, but it's very much a give-and-take approach in the industry. Behind the scenes, everyone works together.

There is perhaps no other industry where different folks are as willing to help and be so cooperative with another company. Some of Gwaltney's best friends work for other utilities, and it's incredible to him to see the relationships and friendships that he's built across the country. It's almost as though they are part of the FPL family because they're all in this together.

One part of the Florida family, however, isn't a utility. However, the impact it has on restorations is huge. The Florida Municipal Electric Association (FMEA) is a statewide trade association that represents the thirty-three public power utilities in Florida. Amy Zubaly has worked for FMEA twenty-three years, and since 2017, has served as the organization's Executive Director. In times of disaster, she is the mutual aid coordinator for all FMEA members as well as the liaison between Florida public power utilities and state and federal agencies. As the critical link between FMEA member utilities and state government, Zubaly works chiefly with Florida's state emergency operations center and division emergency management, as well as with the governor's office. During times when Florida public power is substantially impacted from a hurricane, Zubaly is also the American Public Power Association's (APPA) state liaison, providing situational awareness and updates from FMEA member utilities to the Electricity Subsector Coordinating Council, the U.S. Department of Energy, and other related federal entities.

Within the first year of Zubaly taking the helm at FMEA and stepping into her new role as mutual aid coordinator, Hurricane Irma made landfall in Florida in September 2017 causing widespread devastation throughout the state. With tropical storm force winds extending four hundred miles from the center, this category four hurricane was one of the largest storms to ever hit Florida. Irma's impacts led to one of the biggest, if not the single biggest, mutual aid event that public power had ever coordinated, and it was large-scale. By the time Irma had finished passing through Florida, nearly seven million customers – roughly

two-thirds of Florida's electric customers – were left without power, with every electric utility in the state impacted. Twenty-three of FMEA's thirty-three members used mutual aid assistance to help restore power.

The mutual aid process doesn't always wait for a storm's impact to be felt by the utilities. It begins when Zubaly receives a call from one of her members wanting to secure additional line resources. Often, though not always, this is days in advance of landfall. Zubaly assesses state emergency operations center projections and current situational impacts to determine whether needs can be met fully in-state, or whether additional resources may be needed from neighboring or other states. Once it is determined that out-of-state resources are needed, she'll set up a mutual aid call through APPA with other public power mutual aid coordinators across the country. On the national mutual aid call, Zubaly provides a Florida situation update and asks the other coordinators to determine the level of assistance they can send from their utility, region, or state. In response, the other coordinators communicate their available resources directly with Zubaly, who in turn matches up those resources with the needs of her Florida members.

In Irma's instance, FMEA had been tracking the storm as it moved across the Atlantic Ocean for almost two weeks. For Zubaly and FMEA's member utilities, it was an agonizing waiting period. Hurricane Irma had locked in on Florida relatively early on; the hurricane models were consistent with Florida getting a direct hit from a powerful storm. About a week out, several of Zubaly's members started reaching out to her, wanting to get crews lined up and reserved. Irma's path crossed the Florida Keys, and then went right up the backbone of the entire state, impacting almost everyone.

The large-scale Hurricane Irma mutual aid event Zubaly coordinated involved nearly two thousand public power line workers from approximately two hundred different utilities across North America. That assistance came from twenty-six states and Canada. Because public power is a little different from the large investor-owned utilities, it's not like Florida was getting a hundred fifty line workers from one utility. It was maybe two crews or eight people from a utility in the middle of Iowa or from small-town Alabama pooling together with other small utilities from the same state. So, to get two hundred different utilities organized through the mutual aid network coordinators was no small feat.

Following Irma, Florida public power had about eight hundred twenty-seven thousand customers without power, which is about sixty percent of all public power customers. Within twenty-four hours, FMEA's member utilities already had half of their customers' power restored. In the next twenty-four

hours that number had jumped to eighty percent. Within seven days, more than ninety-eight percent of public power customers, that could safely receive power, were restored.

Hurricane Irma presented many challenges in the restoration process for Florida, a highly populated long, peninsula state. One of the difficulties was that Florida evacuated nearly seven million people, and once the hurricane came through, those seven million wanted to come back to their homes. Meanwhile, many emergency response crews were trying to get into the state – from police and rescue to electric utility personnel. Without power, gas stations and food establishments remained closed, leaving both Florida natives and out-of-state restoration personnel without access to fuel and food.

To answer the fuel shortage challenges, the state emergency operations center (EOC) set up designated fueling sites in the state for emergency responders. Zubaly worked directly with the state EOC to ensure that electric utility restoration personnel had access to those sites alongside police, fire, and search and rescue crews. In addition, Zubaly, through the FMEA members, connected public power utilities that had their own on-site fueling pumps with mutual aid crews in need of fuel that were coming it to help restore other utilities.

So, with a little help everywhere, they made the repairs amidst the extreme heat, massive traffic, fuel shortages, and everything else, in record time. Irma was a big lesson for electric utilities across the country on how they approach storms. We don't wait until a storm hits to start lining up crews. We put crews on notice, in advance of the storm, and have contingencies for potential challenges like fuel, food, and accommodations for those responding. Then those lessons learned during Hurricane Irma were put to use just one year later when FMEA organized yet another large-scale mutual aid response – this time to category five Hurricane Michael, which leveled areas of the panhandle of Florida, and significantly impacted five Florida public power utilities.

Almost immediately after completion of Florida's Hurricane Irma restorations, Zubaly received a call from APPA. They were trying to coordinate assistance over to the U.S. Virgin Islands (USVI), which had also been substantially impacted within two weeks of each other by Hurricanes Irma and Maria.

While sending crews to USVI would be a challenging process, as is the spirit of public power, FMEA members answered the call, and Zubaly was able to pull together several crews who were then joined by public power crews from several other states as well. Six Florida public power utilities helped get the lights back on in the USVI – the City of Tallahassee, Ocala Electric Utility, Homestead Public

Services, Fort Pierce Utilities Authority, Lakeland Electric, and the City of Winter Park. Crews were swapped out several times, leaving equipment and trucks on the island while rotating in fresh crews.

The logistical coordination involved in sending crews to USVI, or any island territory, is complicated. How do you get crews, and their equipment, across large bodies of water to islands? You can't drive them across the water. So, you've got to barge them there, which presents a whole host of other challenges and additional contractual agreements that must be put in place. A lot of that was unfamiliar territory for Zubaly and FMEA's members. But with some perseverance and a bit of a learning curve, that restoration was completed in February of 2018, almost six months later.

So, what keeps Zubaly doing this incredibly complicated, multifaceted, impactful job? Well, when she's in the thick of it, she cleans off her desk, and with everything to the side, it becomes hurricane restoration central. The first forty-eight to seventy-two hours can be messy and stressful. But as she starts seeing the number of people getting restored and the progress each utility is making on the restoration effort, she finds it incredibly rewarding. Once those crews get back home, she'll get sent copies of articles from hometown newspapers from small towns in states around the country or newsletters from other state electric utility associations, talking about the great experience their crews had while helping restore power to Florida. Some may not think of sending crews out as much benefit once they're headed back home, but it's just as beneficial to be able to send crews out to respond because it's a learning experience for those crews as well. Seeing those types of stories, the social media posts with photos of line workers being fed a hot meal from a grateful resident, and the Main Street parades in honor of restoration personnel and their hometown utility is what keeps Zubaly going. That is its own reward.

One individual familiar with Florida aid sent abroad is former lineman Korey Bush. Bush currently serves as Assistant General Manager of Customer Service for Lakeland Electric, based in Lakeland, Florida. Two hurricanes in Bush's career will always stand out to him. While they're different in timeline, impact, and size, both illustrate how devastating Florida hurricane season can be. What made these experiences particularly memorable for Bush was how heavily involved he was with the mutual aid effort.

When Irma hit, Lakeland Electric felt the impacts of the storm just like the rest of the Floridian utilities. Nearly half of the month of September was dedicated to the restoration. Then shortly after that, the mutual aid requests were still

coming in, this time for the Virgin Islands. Zubaly, who is also Lakeland's mutual aid handler, reached out about Bush helping with the ongoing restoration down in St. Croix. The back-to-back hits of Maria and Irma had wreaked total devastation on the islands.

The U. S. Virgin Islands Water and Power Authority (WAPA) had made some progress in getting crews down to assist in the restoration, but what they needed help with was organization and project management. Bush's help was requested for a thirty-day mission in St. Croix. A couple of weeks later, he and some of his colleagues were on a plane to St. Croix. Bush ended up staying on the island for fifty-four days.

Some of his successes on the island had to do with helping WAPA and their employees manage the entire restoration. It was a constant challenge just to get materials. On the island, everything from poles to transformers was a three- or four-day barge trip away. Some of the things that Bush feels he has previously taken for granted were the cable hangers, twelve-inch bolts, and other basic materials that became hard to get a hold of there. Meanwhile, he was managing the crews and the people in what became a huge, concerted effort. With a restoration like this, it wasn't just fixing a power outage, it was a rebuilding process. So, when his thirty-day mark came around, they were happy to see him stay. It was the end of the year, and it worked out that no one really wanted to step into the unknown to replace him. Luckily, he was able to stay and see the whole project through. By the time Bush left, WAPA had roughly ninety-five percent of its system restored.

Another hurricane that hit close to home for Bush was Hurricane Michael in 2018, which had a huge impact to the City of Tallahassee's utility system. Bush and some others from Lakeland were dispatched up there, but they had brought line crews and Tallahassee needed damage assessors. So, some of them stepped up for that role instead. Even so, for that storm, Tallahassee had been incredibly prepared. They had called in an abundance of help ahead of time. The restoration was incredible; everybody was back on in a couple days.

But one of the smaller towns outside of Tallahassee had a big need for more assistance. Bush was tapped again as someone with a wealth of experience. It was about a forty-five-minute drive, but he went over there with a crew and found the City of Quincy already at work with their restoration efforts. What he found was a real need for organization and some help with resources. So, he set up there and was able to walk them through the restoration. They were finally back up in about

ten days. It's a great example of Florida's municipal network. Crews come from all over the Southeast to pull together and help their sister cities.

Coming up as an apprentice, becoming a lineman, and making it all the way up to AGM, Korey Bush knows how important safety is. Ultimately, it's a dangerous industry, so the safety of workers is as essential as their work. In a storm restoration, lines are down, poles are down, and in instances like St. Croix they're rebuilding. But people like Bush understand that it's not just electricity, there's the threat of the generators. Every day, Bush and his crews were talking about checking for back feeds, installing the grounds in the protection of the alignment, and making sure Personal Protective Equipment was where it needed to be.

Then factor in that those working in the mutual assistance effort are out of town, on a system they don't know, with local, unfamiliar dangers of its own. It could be insects or snakes, or something else entirely that they aren't used to dealing with. But navigating that new territory in their work is an everyday practice for restoration workers. While it may be a little elevated during a restoration, that focus on safety throughout the work they do is integral to every line worker's day, even on a home system.

Equipment in the industry is fairly standardized, but there are still differences. There's also locating and transporting that equipment and getting to know a system that's out of a worker's service territory. Sometimes a restoration may need help in project management or providing community support. It's part of the magic, taking all these new resources and creating a plan of action. Once the initial shock of the storm passes, assessing the damage begins. Critical needs are identified. Bush thinks of the repairs needed first for hospitals, water treatment plants, and other important services. He watches those plans materialize and then looks ahead to the next important steps. Restorations take on their own life forms from there.

What Bush finds important to remember, however, is that serving as mutual assistance means he's a guest in someone else's house. At a new place working with new people, they don't know who he is. Bush realizes it's important not to come in and boss anybody around, to be diplomatic in addressing problems found, and to earn the trust of the local folks that are partnering with his team in the repairs. With this effort, he hopes they learn to trust his judgment as he helps them with the undertaking. But once he connects with them and they come to understand that they're all there for the same goal, things really take off.

The way the community pulls together to help those who are helping them can be a remarkable sight. It's not only the support personnel who spring into

motion to keep the operation running, but the local community helps as well. Local businesses offer to cater. Folks who have just had their service restored go out of their way to offer relief. Many times, the news portrays so much negative information when the opposite is really true. For Bush, it's so nice to witness the goodness of humanity around him. When the industry pulls together, we're not as different as some might have us think. That can be so refreshing amidst the chaos after a storm.

But Bush also brings to light a part of the community which is severely underrepresented in the scheme of a restoration: the families of those working. When the call came in December for Bush to go to St. Croix, he was closing on a house in two weeks. He called his wife to get her thoughts on the matter, and she was the first to say he had to go help. She took care of the entire move while he was away, and several other family members pitched in to help.

Behind every person that goes to a restoration is a family that's taking up the slack. They selflessly do it because they know the value of this work. The workers behind the restorations know the purpose they are fulfilling, even in the face of their personal sacrifices along the way.

Coming from States Away

Although we've zeroed in on some anecdotes from Alabama and Florida, there are so many states participating in these regional and even national connections. The lengths we go to in order to support one another in this industry are almost boundless. We already know one individual, Andol Johnson of Santee Cooper, who has an exemplary story on this subject.

The most challenging restorations that Johnson has ever been a part of have been far outside of his home service territory. He was part of the mutual aid response in both Hurricanes Irma and Maria. Both were category five storms. Like Bush, Johnson was also working in St. Croix, in the Virgin Islands. By the time it was all over, he had been there for over a month.

According to Johnson, most linemen deployed as mutual assistance volunteered for that work. They did so for a variety of reasons, including money, excitement, and experience. For him, it was a bit of checking all three boxes. Restorations can be a rush. At the same time, it's hazardous, and the conditions are no picnic.

Over in the islands, it was very hot. Each day the temperature was over ninety degrees, and it rained most days, too. Meanwhile, Johnson was walking anywhere from four to six miles daily, loaded down by the wire he was carrying from place to place. This was necessary because when they first got to St. Croix, their trucks took another week and a half to meet them there via cargo ship.

Each repair required them to climb the poles. With no trucks available during the first wave of repairs, they were left with no other choice than to use their own physical strength to access the wires. That was a bit dangerous because a lot of the poles weren't buried to proper specifications. They dutifully made their checks often and kept everything as safe as they could.

We received similar anecdotes from others around the country. Dave Martinez lives across the nation from Johnson. Martinez works as a Construction Operations Manager at San Diego Gas & Electric, maintaining distribution level voltage systems at twelve kilovolts or lower. He operates in the High Fire Threat District in the company's service territory. He was involved in the reconstruction of the distribution system and parts of the transmission system during the 2003 and 2007 California wildfires, two of the most significant disasters that company had experienced up to that date. But he's also worked during numerous smaller scale events throughout the years. Even small fires have brought the need to repair anywhere from five to a hundred poles on numerous occasions.

Starting out, he came from the Marines. He was originally hired on at an entry-level position as a laborer. He dug ditches for a couple of years and eventually worked up enough seniority to apply for one of the electric side jobs. He later entered the apprenticeship program, journeyed out, and became a lineman. From there, it just progressed as the years went by, later moving into management at his current role.

After some of the more recent wildfire events, SDG&E has been looking at its infrastructure and how to improve it. They have worked to implement smart technology in SCADA (Supervisory Control and Data Acquisition) devices, modern relay equipment, arc snuffing switches and more resilient materials like steel or fiberglass poles to replace wood. They have started evaluating conductor heights and setting larger, taller poles that elevate the wire high enough to avoid damage from fires burning underneath it. Things have constantly evolved over his twenty-two-year career with the company.

Martinez has enjoyed several rewarding aspects of his career. One has been the freedom to move around to different areas. He's worked in every corner of SDG&E's service territory, in a variety of roles. He has also been on

six mutual aid assignments in the Western Pacific. Although he's never gone to the East Coast, he's seen both ends of the spectrum: wildfires and winter rain or snowstorms.

In a fire event, there is mass devastation. It's not just a wire down or one single pole burning. The destruction doesn't stay isolated to a small area. The devastation can be seen for miles and miles, sometimes leaving entire towns and communities in ruin. Martinez then works along with others to completely rebuild the infrastructure.

However, in a snowstorm, there may be some isolated broken poles or maybe a small segment of pole line broken that needs to be replaced. But for the most part, clean up entails picking up wire, repairing wire where the structures are still sound, replacing broken hardware on top of a pole, or maybe even changing out a few transformers.

Yet another individual we met in chapter three provides some interesting insight into how we coordinate international mutual aid. Tampa Electric's Tony Faison is a member of the Southern Electric Exchange, an emergency management organization that helps prepare for storms and coordinate mutual assistance. On his home turf, he's in charge as the incident-based commander, so that if there are any problems, they can set up to bring foreign crews in to help out. In the wake of Hurricane Maria, he was asked to travel abroad to Puerto Rico to support the restoration efforts there. In fact, he was asked to serve as the lead line supervisor in charge of crews, so of course, he said yes.

The responding crew had to do a lot of preparations for that trip because the Puerto Rican Electric Power Authority's (PREPA) electrical system is different from most of those in America. They even had to purchase some equipment to build their own neutrals and do some things differently. All the crews shipped their vehicles and equipment over by barge, then they all flew in about a week later to meet the barge there.

Once Faison landed on the island, he met with the host utility in Puerto Rico, as they were the main utility assisting in the restoration. They provided maps sectioning work zones on the island. Faison and his crews were at Bayamon, as their job was to get mainline feeders back in to start restoring power to San Juan and the surrounding area. But the problem was that they had no material. When crews arrived, they saw poles down, and wires in gutters overgrown by vines and trees. They dug through the mud and dirt to salvage whatever they could find to get the line back up.

The team was able to build over a mile of line and get it back up and energized. Once that section was back, they called base. The laterals going into the neighborhood were breaking off. All the transformers were damaged, completely empty of oil or smashed to pieces. Now, they had all the wire ready, but no transformers. So, Faison called PREPA, who had no transformers, but plenty of wire. He was later contacted by a storeroom person from Florida Power & Light, who was in search of wire. Faison set up a bartering system, driving across the island to get transformers and drop off wire. They were finally able to make things work to get the power restored to the section he was working in but ended up doing a lot of unusual things to accomplish this task. On places where they would usually dead end the primary on a pole, they sometimes had to do so on a palm tree to get the customers back on.

Faison spent close to three months in Puerto Rico for the restoration there. Working with new people for so long naturally fosters a kinship, but Faison also notes how homogenized the workforce was from the beginning. Everyone was there for the same purpose: to fix the power. Even when going abroad, it's a brotherhood working together. There are no walls between companies or nationalities.

Speaking of going abroad, what about our neighbors up north? Up in Canada, Doyle Sam is Executive Vice President of Operations and Engineering at FortisBC Inc, British Columbia. Just like any other company in the industry, Fortis is no stranger to emergency events. They do a fair number of tabletop exercises throughout the organization to practice with inter-office agencies, regulators, and emergency responders. But while they're pretty practiced at it, another notable windstorm came through mid-November of 2021. It was FortisBC's' most impactful windstorm in at least twenty-five years. About thirty percent of their customers lost power, and as the territory includes a relatively small customer base of around one hundred fifty thousand direct customers, that was significant.

When the windstorm hit, Sam and his teams set up an area command center locally. Then, later that same day, a flood event hit that caused major concerns throughout British Columbia, which elevated the response from an area lead response to a corporate lead emergency response. The flood caused both additional electrical outages for customers and damage to the natural gas system which interrupted the natural gas supply to those same customers and more.

With this event, Sam and his team followed an incident command system used not only in his company, but across British Columbia. Other companies and countries have called it a unified command structure. This regimented and prescriptive structure informs an effective response to these events. The system

is designed to create organized lines of communication and ensure responders can use resources efficiently, whether it's tools, equipment, financing, or anything else. The methodology also includes the same communication language used by provincial incident responders, which helps streamline coordination with local agencies.

Historically, the company's operation of the field response to these events has been received rather positively. In past decades, the struggles they have learned from have generally been related to communication. These days, a strong focus on communication with customers and the public has been bolstered by things like social media and other platforms that have substantially increased the way real-time information flows. The public affairs department communicating with government bodies is also key to this effort and helps to maintain and manage expectations with customers.

Besides these communications strategies, it is the intense logistics involved in these restorations that makes all the difference. There are material supply operations for the restoration and coordinating mutual aid crews from all over Canada. Just like the United States, Canadian companies have mutual aid agreements. Fortis Inc. is fortunate to have mutual aid agreements across all the Fortis companies internationally as well. There are also mutual aid agreements with other companies and as a member of the Western Energy Institute, FortisBC has access to mutual assistance north and south of the border. Mutual aid involves everything from human resources to managing critical tools, equipment, and supplies for the restoration.

Typically, such as in the events seen in 2021, one of Sam's directors will become incident commander, managing all logistics responses for that event. Sam's role is basically to make sure that person has all the resources they need. He communicates with the affected parties, his board of directors, and his parent company, and later reaches out to start discussions on mutual aid and works with other companies as well if they need support on neighboring systems.

Being Cooperative

Sometimes supporting your neighbors in this industry is even more special. Our utility cooperatives are even more connected to their communities as the members own the utility. In that way, the network of mutual assistance is even more tight-knit.

Consider Community Electric Cooperative (CEC), based in Windsor, Virginia. When Jonathan Powell comes in to work in the morning, his crew leader Danny Beale has already had his work lined up for days. Beale keeps Powell informed so they can get their work done with a solid and efficient plan. As Lead Lineman, Powell is leading that charge, gathering the crew as they go to load up materials. Once they get to the work site, they have a tailgate meeting to go over the jobs and start the day's work.

Beale has seen plenty of different storms with varying restoration periods. For instance, Hurricane Isabel back in 2003 hit them hard. Just about the whole system was out then. The disappointing part about that was how they worked for four days straight and still couldn't get anyone's lights on because their substations were out. It was incredibly demoralizing, to work sixteen-hour days, just putting wire up and waiting for their stations to become hot.

In 2011, when Hurricane Irene hit their service territory, both Beale and Powell were working in the mud once again. In fact, they kept the boat the whole time in the swamps. Powell remembers taking the boat and pulling people's meters because the floodwater was about to go into their houses.

Then there was Hurricane Sandy in 2012. The restoration lasted more than just a few days' worth of work. But they were also traveling. Folks from every co-op in the state of Virginia met up and, in a convoy, left for New Jersey to lend help. When they got to the coast, it was a sight Powell had never seen. He just stared at the devastation, not knowing where to even start. It all worked out, but Powell's crew was there thirteen days.

In any restoration, one of the paramount focuses is safety. The crews become so involved in the work and work so many long hours, that it's easy to be mentally stuck in getting tasks completed. They drift into the wrong direction if they're not careful, and that's how accidents occur. Fatigue can hit after ten days straight of working twenty-four-hour shifts. Then usually someone gets hurt, or worse. That's why organization and communication among everyone is so important and is meticulously managed.

One of the people who helps with that at CEC is Jessica Parr, Manager of Communications. At the cooperative, she does everything from internal and external communications to special event planning, to partnering with other cooperatives on community and regulatory initiatives and power outage messaging. Parr also handles all communications and marketing for Community Electric's subsidiary, RECORE, which does all the commercial and residential standby power generation.

Parr has been in the industry for five years and to this day, every time some of her linemen step up, it never ceases to amaze her how involved they are and how much they care. It could even be someone from another cooperative whom they've never met, and never worked with, and they're all in every time.

It's the same way when it comes to mutual aid efforts. While Parr's cooperative has been fortunate to not need a lot of assistance through the Virginia, Maryland & Delaware Association of Electric Cooperatives (VMDAEC), its geographical location sometimes has category three or four storms headed directly at them. However, often at the last minute, they swerve in another direction. Since February of 2021, Parr has sent at least four people six different times for mutual aid. At her cooperative, there are only eleven team members in the entire construction department, which includes the linemen. So, sending four people elsewhere is hefty. But the linemen always step up and are eager to volunteer.

Most of the mutual aid assistance in Parr's area is arranged by the VMDAEC. Whenever there is a storm coming her way, whether it's going to hit them or somewhere nearby, all cooperatives in the area hop on the coordinating call. Even if they're not expecting the direct hit, they'll have lineman to deploy. Part of Parr's job is to monitor those calls and find out if her people are needed somewhere, including how many, and who should go. Once it is determined who will go, then the darker side of her job is to make sure that she has everyone's bios in case anything happens. However, if that day did come, she would work with the CEO on all internal and external notifications and communications. Fortunately, that has not been necessary in her career. Nor has it happened in Community Electric's eighty years.

Another nearby cooperative close by is Southside Electric Cooperative (SEC), based in Crewe, Virginia. George Felts serves as SEC's Vice President of Engineering and Operations and has been part of the co-op for twenty-four years. In that time, he's taken on roles outside of storm activity in managing operations, construction, maintenance, and outage restoration. On the engineering side, his work includes system planning and integration with new members, new member design, service designs, and more. But he has a big team on the operations side of the house, and it's a team he relies on and trusts throughout Southside's day-to-day operations, even more so following a storm.

It doesn't even have to be a big storm. Felts and his team are always dealing with outages and restoration activity. But when the bigger events do come along, they have an entire process and emergency plan following rural utility service guidelines. They also follow an emergency restoration plan which starts a

process that may change their roles from what each of them does on a daily basis. That new role may be coordinating mutual aid, organizing logistics and supplies, pre-planning for staging of outside crews, or something else entirely.

Being on the East Coast of Virginia, SEC gets a variety of different storms. From winter ice storms to summer thunderstorms, to hurricanes, it runs the gamut. For Felts, one of the more memorable storms was Winter Storm Shirley in February of 2021. Shirley was by far the most destructive storm that SEC had ever seen in the cooperative's history. The magnitude of damage was unlike anything Felts had seen in his career there.

Another storm that Felts thinks back to is 2003's Hurricane Isabel. Prior to Shirley, Isabel was SEC's largest storm event on record. However, it wasn't necessarily the rigor of the restoration that seared the experience into Felts' memory. Three days before the event hit, he had gotten married. So, thanks to Isabel, his honeymoon was cut short. But like many others on holiday when a storm arises, he came back to work, and worked with his team for the next ten days.

One member of Felts' team is Kinte Robinson, an Operations Supervisor for SEC's Western District. Robinson has been at the Cooperative for twenty-one years now and, like Felts, has many vivid storm memories. However, his most memorable is the derecho storm of 2013. As it was forecasted to come in, he had a cruise with his family scheduled. The storm hit a week prior to his vacation. So, he finally had to make the decision to tell his wife and kids to go on without him. He knew he had to stay back and get the job done. All week long, he and his crew were working sixteen hours a day, trying to get everyone's power back on. Miraculously, the day before it was time for his family to leave, SEC wrapped up the restoration and Robinson was able to go on his vacation after all.

Mike Southall, a Line Tech Supervisor at SEC, has also been with the Cooperative for twenty years. Like Robinson, he has dealt with balancing his work with his family commitments. With five children, Southall has missed at least one of their birthdays over his career for not only major storms, but also the average evening thunderstorm. But the derecho storm was different for him as well, specifically because it was so abrupt. Even with great meteorology and the wealth of data that SEC had to draw from, they didn't see the storm coming. There wasn't even any mention of it in the local weather forecast.

Even with the average storm, SEC may only have four or five days to make a unique plan. But the derecho storm came through with little pre-warning. It was sudden and the work was a struggle in the hundred-degree heat. It was also the

first time anyone in their area of the state heard anything about a derecho. It was a new type of storm to many on the team.

However, according to Felts, the aftermath of the storm was not necessarily new. Once it was over, the damage was like any other restoration. So, the team at SEC was able to react as they normally would. In the span of less than an hour, the storm cleared SEC's system from end-to-end, leaving six days' worth of damage for them to respond.

They relied heavily on their emergency plan, which they were able to put in place quickly. After all, our industry has emergency plans to help start restorations efficiently, even if the storm is unexpected. This also enabled SEC to pull mutual aid from several other states. But the storm had also hit quite a few other Virginia cooperatives. So, everyone was calling for help. Fortunately, mutual aid personnel came together fairly quickly.

The speedy jump to assist is characteristic of SEC, like most other cooperatives and utilities in our industry. Robinson, for instance, has been away from his home service territory to provide aid following a variety of storms, including wind and snow events. He's often had the pleasure of receiving aid from others to help get his members' lights back on. So, of course, he's ready to do the same when he goes out of town to help those other cooperatives. When he and his crew arrive, they treat the local folks with the same respect and kindness they would their own SEC members. Because at the end of the day, he loves what he does. This job isn't made for everyone, but most of the men and women in this field like what they do. It really doesn't matter whether they are working on their own system or have traveled to help their neighbors with electric restoration, as these folks love what they do.

However, that doesn't mean it can't be a struggle. Several different challenges can arise during restorations, whether it's the natural aftermath of the weather event – deep snow, wind-blown debris, or even flooding – or just the usual logistical slog of getting all the needed tools and materials in one place.

Regarding tools, most may expect them to be a unique challenge too, especially when you're working on a system that isn't your local kit. However, that isn't always the case. Scott Diggs, District Operations Supervisor out of SEC's Powhatan office, has experienced several different cooperative construction and restoration projects where everything has been largely the same, even on out-of-state systems. There may be a few differences in the way they do things locally, but for the most part, he could just jump right in and start restoring power.

As part of an emerging pattern of cooperative loyalty, Diggs has also been with SEC for over two decades. As such, he's been all over the place with restoration work. One memorable storm that hit home was Winter Storm Shirley. The ice storm that came across SEC's territory caused the worst damage that he had ever seen. At first, the damage was overwhelming. He knew what it would take to do things like change out poles and how long that would take. Seeing all the damage, he couldn't help calculating in his mind how long the restoration would last, and the amount of resources that the team was going to have to use to accomplish that type of mission.

The damage was substantial. The outage caused by the storm lasted thirteen days, with thousands of members without power. The extent of the damage was largely due to the eight hundred sixty-six broken poles and nine hundred forty-six reports of downed wire. But what made Shirley even worse was the inches of rain the area had suffered the previous month. It made it even more difficult to get to the places that needed attention. You couldn't just drive anywhere you wanted. There was a lot of climbing and track machines. Pulling off of somebody's driveway was a struggle in itself. It made normal processes take a lot more time, and more energy.

Tony Kemp, Line Tech Supervisor and another twenty-year SEC veteran, recalls what a huge need they had for assistance following Shirley. The amount of mutual aid that SEC had during that storm restoration was just unreal to him. They even had mutual aid from investor-owned utilities, which normally they didn't need to call in. It was overwhelming at times, but the teams worked through it.

Just as Virginia has organizations like the VMDAEC, the state of Louisiana has the Association of Louisiana Electric Cooperatives (ALEC). In Louisiana, mutual assistance is almost constantly turned on. As ALEC's Director of Loss Control, Aarron Graham has kept himself busy the past few years with the number of hurricanes and tropical storms that come across the gulf. Every now and then, there may be a couple of good years where no major storms come in, but anytime a storm is projected to hit Louisiana, he is working on mutual aid calls.

For him, getting started is as simple as an email to a distribution list. An email requests a phone call, he sets the date and time, and suddenly he has a massive conference call with many people across the country. That's when the real coordinating begins. Graham explains what he's looking for, and the types and amount of people needed, whether it's right-of-way crews, construction crews, or service crews. He tries to call people in from states as close in

as possible. Using the storm event flow chart, Graham will start with Arkansas, Texas, Missouri, and Oklahoma. Depending on the severity and path of the storm, he will work out from there, going as far as he must to get the help that they will need. In the past two years with Hurricanes Laura, Delta, Zeta, and Ida, he's brought in around ten thousand mutual aid workers for restoration efforts. They've had mutual assistance come from just about everywhere, not only from those states bordering Louisiana – Arkansas, Mississippi, and Texas – but also Alabama, Florida, Georgia, Illinois, Kentucky, Missouri, Oklahoma, South Carolina, and Tennessee. With Ida, they came all the way from Illinois. Back in 2005 for Hurricane Katrina, crews came in all the way from the west coast. The Californians actually brought their trucks in by train because it was easier than driving in to help.

But the gulf coast includes several states, of course. What happens when a disaster hits not only Louisiana, but also Texas, Alabama, Mississippi, and Florida? If multiple states are affected, Graham will coordinate crews without having them cross other states to get to him. If help is coming from South Carolina, they may go to Mississippi before they move into Louisiana, but only if Mississippi has already filled their need for assistance. Everyone's got to have what they need before they start crossing other recovering states.

It's quite challenging. There's a lot to track and keep up with in a restoration. But Graham isn't in it alone. There is a tremendous amount of cooperation. He's talking with so many other cooperatives all the time. The Association of Louisiana Electric Co-ops is a statewide association, so anytime they go into hurricane mode, the whole staff is in it. They make themselves a home away from home for the first couple of days. Graham has a cot and pillows in his office for those times. In fact, most of their staff will stay there, and sleep there too. They'll bring snacks, stuff for sandwiches, and things to cook. Then they pretty much live there for those first several days until they've got all the crews where they need to go.

Managing those crews once they've gotten to you is no small task. It's a huge production. One of the biggest things is that these people have to live there too. There are only so many people you can put into a room, cooking in a microwave oven. You need to put them up. They need water, food, and a safe place to stay. Each co-op handles that a little bit differently, according to Graham. Some of them use church camps, and Boy Scout camps, and they'll even contract with hotels if they have that capability. Others may build tent cities, utilizing a few big tents or sometimes camper trailers. Most of these can sleep anywhere from two

hundred fifty to five hundred individuals. There'll be sleeping tents, eating tents, even places for showers, toilets, and laundry. Even so, it's harsh conditions.

Graham says you have to be a little crazy to do this kind of work. You work in the worst conditions possible. It's bad weather, whether it's hot, cold, hurricanes, tornadoes, or hail. You have to like this type of work. It's a unique brand of dedication. They know when their communities are down, that the residents of those communities can't come back until power starts to come on. It's not just homes and neighborhoods that are out, it's things like water stations, sewer lifts, and hospitals.

Those coming in as mutual assistance may be leaving their families behind for a long period. Locally, your workers' families may be out of power themselves, and their homes may be damaged or even totally destroyed. But they're out working, restoring power while their families are staying with other relatives. Graham has even seen co-ops get camper trailers for their employees whose homes have been destroyed, letting the employees and their family stay there while they're out there working. Meanwhile, they're working long days, with constant impediment from things like blocked roads, storm debris, and more.

It's dedication that keeps them going. The workers take great pride getting out there, knowing what they're doing is a huge help and a benefit to the community. For him, it's a great pride to know that he has helped make a small contribution to restoring someone's life and getting their community back on its feet, because he's been on the other side as a lineman as well. The workers really see faces change when people see those trucks coming in and lights finally come back on. They sense the relief as the restoration begins.

One of the organizations Graham may call upon for mutual assistance is the Southern Louisiana Electric Cooperative Association (SLECA). You may remember its General Manager, Joe Ticheli, from the previous chapter. Now, let's turn to Matt Peters, Operations Superintendent, who started with SLECA three days out of high school as a groundsman and held numerous job titles until assuming his current position in 2017. Peters believes that climbing the ladder at SLECA by holding various positions enables him to relate to his employees and work with them as they grow in their careers.

He has been on numerous storm restorations, both in SLECA service areas and assisting other cooperatives throughout Louisiana as well as other mutual aid states. Mutual aid is shown not just in agreements made through ALEC but in the relationships that are made when SLECA assists other cooperatives or when they assist SLECA. When a cooperative in any mutual aid state is affected by a

natural disaster, Peters is ready to gather and send a team to help them rebuild. In turn, when SLECA needs help, it's a good feeling to know that help is only a phone call away.

Leaving home is never easy with a wife and three children at home, but Peters knows when his phone rings, it's time to go to work. It's an understanding that comes with the job, but it means sometimes missing important life events like birthdays, anniversaries, and other milestones.

When the storm is coming close to home, his family knows the drill. Making the necessary preparations for them to evacuate and stay out of harm's way gives Peters peace of mind that they are safe, and he can focus on what needs to be done at SLECA.

After Hurricane Ida made landfall, Matt was lucky to find that his home had sustained minimal damage and his family remained safely evacuated. Unfortunately, some of SLECA's employees were not so fortunate. Immediately following landfall, fourteen SLECA lineman needed a place to stay as their homes needed repairs. Tent City became home to several SLECA lineman as well as over twelve hundred linemen from all over the country. Things at SLECA were rapidly progressing toward restoration. For Peters, it was a great feeling to know that during a time of disaster and destruction, people would come to help and be there as long as they needed them. He refers to it as a peace of mind that is hard for him to explain.

Roughly one year later, SLECA is still experiencing the lingering effects of Hurricane Ida. SLECA lineman work daily to convert consumers between temporary service to more permanent service once their homes can receive service again.

CHAPTER 5

Behind the Restoration

Some of the restoration situations described in this book have been quite complicated and dangerous, with a lot of moving parts. The inspiring individuals who lead and serve on these restoration teams are the heroes we continue to herald. Everyone in this industry seems to maintain an uncanny willingness to step up. That dedication isn't limited to the crews working sixteen-hour shifts out in the field.

There are many working behind the scenes to plan, supply, support, coordinate, and care for those boots on the ground. There is infrastructure constantly under improvement. There are coalitions organizing support well in advance and technological innovations being born every day. There are many parts behind the historic restorations collected in these pages. These are the people and plans that may not come to mind initially when thinking of who to thank for our lights flicking back on.

Communities of Dedication

Even though natural disasters can tear apart the landscape, they can really bring communities together. Because when it's done, everyone can see the fruits of the labor. The lights are on, people are happy and safe. The communities are back up and things are getting back to normal.

Jessica Parr of Community Electric Cooperative (CEC), introduced in the previous chapter, gave us some examples of ways that utility cooperatives serve their communities even outside of restoration activities. Parr's work with the cooperative includes several different community events and initiatives.

They do everything from local golf tournaments and holiday parades to larger scale enterprises, such as their most recent partnership with Roc Solid Foundation, an organization that builds hope for kids fighting cancer. The cooperative is helping to put together Ready Bags, a collection of essentials given to families just after their child has been diagnosed. They're also planning to help build backyard playsets for kids during treatment.

Concern for the community is a principle at the core of CEC. They have also conducted larger campaigns, like helping with the Fallen Lineman Foundation. Whenever someone gets injured or passes away, the cooperative rallies together to raise funds and resources to help the families.

The same community dedication comes in during restorations, even though it can be hectic. People have a real can-do attitude in everything, even with something as simple as food. Employees at the cooperative have made sandwiches at the home of a coworker who happened to have a backup generator. Once power is restored to the local restaurants, those businesses often become involved with catering to show their appreciation. The whole town sees that there are construction crews on-site and cooperative employees working through the night. They come together to support those essential workers who are supporting them in getting their lights power restored.

There were similar stories unfolding in Southside Electric Cooperative's (SEC) locale. It wasn't just the cooperatives that were working through it. The entire community had been impacted by Winter Storm Shirley, and they could see the work the cooperative was doing to get the power back as quickly and safely as possible.

The community came out to show their appreciation. People who still didn't have power were arriving at the SEC office with meals, picking up tabs, and buying coffees around town. Churches and youth organizations fixed lunches and snacks for workers.

Neighbors were helping neighbors, even in situations that aren't utility related. For example, during the ice storm, Tony Kemp witnessed a car accident on his way into work. He happened to be the first one on the scene. So, he was able to stay with the driver until assistance arrived.

The dedication of the CEC and SEC teams is yet another example of how utilities serve their communities. They're not only dedicated to their jobs, but to the members of their cooperative and even those of other cooperatives when the need arises. They can wear themselves out with a two-week long restoration and immediately volunteer to go help another cooperative who still has damage. No matter how hard they've already been working, they always find a way to make it happen.

It's no different with public power. They're serving the same public community, after all. A poignant example is that of Blountstown, Florida. The biggest storm in the City of Blountstown's history was Hurricane Michael in 2018. It's a day that Traci Hall, the city's manager and finance director, will never forget.

The eye of the storm went directly over Blountstown, as a category five hurricane. As it came through, Hall was sitting in City Hall, alongside her mother, the mayor, and a couple of the city's electric linemen. They rode out the storm there, watching roofs get blown off and tumble down the streets, and traffic lights fall to the pavement. She remembers staring out the window as the roof of the local police department was ripped off, with insulation flying everywhere. When it was finally over, the city had lost its entire electric system. Practically every pole and line were down.

Blountstown is also a little different than most cities in its area because its utility services include all of them – water, sewer, natural gas, sanitation, and electric. So, in a restoration like this one, they had to think about everything. But of course, electricity was the most important to everybody, because down in Florida it gets hot and humid after a storm.

The evening after Michael had passed, Hall and some others were able to get out and start walking around, combing through the streets. They pulled traffic lights, stop signs, and street signs out of the road, and those were the roads that they could manage to get down. Many of the streets were obstructed by storm debris. The volunteer fire department and the local police department were all out with chainsaws trying to clear the roads for Emergency Medical Services to be able to get to the hospital.

When she walked through the aftermath of the storm, unable to drive through most of it, Hall had never seen anything like it. There were hardly any trees left, and those trees that had managed to weather the storm had been sheared off at twenty feet. You could see how the wind had come straight across and knocked the tops off of everything. It was not just the trees, but roofs too could be found way on the other side of town from where they belonged.

The Florida Municipal Electric Association came in with mutual aid for the restoration effort. Crews came from nearby Ocala, with multiple other crews coming in from as far as Tennessee. They amassed a workforce of about sixty-six linemen. For Blountstown, weighing in at around four square miles in area, that was substantial. The small utility's commercial and residential electric customers total about thirteen hundred.

With all the debris still taking some time to get cleared away, the linemen just started working wherever they could get to, clearing where they could as they went. With the help of all the mutual aid crews, they pulled together to get the job done. The restoration was under way. Everyone was pulling sixteen-hour shifts

At first, they housed the workforce in the local high school gymnasium. After several days, they ended up moving to the Fellowship Hall of a local Methodist church. Meanwhile, Hall knew they had to feed all these guys, but the places to get food or catering were obliterated. However, the local grocery store had recently moved into a new facility about a week before the storm hit. The morning after the storm, they had partial generator power. The night after the mutual aid crews got in, Hall went back to her house and told her husband to get the grill going. She went to the grocery store and bought sausage and bread to make sausage dogs for breakfast. Others from local churches, with gas-powered or commercial stoves, and other employees from Hall's office started cooking too. They bought hams, gallons of green beans, and things like that. The pastor of a local Baptist church and his wife cooked pancakes and sausage one morning for the workers. Eventually, the operation got a food truck out of Monticello that cooked three meals a day for city employees and mutual aid workers.

By the eighth day, Blountstown had electricity. About ninety percent of the town had power restored, and the remaining areas were restored two days later. But in this aspect, Hall's city was fortunate after Hurricane Michael. Blountstown was the only community within that area to have power restored that quickly, as others who lived within an hour's drive in each direction had to wait at least twenty-four days more to see their power restored, including Hall's mother, who lived only five miles from town.

So, those who had served in the Blountstown restoration moved on to the next community. Hall watched linemen's trucks and bucket trucks head south along the coast as soon as they could get roads cleared. The community came together and then it expanded. When that eighth day came, Hall describes it as heavenly. The city was both grateful and proud of the work that had been done. In fact, it was that year during the Christmas parade, that they honored the electric companies in the area. They also invited local nearby cooperatives to participate in the parade with their electric trucks. The utility workers were the showcase in the Christmas parade that year because everyone was so thankful. Everyone had experienced the same tragedy and wanted to honor those who had given them relief.

Storm restorations often take commitment from the communities and the areas that companies work in. Communities respond with the utilities, in a way. According to Alabama Power's Scott Moore, Alabama communities have often supported their work by providing things like a hotel, a gym, or a YMCA space. They pitch in when companies need large contingencies to put people up while

supported their work by providing things like a hotel, a gym, or a YMCA space. They pitch in when companies need large contingencies to put people up while restoration efforts are underway. It's the relationships all the way from mayors and leadership boards to different community-based organizations that make the whole engine work together. Of course, the local communities have a vested interest in getting power back on as well. But to Moore, one of the most important tasks for the utilities and service providers is recreating that sense of normalcy quickly, beginning restorations as soon as possible.

Because when the roof gets torn off, power is needed to start rebuilding. Many local businesses and customers' homes are often damaged or destroyed. Without the foundation for that rebuild, it creates a doldrum that's difficult to work out of. Also, with this work, there's always a frustration factor. Everyone wants to be first to have their power restored. But there's a process. It's like rebuilding a water line, Moore explains. Wherever that break is, repair crews have to build up to it, redo that break, and then see where the next leak is.

The linemen and engineers work in the field for what seem like endless hours, especially if they know they're close to completing their repairs. Moore recalls times they've worked through several major holidays. There are days when they've worked forty-eight hours straight, completely focused on restoration. Shifts overlap in order to let folks get a break throughout, but the whole operation works to the very end to see the lights come on.

The people undertaking this work are always watching out for each other, and that sense of teamwork and pride during restorations is a special feeling. Moore's greatest memories are those where they'd hear cheers in the house as the lights came on. Residents would come out and thank workers for their dedication. Pride in that service is at the heart of those undertaking this critical work.

But with that pride comes great sacrifices as well. Like many others, Moore has missed a few Christmases in his career. His family has been one of his largest sources of support despite this. It goes to the broader picture of those working in this industry. Families are often just as engaged as the workers are. They have to understand that when the lights go out at two in the morning, the responders have to go to work regardless of the time of year.

Alabama Power's workers have one of the highest call-out percentages in the country, but Moore says his guys just own that issue. The commitment from the state, the local IBEW reps, and the relationship with the brotherhood is so important. They foster a strong this-is-our-job kind of mentality, really making sure that folks do the right things when it comes to doing the work. Electricity is a

commodity that we so depend on, and it takes a special breed of person to commit and stand up to that challenge. Moore admits that not everyone understands until they get to be a part of it.

Technology Advances

Storm events are projected to be tougher and tougher going forward. Meanwhile, we're all becoming more reliant on electricity, whether it's powering our handheld devices, household appliances, or electric vehicles. With climate change concerns both here and on the horizon, it's important to shore up the system providing what is now most certainly an essential service. In recent years, both organizations and the industry have been changing gears. We're now designing for the storms of the future, knowing that the frequency and intensity of storms will be different.

When it comes to resilience, it's all about preparedness. After all, Mother Nature has her own schedule. It's not a matter of if your system gets hit, but rather when it will. Necessity is the harbinger of invention, so new technologies are constantly in the works and many of those new tools aren't even necessarily for restorations. Instead, it's about tracking the weather in real time, in order to prepare and plan immediately.

Forecasting data is becoming crucial to the restoration process, and there are colossal amounts of data and lots of variability in results when thinking about climate change forecasting. So, there's a lot of work currently underway with companies working to better understand the data. Where is the right data for our industry's planning? What is the right analytical model for our industry? By seeking to answer these questions, we can better prepare for the future, instead of strictly focusing on the past.

In Matthew 'Jason' Holland's seventeen-year career with Dominion Energy, he's been involved with quite a few storms. Now, as Director of Electric Distribution Operations, he's responsible for all of Dominion Energy's storm restoration work. He's leading the charge on resources, restoration, building a plan, and all the planning criteria and communications that go out internally and externally.

New Year's Day of 2022, Winter Storm Frida impacted Dominion Energy's entire Virginia service area. Naturally, Dominion Energy relies on weather forecasts to help build a plan for any weather event and make sure it has the right number of resources allocated in the right locations. Holland coordinates

appropriate staging as Dominion Energy sees fit so that everyone is prepared for the storm and can restore customers safely and quickly. Unfortunately, the weather projection at the time called for one to two inches of ice and some wet snow. People were a little concerned, but not overly concerned. Well, Mother Nature had another plan in mind and the area got almost a foot of wet snow throughout the day, and multiple inches continued to fall non-stop. The original strategy for the storm was adjusted to account for the additional snow and ice that exceeded the forecast. Holland and his team had to adjust rapidly.

It's been a challenge over the last couple of years. Looking at that winter storm as an example, Holland has come to understand that the forecast is only as right as Mother Nature's going to allow it to be. Plans can't be fixed. Winter weather is too fickle for that. One degree difference in temperature can make a difference. Warmer weather and snow can mean wet snow, which impacts roads and weighs heavy on lines and conductors. Colder weather means freezing snow and freezing rain. It may be light and fluffy coming down, but huge amounts of ice can build up on a line. So, there's always a balance. Things can change at any point in time. It makes being prepared an even bigger concern.

One lesson Holland has learned concerns travel during these winter weather events. Travel is a major public safety issue, but it can also become a major obstacle when moving resources and crews who are working to get the lights on. Pre-staging is a must, meaning that if Holland's team knows a weather event is going to hit a particular area, they're getting workers staged in those areas before the weather impairs travel. They can't wait around post-event for roads to get cleared or ice and snow to melt before crews begin working.

Another important aspect to all this is that planning isn't only for severe weather forecasts. It's really understanding what the weather looks like at all times and knowing what impacts weather will have based on that awareness. Holland has developed a strong strategy working closely with Dominion Energy's meteorology team and data analysts as well. Not only are they forecasting the weather, but they're also looking at historical trends, the type of weather, the intensity, the timing, and the location. They're asking themselves questions like, how many customers could potentially be affected? How many work locations will be generated? Holland's team builds the criteria to determine what they need, and it may mean realizing the situation is more than they can handle with internal resources. In those cases, it's time to reach out to external mutual aid resources, engaging other utility partners to provide resources and boots on the ground before the storm makes impact.

Meanwhile, during all this, Holland is also communicating with external regulatory, legislative, and governmental partners regarding the situation, informing the municipalities of Dominion Energy's plan, and if the plan changes, keeping them up to date. The team is working with the emergency management department to ensure current strategies align with those plans. The initial focus is on restoring service to critical infrastructure such as hospitals, water treatment plants, and police stations to ensure they are prepared for emergency services. It's a constant process of communicating with everyone to ensure that strategies are in place and address the needs of their customers.

Dominion Energy follows the situational incident command structure, so during a storm, Holland is engaged as the incident commander. He then leads teams in all strategies, whether it's resources, people, materials, or systems. At some point, he is engaged in every aspect of the response, making sure that all the wheels are turning and going in the right direction.

While many of the actions Holland takes are proactive and part of constructing these storm plans, much of his work can be reactive as well. Things like Dominion Energy's outage management system and communication systems to keep customers informed before and during an event, all tie together. As a customer calls in to report a power outage, Holland's team uses that same method to communicate back out to them to share the current status of the outage and make sure customers understand the plan.

Holland describes the outage management system as homegrown, but Dominion Energy is in the process of upgrading it to something informed by industry-wide experiences. It's being built around lessons learned over nearly three decades of working through storms, and it's being designed to allow for enhanced data capture and improves all restoration activities, resulting in an improved outage experience for Dominion Energy's customers.

Constantly improving is a trend at Dominion Energy. Years ago, when Holland started with the company, a multi-day event could mean up to nine days. That's the exception now, and is only experienced during severe catastrophic weather events. New systems and technology have made leaps and bounds in past decades. Dominion Energy continues to implement new technology so that every decision being made benefits customers as well as the restoration process.

One of these tools is the use of big data to support data analytics, something Holland is quite familiar with. His team is looking at historical data from storms during the nineties, the two thousands, and earlier this year. They can take weather that's forecasted today and compare it to something that happened years ago.

A new storm may be very similar to a previous storm, whether it's the same track, same amount of precipitation, or something else. They can run the data and see how a particular storm impacted Dominion Energy's service area and use that data to help build a response plan based on a new forecast. How did Dominion Energy respond then? How should Holland's team respond differently?

Holland believes the next five years will only see things continue to evolve. The entire industry, not just Dominion Energy, is going to continually come up with ideas on how to do things better. Will any of us do everything perfectly? No. No company does. But they're going to do what makes the most sense and brings the best value to our customers.

Perhaps unsurprisingly, it's no different on the West Coast. Paul Roller is Senior Manager of the weather services team in Southern California Edison's Business Resiliency organization. He has been with the company for over fourteen years. A meteorologist by trade, he first worked at an aviation forecasting company in Houston. Then, when he first started at SCE, he was one of only two meteorologists at the company. Originally part of Energy Procurement and Management, his initial function was to forecast temperatures in Southern California. Those temperature forecasts would go into a load forecast model, which was used to buy and sell electricity in the market.

That was 2008. Fast forward ten years, when climate change had become a much larger issue and concern. A higher frequency of fires were breaking out across California, making wildfire mitigation and keeping communities safe an even greater priority for the company. Weather Services, a team of three at that point, was moved to Business Resiliency. Roller's new main function was to provide situational awareness to the organization, more specifically to the function of Public Safety Power Shutoffs (PSPS). The team eventually added even more meteorologists, now up to a team of six, to bolster operational support.

Once Weather Services joined Business Resiliency, Roller and his team started ramping up procedures in response to wildfire danger. They were constantly looking for any impending impactful weather. Today, they're working on nearly daily forecasts for the company, especially in the summertime. When they do see something significant on the horizon, they'll start sending out weather alerts to the company. They also update their Threat Level Matrix, which monitors all areas of SCE's service area for any threats from heat, extreme precipitation, thunderstorms, and fire weather. Threats are rated from zero to five, zero being no threat at all and five being an extreme threat. This is sent via email to everyone in

the company who wants to receive it. It goes out to the field, so field supervisors can know what conditions are upcoming, and they can prepare appropriately.

Back in August 2020, there was a wide-stretching heat wave across the West. There were heat advisories or heat warnings up and down the coast from the Canadian border to Mexico. In Southern California, temperatures were above the nineties for the downtown area, which was above normal. They were already in what Roller's team considered heat wave criteria, but the heat was even stronger in Northern California. Sacramento was breaking records for heat. CAISO-wide, it was an extreme heat wave. That's part of the reason CAISO started initiating rotating outages.

There were also some wildfires going on. A few of them culminated as the Apple Fire, which had ignited in Riverside County at the end of July. It eventually impacted over thirty-three thousand acres, destroying a few buildings in its path. The plume of smoke was unfathomable, said to be so large it was generating its own winds. Roller's department stood up an Incident Management Team (IMT) for a couple of days to help support power restoration and addressing that fire.

The IMT often starts with Weather Services. When Roller's team sees adverse weather coming, they contact the Business Resiliency duty manager. They provide the forecast and consult with the incident commander on whether to set up a team. Once that decision has been made and a team is up, it's up 24/7. Two teams rotate through twelve-hour shifts, monitoring and responding to the situation and making sure the company is doing what's best for employees and customers.

In 2020, the August heat wave continued into Labor Day weekend. Temperatures hit one hundred eleven degrees downtown, the second hottest ever recorded there. In Woodland Hills, they hit one hundred twenty-one degrees, the hottest temperature ever recorded in Los Angeles County. Oddly, the good thing was that the heat wave happened over a holiday weekend because the load wasn't as high as it could have been. Additionally, it was a quick-hitting heat wave. Despite these spikes, the next day it was in the eighties. This was partially due to smoke from fires that also started over that weekend blowing into the basin. Another IMT was responding to these fires, and right after this, strong, early-season Santa Ana winds kicked up. This meant that while Roller's team was responding to the heat, they also set up a team for a PSPS event.

SCE continues to invest heavily into its weather forecasting capabilities and PSPS operations. So far, the company has procured four supercomputers, each of which has the computing power of two hundred fifty regular computers. These

supercomputers run Roller's eighteen different weather models at high resolution, even getting down to a one-kilometer scale. This lets Roller's team see grid cells one kilometer apart to help them forecast weather for California's complex terrain of mountains, basins, and deserts. The higher resolution models resolve the complex landscape better and produce a more accurate forecast for wind speeds through those areas. Many parts of the mountains are high fire risk areas, highlighting the importance of high-resolution weather models.

SCE is also investing in weather stations. It has installed over fifteen hundred weather stations to create the country's largest private network of weather stations. These sensors are installed most often atop a pole already in the company's system. Meteorologists and crews work together to site locations where poles are ideal for collecting data and reachable for crews to install them.

The focus is on installing in locations where they believe the wind will be the strongest to capture speeds and gusts and the extreme weather in these places. But the weather stations also record temperature, dew point, and relative humidity. The weather stations include solar panels that recharge their batteries so they can keep constant readings. The stations send these measurements to Roller's team to read every ten minutes, but they can get readings every thirty seconds on some of these weather stations if they want to. During a strong PSPS event, they not only rely on those weather stations, but also on wildfire cameras that look out across SCE's service area. There are over one hundred fifty wildfire cameras in different regions of the territory, watching for fire and smoke. That way, when a fire is detected early, first responders know where to go. All these tools help Roller and his team provide SCE with up-to-date situational awareness.

Today, Roller has a history of weather observations to draw from. An artificial intelligent (AI), or a machine-learning model, uses those observations to help bias-correct his team's weather models. They're always trying to improve weather models and give the company the best outlook they can. But even with all of this, the weather is still very unpredictable. Mother Nature can still throw us curveballs after all.

Infrastructure Innovators

We as an industry must build to increasingly rigorous standards. There is already a substantial movement toward not just replacing fallen wooden poles following storms but replacing wooden poles that are still standing and replacing

with hardening in mind. That means setting poles deeper, using steel poles instead, and building steel lattice towers as well.

But these infrastructure innovations are still an affordability issue. The question always being assessed is what the new standards should be and what will be the impact on the customer. For instance, many utilities across the country are increasingly undergrounding lines that have been suspended overhead, and the cost of doing so is a major consideration, though it's oftentimes economical long-term considering avoided outages and maintenance.

Innovation continues to surge in various parts of the utility sector. One woman who knows a bit about this growth is Charlene Whitfield, Senior Vice President of Power Delivery at Dominion Energy. In that role, she is responsible for electric transmission and distribution as well as customer solutions organizations in Dominion Energy's service areas in Virginia and North Carolina. Altogether, that counts for about 2.7 million customers.

Whitfield has been with the company for forty years, but to her, it seems like she started working there yesterday. She loves her job and has enjoyed a rewarding career. Her career began in what Dominion Energy calls its electric distribution design organization. The organization is responsible for designing the projects that provide electricity to new and existing customers, including residential, commercial, governmental, and industrial customers. It was in this three-year training program that Whitfield learned about electricity. She's held various positions since, in the design organization, the customer service organization, project management, electric distribution construction and operations, and more.

However, you can't have a career like that without having a few storms pass through along the way. The storm she'll always remember was in 2003: Hurricane Isabel. Dominion Energy had just over a million customers without power. It was a devastating storm that knocked down large trees, broke many poles, and saw a lot of wire blown down, not to mention the damage to customers' homes.

Naturally, as part of the restoration process after a big event like this occurs, Dominion Energy relies on its own dedicated resources, as well as assistance from various contractors to get the job done. In cases like Isabel, they may also bring in mutual assistance resources from other utilities across the country.

When Isabel hit, one of Whitfield's first roles was onboarding the contractors who were coming in to help. For the first few days, she worked around the clock – just as many of her co-workers did – to ensure Dominion Energy was prepared. But she soon transitioned into a project management role. She took a contingent

of about one hundred contractors and traveled from Northern Virginia to the Hampton Roads area. They were assigned a neighborhood where there had been significant damage. Customers had been out of power at that point for nearly five days. It took Whitfield's team several days to get the power restored in this neighborhood and the surrounding area.

Charlene Whitfield's present responsibilities reside on the electric transmission and distribution and customer solutions areas of Dominion Energy. As such, she's involved in a few different programs Dominion Energy has rolled out related to grid hardening. On any given day, Dominion Energy is looking at reliability improvements across its systems. What can it do to improve the reliability of a particular circuit or a particular area? According to Whitfield, Dominion Energy has sought and received approval for what it calls the grid transformation plan.

The grid transformation plan allows Dominion Energy to strategically invest in hardening the grid through electric line upgrades, installation of smart grid devices, corridor improvements, and smart meters, along with other opportunities. Dominion Energy's goal is to harden the grid to improve resiliency and reliability.

Dominion Energy is also working on upgrading the technology within its substations to increase visibility of where outages occur and improve the ability to limit those outages to smaller segments of customers. Dominion Energy received approval in January 2022 for around six hundred fifty million dollars in phase two grid transformation funding and plans to continue to look for more opportunities to improve the reliability of the grid.

Last but not least, there's another program that Dominion Energy has had in place for several years: the strategic underground program. The program targets the worst performing tap lines within communities. Tap lines are offshoots of the main lines that usually run along major roadways. The goal is to underground those neighborhoods' tap lines so that when a storm comes through, it doesn't knock down those tap lines. Undergrounding the worst performing tap lines helps restoration efforts for all customers by allowing Dominion Energy to focus restoration efforts on the main lines to help get power back on for everyone sooner.

The strategic undergrounding was a program that chapter three's Alan Bradshaw had the privilege to lead. It gets back to reducing the amount of work that needs to be completed. In many of the locations where overhead power lines run through neighborhoods, they're located in backyards. One of the worst things is seeing a row of bucket trucks parked on the side of the road while all the line

workers are in the backyard climbing poles. A most valuable piece of equipment, a bucket truck, is basically rendered useless in those cases. Then the number of line workers that are sent there must also double or triple because the work is so manual. Making these changes in those hard to restore areas and those that are impacted frequently can significantly reduce the amount of work that needs to be done in a restoration. It also frees up those same line workers to be assigned to other outage projects – therefore getting the power restored for everyone faster.

Flipping back to the West Coast again, this time with San Diego Gas & Electric (SDG&E), Brian Childress sees a lot of the tools and technological changes the industry is making to keep the lights on and get them back faster when needed. Childress is a Distribution System Operator at SDG&E. Whether it's a lineman, electrician, or anyone else, any work they do on the distribution electric system at twelve thousand volts or less goes through his department. The Electric Distribution Operations Team writes the jobs, and checks and approves everything from the very beginning all the way to the end. Normally, Childress works eight-hour or twelve-hour days, but he may have sixteen-hour shifts at times.

On normal days, the department has anywhere between eight and a hundred jobs going in two separate districts in the north and south ends of their service territory. For all these jobs, Childress is calling crews to accept hotline orders. If a circuit breaker were to trip because of a fault, it would re-close. If there's still a fault, it'll trip again and close a second time. The hotline work makes it a little bit more sensitive. If the crews are working up there and get into the lines, it will trip and not close back. Similarly, if a crew's out there working de-energized, then Childress gives them the okay to open and de-energize the circuit. If they're working in a certain section, but there are thousands of customers beyond that section, they'll try to offload those customers so that they never see an outage.

If it's possible to imagine, Childress is busier in restorations. When any fire happens, Childress and his team are notified by the company's fire coordinator. In his office, technical support staff will have phone calls between management, the fire coordinator, and meteorology.

Childress and the system operators get information from them and move forward with what needs to be done. In the case of the 2020 Valley Fire, they ended up needing to de-energize the system. Those in the field provide a location to isolate and Childress's team is just opening up switches, dropping load, and trying to make the area safe.

Unfortunately, this was also in the middle of the pandemic. The department was understaffed.

It was a lot of extra work and extra hours. Not to mention they were split between the main operating center and their backup control center. Childress was constantly on the phone regrouping on updated information. Anytime there was a fire or other event, it created more challenges. For a good year, Childress was working six days a week most of the time. It was stressful and tiring on everyone.

The 2007 wildfires led to a lot of changes for SDG&E. Ever since then, SDG&E has been hardening its electric system against wildfires. The company has re-conductored a great deal of the backcountry, and it has been working on undergrounding power lines.

During high fire risk weather conditions, SDG&E and utilities throughout California may implement Public Safety Power Shutoffs in order to prevent their electric system from becoming an ignition source. SDG&E operations personnel maintain a high level of situational awareness thanks to the company's advanced weather forecasting and system conditions tracking, including the Potential Fire Index and the Santa Ana Wildfire Threat Index. As situations evolve, highly experienced subject matter experts on staff take actions to protect public safety and mitigate any threats.

Turning off power is a last resort, only enacted when necessary to keep the public safe, and power remains off until conditions are safe again. The challenge is predicting how long an outage might last. There are a variety of factors, including the duration and location of strong winds, potential damage to the system while de-energized, and whether aerial patrols are possible at the time. In addition to a dense network of weather stations and advanced mountaintop cameras that monitor for smoke and fires, field personnel also help SDG&E gauge conditions in real time to support operational decisions. SDG&E also collaborates with the National Weather Service, the United States Forest Service, CAL FIRE, and the San Diego County Office of Emergency Services to share information. The restoration process can begin once wind speeds reduce for a sustained period, and there is sufficient daylight to allow crews to patrol a line and deem it safe. Once equipment and conditions are confirmed safe, crews will begin systematically restoring power.

One crucial piece of infrastructure that we have yet to discuss at length in this book is power stations. Two examples of how restorations can be difficult despite best laid plans are a couple of power stations located in Austin, Texas, Sand Hill

Energy Center and the Decker Creek Power Station, both operated by Austin Energy. In February of 2021, the City of Austin learned about a winter storm coming to town, so they prepared. These two power plants experienced some harsh challenges due to the storm that would later be called Winter Storm Uri.

Wesley Bray has been with Austin Energy about sixteen years. Today, he serves as Mechanical Maintenance Supervisor at the Sand Hill Energy Center. He manages a crew of five mechanics that tend to a wide variety of things around the plant, from working on pumps, to valves, engines, and gas turbines. Some days they might be welding. Other days they may be running PVC pipe or rebuilding a pump.

According to Bray, getting the manpower to assist in Uri restorations was the biggest problem he faced. Many of his crewmembers live outside of the City of Austin in rural areas. Some of them weren't even able to get out of their driveways or down the highway to get to the plant due to road conditions. Bray was the only one that could make it in at first. For the first five days or so of the storm, he was the only mechanic. The plant had planned ahead and had operators and electricians, instrumentation people on site. They even had enough to have separate day and night crews. But as the only mechanic, Bray was pretty busy and was leaning on operators who are cross trained to help with mechanic work. He didn't get much sleep because his radio was always on, and it seemed that the storm conditions got worse at night. He was constantly listening to see if they needed help somewhere in the plant and was always ready to go assist at a moment's notice.

Bray believes it was impossible to prepare enough for that storm. None of them had seen it that bad, especially while working at a plant. They had prepared and made plant improvements over the years and felt better prepared as far as the facility went. But as far as having their heads wrapped around what they were about to experience, he doesn't think anyone was quite ready. Being in Texas, they don't experience a lot of ice and snowstorms. Every winter they prepare and get the plan together, making sure they have certain things in stock and ready to go. But that's the usual plan, and it included nothing specific to deal with something as unprecedented as Uri.

Austin Energy did its best to prepare, carrying out plans that had been well thought through. Alonzo Rodriguez, a Power Plant Technician at Austin Energy, works at Decker Creek Power Station to this day. When Uri was on its way, everyone at Decker went through their winter storm checklists to ensure everything was prepared for storm weather. All the water sources were cut off, the outside

equipment was covered with tarps, and all outside heaters were placed. Fuel was added to all the vehicles and salamanders, and extra fuel was on standby. Then they shut all the doors and windows at the plant and were ready. They had covered what generally freezes over and causes problems in the winter. What they weren't ready for were the unexpectedly complicated conditions inside the plant.

They never anticipated dealing with the plant's interior freezing on them. But the winds were coming at them hard, blowing snow in through the air vents. They weren't ready for that and could hardly keep up. The wind was so powerful, Rodriguez even described it as feeling like having buckets of sand thrown at him. But on the bright side, they had done well covering the outside. They were prepared for that.

Still, that snow on the inside posed a lot of challenges because it was opening vents and it wasn't even identified as an issue for some time during the whole operation of combatting Uri. It was a whole different experience than what they had dealt with before – what they had known how to prepare for.

Kendall Rieger, who now works under Bray as a Senior Power Plant Specialist at Sand Hill, was employed at the Decker plant at the time. The mechanics at Decker were scheduled into day and night shifts, with two mechanics per shift. When it all started, Rieger didn't think it was going to be that bad. Then driving in to work and later, driving home, the roads just kept getting worse. It became easier to simply stay at the plant. Plus, if they went home, there was no electricity anyway. For many of them, it was warmer at the plant than it was at their own house.

John Lalande oversees plant operations at Sand Hill as Power Plant Operator Superintendent, and like the others, believed they were as prepared as they knew how to be for Uri. The Sunday it all started, Lalande came in with one of his shift supervisors as the storm was already coming in. He'd had the forethought to go to the local HEB and pick up all the frozen and canned food he could fit in a car. Because they had been through something similar before, though not to the same extent, he remembered that one of the things they struggled with was having an adequate amount of food on hand. It was Lalande and sixteen others on the operations and maintenance staff, who all stayed at the plant for the entire event.

Dealing with Uri as a whole was an incredible experience. Crews were staying full-time at the power plants, sleeping in cots, and relying on people from the outside to bring them additional food, and there was still difficult terrain to get

through for that support to reach them. But as they took care of the workers, the workers took care of everyone else as best they could.

For all of those involved, however, it was intensely rewarding that they were able to keep the unit online amidst all their struggles.

Rodriguez explains that one of their level indicators froze inside the Decker plant. They used hair dryers and heaters, trying to dry it out. They were using heated blankets to keep equipment warm when salamanders ran out of diesel. Then, in two hours, they had them working again. The rest of the time they were fully online, which may come as a surprise to many Texans, or anyone else aware of Uri's impact in the state. But perhaps it's important to point out: these power plants were tasked with generating power.

So, they kept the unit running. ERCOT nearly lost the whole grid, but Austin Energy was still making electricity.

It was largely the same for Bray at Sand Hill. The plant was up over ninety percent of the time throughout the storm. It only tripped once or twice, and once was because it lost gas due to the gas supply getting so low. Bray was very impressed to see everyone step up and opt to stay at the plant, noting their willingness to commit the time to stay there for a few days, and be away from their families. Seeing that people were willing to get out there, risk their own safety, and climb ice-covered stairs while carrying propane tanks to thaw out equipment, was inspirational.

Rogelio Zavala, Operations Supervisor at Decker Creek Power Station, also has memorable moments from that time where every individual was taking action. He remembers a lot of things like pipes rupturing, valves cracking, and other things simply bursting throughout the plant. People were trying just as hard to figure out what the problems were as they were trying to fix them. There were constant questions to be answered. What did they need to fix it? How could they isolate each issue? But none of them hesitated. Everyone seemed instantly ready to just get out there and do the work.

Even if it wasn't someone's specialty, or even their job, people helped. There were times throughout the nights, when they were sleeping, that things got bad. Everyone had to get up from their cots and go outside to keep things running. But there were no complaints, says Bray, just teamwork and positive attitudes. They knew what they needed to do to keep things running, and were ready to do it.

Even so, keeping things up during Uri was harrowing. Bray notes that Austin Energy has been investing in preparations for these plants in a lot of ways. Sand

Hill has been investing in engineering analysis and upgrading equipment to ensure that the plant improves its winter readiness for any temperature.

It's arguably a lot to even ask of a Texas plant, to be prepared for subfreezing temperatures for a week. Owing to the state's usual weather patterns, the plants weren't built with that in mind. But that doesn't mean Austin Energy isn't doing everything to prepare its plants for these possibilities.

Winter Storm Uri tested their emergency plans. Zavala described it as a freak event, something they hadn't yet experienced in Texas. It was truly something many never expected to experience being that far south. It's difficult to be prepared for what you can't imagine. Austin Energy crews regrouped and adapted to keep producing energy throughout the storm without a single safety incident or injury. The experience is helping them refine and improve plans to be even better prepared if another storm like Uri descends into south central Texas.

Planners and Preppers

Many of those behind the scenes are focusing on coordination, planning, and prepping resources and supplies. One such unsung hero is Brittani Harden, who currently serves as Fleets and Facilities Supervisor at Keys Energy Services. Harden will celebrate her fifteenth year with Keys Energy this year, but like many others, Hurricane Irma was one of her hardest storm restorations. However, technically she wasn't even doing her job.

At the time of the restoration, she was Collection Supervisor, but had previously worked as a buyer in the warehouse. Because someone was out on maternity leave, and Harden had previous experience as a warehouse employee, they asked her to assist in the warehouse when Irma was coming in. She was actually set to go on vacation but canceled her flight.

Her role in the restoration was ensuring their teams had enough material. She issued material to crews and received additional orders for more. As a general procedure going into hurricane season, they always buy the maximum amount of supplies they can, sometimes even beyond the max. But while she was working, Harden realized that they weren't ordering fast enough to meet their demand. They were reaching minimal levels. In fact, they were at minimum levels in just the first day.

So, Harden and the rest of the team picked up the pace on normal operations. Tasks they would normally be doing weekly, they were doing twice a day

just to understand what was being used and in what quantities. Because it's easy to see that everything was gone, and easy to say they needed everything, but there's no order-all button in this line of work. They had three warehouses to fill but needed to know where the priorities were. Was it distribution? Underground transmission? What did they want to focus on? What materials were going the fastest? Where did they need to get in the material the quickest? After all, where had Irma done the most harm in their service territory?

Meanwhile, down in the Florida Keys, there were challenges in getting those supplies. During this restoration, all the bridges were closed and so were many roads. Their supply chain coming in was at a complete stop. Then once the bridges had been inspected and reopened, because of the severe storm damage, local officials didn't allow just anyone to come over. You had to have a special letter, a supplier letter. So, on top of everything else they were having to issue those for vendors to bring their supplies in.

It was certainly challenging work, but there were challenges outside of the work that many don't realize. For Harden, it was the number of days without a shower, because the water was cut. As a woman in a very physical job during that time, running around, climbing ladders, and being on forklifts, she wanted to wash her hair at the end of her sixteen-hour workday. Trying to do that with a couple of water bottles was not fun.

However, there were still silver linings. Harden remembers that the camaraderie was wonderful, even during the long days. Those relationships felt multiplied. Key West is a small city, so they're all very close according to Harden. A lot of people that she works with, she also grew up with, which is nice. But when they're put into an emergency, even with all the outside contractors, they're all living that life together. They're living and breathing restoration. They see each other day in and day out and share both the pains and rewards of the entire experience. Some of the contractors that Harden made friends with during the Irma restoration, she's still in touch with to this day. It goes past just that month or those few weeks that they were boots on the ground.

Moving up the East Coast, and up the chain of command, Adam Taylor is Senior Manager of System Operations at Santee Cooper in South Carolina. He runs the energy control center and back-office support for the system operators. For the past eight years – a third of his time at Santee Cooper itself – he has also served as Chair of the company's emergency action plan.

They're always preparing for the next big one, especially since Hurricane Hugo in 1989. However, in recent years, the storm plan has gone from a tailored

full-scale response to something a bit more modular. Lately, they can limit a response such that hundreds of contractors and tent cities aren't always necessary. Since 2014, Taylor has helped activate emergency plans every year, if not multiple times per year, and sometimes it's limited to a small part of the system. It's down to how many resources they want to bring that determines cost of the operation.

Two restorations in recent memory have been particularly challenging for Taylor. The first was the ice storm Pax in 2014. Santee Cooper hadn't dealt with a major storm since Hugo. They had the plan, but the plan needed updating. So, they felt like they were making things up as they went along at times. Some things just had to change on the fly. They were able to track what the issues were and get the crews to the right places, but finding contractors was a problem because everyone needed contractors. They were also still learning how to efficiently use helicopters, both for patrol purposes and to cut debris off lines. There was no way to know how bad it was going to be as the trees gave way under the ice. But Taylor learned a lot from that. Afterward, he was able to gather with others and review those lessons learned to incorporate new strategies into the storm plan.

Then there was the second storm, Hurricane Matthew, which caught them by surprise. They were a lot better prepared having gone through the ice storm, but to Taylor it was still something to see. He sat in the control room just watching the transmission system fall apart. Before that, he had always been in the field, so he didn't know everything that went on in controls. All the big picture angles – just learning how to set priorities, the importance of keeping generators and plants connected, how stable bulk transmission comes first before getting customers back on – were a huge change for Taylor.

Working in monitoring, he's very busy these days. There are always things that need to be done. It's been eye-opening for him to see what else was going on. When you're in the field, you only see what's going on in front of you and may wonder what everyone's thinking back at headquarters. Why does it take so long to get lunch and things like that. But there's a lot of logistics and planning and decision-making that must happen to get people in the right place and get the lights back on as soon as possible.

As far as planning goes, one thing Taylor knows is that we are always working on storm plans, trying to make them better. We drill scenarios, but it's always preparing for the last storm. The next one is often going to be completely different. So, have a good plan, drill it too, but use some imagination when making plans, because the next storm can throw a curveball.

In the world of restorations, curveballs are aplenty. Crises spring up in way we don't expect. So, how do we predict the unpredictable? The short answer is we can't. But there are quite a few ways the industry is trying harder than ever to prepare for storms and plan restorations to the highest efficiency.

Don Daigler has been with Southern California Edison for about a decade. Before he arrived, SCE responded to crises like many other utility companies – by assigning a lead organizational unit, adding key departments and offices to the working group, and coordinating with emergency responders, regulators, legislators, and customers. However, SCE also had the foresight to search for someone with a background in emergency management and crisis response who could build a centralized crisis management unit and enhance the company's ability to respond to sudden challenges. That's how it found Daigler, who now serves as SCE's Managing Director of Business Resiliency, and who has created a progressive crisis management model for the company.

When Daigler's new Business Resiliency unit began its work in 2013, their focus was anything that would create "a bad day" for the company. That meant everything from reputational concerns to kinetic damage to the grid system. They assumed a coordinating role in all aspects of the company's business.

A majority of the work done every day at the utility doesn't need Daigler's team to help manage their work. Furthermore, in today's world, newer threats like cybersecurity events are the primary responsibility of the company's cybersecurity team. However, when events escalate beyond the scope of the cyber team to manage, such as a cyber breach or ransomware attack, the cyber team would be integrated into a corporate level structure that falls under Daigler's purview.

If multiple parts of the company are impacted or there's significant external interest, Daigler's organization comes in to provide the corporate overlay that manages the overall event. This structure brings together operations, logistics, customer service, corporate communications, local public affairs, and others as necessary.

Daigler's broad crisis management is accomplished using the incident command system, which is a standardized approach to the command, control, and coordination of an emergency response. Preparedness for these crises that arise comes through the use of situational awareness tools, contingency planning, training, drills, exercises, and ensuring teams are equipped appropriately.

For example, on the situational awareness front, business resiliency runs the company's meteorology and fire sciences programs. They have three fire scientists looking at fire fuel configurations to assess the potential threat to the

energy grid. How much fuel is there and how dry is it? Business resiliency also has a seismologist looking at the threats an earthquake would create. Meanwhile, hazard assessment and mitigation programs look at how to continue hardening the grid in preparation for these events and how to minimize event impacts on the system.

When things do start to escalate, Daigler's business resiliency team, a group of seventy strong, spring into action. Many have previous experience in crisis response as former firefighters, county emergency managers, or Federal Emergency Management Agency employees.

Daigler has organized these teams under the same principles that the federal, state, and local governments operate within. The National Incident Management System, developed by FEMA, is used to establish the main criteria for the incident command system. It drives consistency regarding which forms, terminology, titling for positions, and training is used.

The team is trained similar to a fire team. A planning section chief in his organization is trained the same way as a fire planning section chief. To date, Daigler has trained around seven hundred fifty employees to fulfill roles in the incident command system as part of an incident management team (IMT). In addition, the state of California has adopted the Standardized Emergency Management System, which is how the state implemented what is now a national standard. Business resiliency has helped the company remain compliant with these guidelines for nearly a decade.

Daigler also created a Watch Office, a twenty-four-hour per day, seven day a week monitoring group designed to compile all the information about current incidents affecting the company at any given point in time. They generate a daily report that goes out to the leadership team. The report includes things like the number of outages they've had, current weather conditions, geopolitical situations that are going on, social media trends, and more. The Watch Office also manages rotating incident management team rosters.

When incidents begin, the Watch Office will be notified. The Watch Office immediately reaches out to the Business Resiliency Duty Manager (BRDM), a lead position for the incident management team. The BRDM then sets up a call with all relevant company personnel. After this, it's up to Daigler's team to make a judgment call on whether they actually stand up an IMT to address the emerging situation.

At its core, Daigler's work gets down to determining the risk or hazard environment that SCE is facing as a company. His team evaluates the information and creates a starting point to address these crisis issues.

Addressing crises often involves system hardening. Since southern California falls victim to wildfires and earthquakes relatively often compared to the rest of the nation, these sorts of recurring events inform how the company's system hardening is done. A utility's risk profile drives its investment strategy.

For instance, covered conductor is installed in a lot of the high-risk fire areas in SCE's service territory because the primary fire threats to the system are unexpected objects, such as palm fronds, interacting with the lines. Covering the conductors prevents sparks in a quick, effective, and cost-effective way.

As Daigler looks to the future in his role, he believes climate changes will have an impact on how SCE continues to operate. Another key element impacting SCE's operations is the company's drive toward a greener, more sustainable environment. The inclusion of clean energy into the system is requiring the industry to create infrastructure that will continue to change the industry dynamic. We're starting to see more advanced technology and computer science-related work being incorporated into utilities. Daigler anticipates the company continuing to monitor and address the evolving threat environments, but with new and improved tools on an ever-changing cycle.

An industry giant who knows much about the changes throughout our industry over the years is Edison Electric Institute's Senior Vice President of Security & Preparedness Scott Aaronson. To him, the 2017 storm season will always stand out as absolutely extraordinary. The season included four major storms over the course of three months: Hurricanes Harvey, Irma, Maria, and Nate.

With Harvey, it wasn't even a huge power outage issue. His concern was the forty-eight inches of rain that fell in the three days the storm just sat over Houston, the fourth largest metropolitan area in the United States. Then with Irma, it was one of the most catastrophic storms to ever hit Florida. It was a category five storm that hit every county in the state of Florida, traveling right up the spine of the state with winds up to one hundred seventy-seven miles per hour.

But what is Aaronson's role in this exactly? Well, he tells people that when it comes to the restorations, he doesn't do a thing. He goes to work in a suit, in a conference room. He doesn't restring wire, and he doesn't reset pole. However, he and his people at EEI do play an important coordinating role when it comes to mutual assistance.

For instance, when Superstorm Sandy hit, it changed the way the industry and government collaborate. It was the beginning of the CEO-led Electricity Subsector Coordinating Council, which was created to facilitate industry-government coordination on threats to the energy grid at the highest levels. What it allowed for was a unity of effort and message across several organizations and companies, the effort seen as the people out in the field, the convoys of heroes, rolled into the area to restore power under terrible conditions. But they needed overhead cover. Sometimes they needed emergency authorities, or a flight restriction temporary lifted so that they could get helicopters and drones in the sky. Sometimes they needed to pass through tolls or roads with truck weight restrictions to be able to get from where they are to the state that was impacted. So, the ESCC has been able to support the industry in unifying all segments of the sector, working collaboratively with government, to get people in theater as quickly as possible.

The ESCC is there to help knock down barriers to getting the power back on as quickly as possible. While the ESCC came up because of cyber and physical security threats to the grid, they quickly realized it needed to be more than that. Because what happens more often than cyber-attacks? We get hit by storms, fires, earthquakes, and anything else Mother Nature wants to sling at us.

But the ESCC's role in coordinating unity of message, while may seem like a bit of a marketing cover is also uniquely important. Communities need to hear a unified voice from industry and government. If the government is going on about how the situation is catastrophic, but the industry is saying we've got things under control, who will know what to believe? But if industry and government both openly outline things like an expected outage duration, the limitations to getting power back on quicker, and how industry and government are working collaboratively, suddenly, you've got a narrative. Customers can plan for how they will cope if they have information like that.

Every one of the incidents Aaronson has been through since 2012 has been an opportunity to refine the industry-government partnership and to create more federal partnerships. The industry also has focused on enhancing this type of coordination with regulators and policymakers at the state level. As far as the actual threats themselves, Aaronson doesn't pay much mind to why the power is out. Storm, fire, earthquake, cyber-attack, physical attack, zombie apocalypse – it doesn't really matter. What he's focused on is consequence management, the impact once the power is out. Now, each threat requires a different form of response. A cyber-attack doesn't require rolling out bucket trucks to the

impacted area, after all. But regardless of the why, it's always about restoring power as quickly as possible.

Additionally, the industry always is focused on getting better, learning from each event. There are new technologies that are constantly evolving to mitigate or solve constantly evolving challenges. The mantra of this industry is that we want to be better today than we were yesterday, better tomorrow than we are today. There are after-action reports that evaluate responses to major incidents, and the lessons learned from these past experiences are incorporated into the industry's playbooks.

Everyone talks about smart meters and better situational awareness, all the sensors out there being new vectors for attack. Aaronson calls it the smart grid paradox. On the one hand, there's a broader attack surface due to relying on a lot of digital equipment, but there's also better situational awareness. There's visibility into systems in ways that we've never had before through these technologies that have never existed before. This data made available by smart grid sensors affords greater control to system operators in normal conditions and a more granular and immediate assessment of emergency conditions when they arise.

It all gets put into perspective when we remember one thing: no other industry does this. When it comes to restoration, companies are not competing. Every organization has their own problems. They're doing their own work. They've got their own challenges. Even in the face of all that, they're giving up human resources – the people. These are the heroes who are saying goodbye to their families for weeks on end, sometimes going into terrible conditions, and working safely and collaboratively on each other's systems, on a totally volunteer basis. This is an industry that recognizes its public service responsibility. Aaronson, like many others, loves this industry for exactly that reason.

Caring for Customers

At the end of the day, keeping the lights on isn't about electricity at all. It's about the people flipping the switch in their home, turning on their electric vehicles to drive to work in the morning, and charging the devices that keep their lives moving forward. The industry has a variety of organizations and departments at every utility and association, all geared toward caring for those customers.

For example, Kari Gardner manages Southern California Edison's Consumer Affairs Office. She and her team handle customer concerns regarding

experiences they have with the business as well as customer comments to executives, elected officials throughout SCE's service area or other regulatory requests that come through from a customer's perspective. Gardner also worked on Incident Management Teams, serving as a situational unit awareness leader for about five years.

When events do occur, Gardner is responsible for advocacy and care, especially for vulnerable populations like the elderly, disabled, or other customers with unique needs – for example, a customer who relies on medical equipment that can be impacted when power outages occur. She is incredibly passionate about supporting these vulnerable populations when catastrophic situations occur. How will the company respond? In what ways will it serve these customers?

Her focus is on communicating with them to provide support so they can ride out an outage comfortably. Or receive resources necessary to help them.

In late 2020, wildfires were burning in SCE's service area. The company had to de-energize to protect firefighters and the community, and there were other outages affecting the service area where the fires were not happening. Throughout the whole ordeal, Gardner was committed to communicating with customers swiftly, so they could know what was happening and make informed decisions. After all, it's not always best for customers to stay in their homes during these wildfire events. Gardner also worked with local agencies that offer support services to these vulnerable customers. It's the safety of the community, not just the restoration of power, that everyone is focused on. Gardner and her team were working long hours but they're customers themselves. Their family members are customers. Gardner's whole team is committed to helping as much as it can in whatever ways possible, whether it's directly or indirectly, through other resources.

When Gardner became the situational awareness leader on the IMT, she relied on her team members to run day-to-day operations. So, while she's learning everything that's happening and providing direction and guidance as necessary, her team is moving on its own to respond to complaints. Another piece of the work in that space is SCE's social media, responding to the chatter from customers and responding to questions. Of course, that engagement peaks during an incident. Customers are going to social media and the call center, and the public service commission, all at once. Gardner is still helping in that area, overseeing the operation, but her primary focus shifts to pulling together the details about the current event so that she can provide the incident team with updated

information on what's taking place. Her role involves obtaining weather information from meteorology services, information on the volume of calls at the contact center, resources available in certain areas and other critical information that needs to be shared.

On Labor Day weekend in 2020, another fire started in SCE's northern territory near Shaver Lake, which was later named the Creek Fire. Many of the challenges related to this event directly affected hydro operations in Big Creek. Communities in the mountainous areas had to be evacuated, and once they were evacuated, it was Gardner's team providing them with support. Some of the resources she has helped establish support those who live in high fire risk areas, which cover about thirty percent of SCE's service area. For instance, customers using medical or mobility equipment or customers on a limited income have access to a program that offers them a free, portable, solar-charged backup battery for their home to use while power is out in their area.

Even though Gardner and her teams are learning from each event and getting better all the time, these events continue to grow more difficult. So, how do they plan for the future? Well, they are always looking at all aspects of their operations, determining goals on what they want to achieve. When they're reflecting on a catastrophic event, they consider both what went well and what needs improvements. They also collect the feedback received from customers, elected officials, county partners, first responders, and internal sources to holistically consider what improvements should be made to their future plans. A few years ago, SCE created an advisory council, a convention of joint utility partners in California. It also includes fifty-eight different agency representatives who partner in the development of new plans to serve the most vulnerable customers and what may be missing from them.

Another important part of all this are the people who stop doing their regular job to help respond to the community. Gardner has led groups of volunteer employees who leave their regular job to become part of a team that goes out into the community in person. They provide in-person support at local assistance centers and bring out a community outreach vehicle to impacted locations to provide services and support to the community. This community outreach vehicle has a phone charging station for customers to charge their electronic or small medical devices. That way, their phones are available to them so they can get important messages regarding the restoration progress and their medical needs can still be sustained. They've now used this in regular operations during prolonged outages or other situations besides PSPS events. SCE also hosts

community resource centers that open up for the public to come in and actually stay inside, get out of the elements, cool off in the air conditioning, and have resources available to them.

All of this work gives Gardner a sense of purpose knowing that the actions she takes are benefiting and helping others. For her, that's what drives her desire to continue doing what she does and do better at it too. It's helping thousands of people.

As much as the industry cares about its customers, there is always consideration for caring for employees as well. Christina Lopez serves as the Senior Director of Employee and Customer Programs for Florida Power & Light's (FPL) power delivery organization, where her team supports both the communities FPL serves and the frontline employees serving them. Perhaps more importantly, her team is responsible for hiring those employees, including new hire engineers, journeymen, and new candidates in their journeymen apprentice program. The team provides the training for entry-level positions into the utility industry, ensuring they learn the fundamentals that they'll take with them as they progress through their careers.

Lopez's team also ensures consistent responses to customer inquiries related to reliability and power-related issues. Her team's roles also include change management and communication coordination within the power delivery organization to ensure collaboration throughout the business unit is fluid.

When it comes to storms, Lopez's team supports the frontlines. Like everyone on the FPL team, Lopez taker her duty to the communities FPL serves seriously when a storm threatens the area.

To prepare new hires, she emphasizes the importance of knowing their roles. And ensuring their families are prepared as well.

In a storm event, she is based at FPL's command center, where she serves on the critical information team. In some cases, she may serve as an incident commander in the field. Regardless of the role she's playing, she proactively works to ensure her team is prepared to execute their roles. Everyone must understand the mission and plan so that they can effectively respond and return home safely following restoration.

FPL's command center is where the company lays out the restoration strategy, including establishing locations for staging sites or coordinating with outside vendors to provide support. Command center staff also is responsible for updating field supervisors about the daily restoration strategy and reinforcing the continued importance of safety.

Lopez has been in the utility industry for thirty-three years and vividly remembers one of her first storm experiences. Hurricane Andrew hit just two years after she began her FPL career, and the aftermath provided a major learning experience for her. It was eye-opening to realize the strength Mother Nature possesses and recognize the value of the service FPL provides to its communities.

Marie Bertot, having spent a lot of her life in the Southeast, is also quite acquainted with Florida hurricane protocols. While she works for Southern Company today, her first major storm experience was with Hurricane Andrew. The storm hit a year after Bertot graduated from college. Prior to Andrew hitting Florida, she had done an internship with the American Red Cross as a volunteer coordinator. As people volunteered, she would assign them either to the hurricane effort or to the blood effort. At the time, she noticed that they didn't have many hurricane volunteers. But her manager assured her, they didn't need a lot of hurricane volunteers, what they needed was blood.

Skip ahead to August 1992, and Bertot is moving from Gainesville, Florida to Miami for her first professional job as Marketing Director at the Miami Beach Chamber of Commerce. On her drive south, she watched as the damage became progressively worse with each passing mile. When she arrived for her first day of work, she walked in the door only to tell her manager, Bruce Singer, that she didn't feel like she was supposed to be there. She explained that she had just worked at the Red Cross, and she knew that they did not have enough hurricane volunteers. So, Singer said he was coming too, and grabbed four of the other six staff members to join them.

They got in Bertot's car and went straight to the Red Cross. This was just two days after Hurricane Andrew struck the area. The moment her old boss saw her, Bertot was given a metallic Red Cross sticker identifier for her car and a bunch of army rations. They gave her team maps, assigned them as damage assessment, and sent them on their way. Only the map was no good because there were no street signs. They were obliterated. They went down US-1 as far as they could and counted the blocks. They had no idea where they were. As they went, they could see where tornadoes had spun off, and houses crumbled down to the ground. The rest of the houses were all damaged. There were whole roofs blown off.

But what she found most interesting was the way the people responded when they saw her team. They came at them like zombies. They would see the car, see the Red Cross sticker, and start walking slowly toward them, most likely still in shock. However, by the time they reached the first third of their yard, they were walking fast, and by the time they got to Bertot's car, they were running.

This happened block after block. It was a phenomenon that impacted her greatly. Because time after time, she could only pass out food and tell them they were just there for assessment. There was so little she could do to help them in that instant. She would be strong all day because she had to be. She wanted to be there for them. But when she got home at night, the tears would fall heavily from the painful images of the day.

Fast forward to 2001, Bertot found herself working in Miami-Dade County as a Public Information Officer for the county communications department. She supported all the different local departments and worked crisis communications for the executive office. When hurricanes hit, she was in the command center with the commissioners and the mayor. It was interesting to see the politics that go into everyone's communication and what they wanted to communicate. Also, when you have thirteen commissioners, a mayor, a city manager, and others all wanting to cater to their constituents, it's a fine dance to be done providing the messaging of recovery. The coordination of that message becomes even more important because you have to speak in one voice.

During that time, Bertot also worked with utility folks, like Florida Power & Light. Miami-Dade had an emergency operations center with seats for everyone: the utility, telephone, and cable providers, and the school board as well. After seeing her work, FPL later recruited Bertot from Miami-Dade. Someone reached out about FPL hiring a bilingual spokesperson and thought she would be perfect for it.

So, that's where she found herself when Hurricane Wilma hit in 2005. At the time, her parents were on vacation. Her father and stepmom had left her in charge of her eight-year-old half-sister and two dachshunds. When Wilma came through, it was brutal for Miami. Some people were out of power for over two weeks. At her parents' house, Bertot witnessed a tree fall through the backyard, breaking a concrete wall.

It was a lot for her to deal with – her home, her cat, her parents' home, their dogs, and the eight-year-old – and she needed to go to work. It's at these times that families of first responders have to be self-sufficient. The families are heroes just as much as the workers, because they know they're on their own. Bertot was able to communicate with her parents and have her little sister stay at a friend's house. It was time to start recovery.

Wilma had a long recovery, with a lot of angry residents. It's harsh when people are angry, but understandable. It's hard to be without power. It's even dangerous for some people, sometimes fatal. So, when you're the one who's supposed

to be getting the lights back on, you're either praised or you're hated. There's not much middle ground. In the aftermath of Wilma, residents were angry with the county. They felt that it was too slow in removing the vegetation to let the crews come in and do their jobs. However, dealing with anger and frustration among those you're meant to be providing a service to is really par for the course. It was after Hurricane Sally in 2020 that Bertot dealt with a more specialized customer interaction: social distancing.

During Hurricane Sally, she was on the Gulf Coast. It would be her last hurricane working with FPL. She remembers being onsite during restoration efforts. A man in a golf cart was helping two little kids pass out popsicles to the line workers. The line workers were loving it. But it was during the COVID-19 pandemic before the vaccines. Bertot started to tell them to stay six feet away from the line workers. As she did, the line workers looked at her. They needed this interaction. It was important to them. So, she backed off. It was a precious moment, witnessing true appreciation from the community.

Later in her career, she moved to Georgia Power, part of Southern Company. That's where she finds herself today. She'd been visiting Georgia for a few years already, working with her mutual assistance counterparts in the area. While working from home during the pandemic, she came up to Georgia where she has family and friends in Roswell. While there, she fell in love with the community. So, when FPL wanted people back in the office, she called her now supervisor, a friend from her crisis communications work, and asked if there was a spot for her at Southern Company. It was perfect timing because they were posting a crisis communications job the very next day.

The way she sees it, in her work with Georgia Power, Bertot is expanding her career experience with snow and ice storms. Just a few months into her time with Georgia Power, Winter Storm Izzy hit. It was a whole new game dealing with rain that would then ice-over. Now, they'd have ice heavy on the lines, and the many beautiful trees in Georgia become very dangerous during the snowstorms. In contrast, by the time the hurricanes Bertot is familiar with get to her now, they're often much milder than they are in Florida.

CHAPTER 6

Electric Futures

Our electricity system is built to last. That's an understatement. Many of the components in operation today were installed in the middle years of the last century. That's old. If a piece of equipment was installed in the year 1960, for instance, it would now be a senior citizen at sixty-two.

Still more of the system's components are newer than that, but not by much. These were installed in the last years of the last century. Still, that is quite a while ago.

As with what was constructed in the last century, when the industry installs equipment today, it expects it will be in-service well into the future. Yes, the accountants do commonly put down an asset depreciation life of twenty to forty years. Anybody in and around the industry, however, knows our equipment regularly outlives these assumptions, typically, by a wide margin.

Consider the ninety-three nuclear generating units operating in the U.S. They are licensed to operate for twenty years and then must go back for relicensing. Yet nearly all of them are headed to operational lives of eighty years, maybe longer.

This capital-intensive nature of electricity's infrastructure seems advantageous. It is, in most but not all respects.

Like a highway or a house, the heavy lifting for the industry's infrastructure is done upfront. Whenever assets do have service lives measured in decades rather than years, we're able to sit back comfortably and enjoy the benefits of that hard work ad infinitum. A little maintenance post-construction from time to time is all that is required.

The oft-cited example is our interstate highway system. One can drive I-95 all the way from Maine to Florida even though our government planned, financed, and built most of this two-thousand-mile road more than a half century ago.

The long-lasting lives characteristic of the power grid's bones, muscles, and joints, however, have disadvantageous consequences. This is paradoxical, but so true.

Consider this common challenge for the electricity industry. A company proposes a particular capital investment to upgrade the grid. Various organizations line up to oppose the project, to prevent it from receiving the required

governmental approvals. This is par for the course. Rare is the project that doesn't garner opposition.

Sometimes the project's opponents concede what seems like a key point. That equipment the capital investment would put into place, yes, it might indeed be "used and useful" for a decade or two. The project's opponents and proponents don't actually disagree about this initial period of operation. There's a comity among the parties. But one which belies what's coming.

Here's where the consensus breaks down. Here's where the conflict between the project's opponents and proponents crops up.

The opponents on occasion go down this path of arguments. While the project may be used and useful for as long as twenty years, they warn that it would be neither used nor useful thirty, forty, or fifty years out.

By then, their thinking goes, new, better, and cleaner technologies will almost certainly become available at scale. This would render the proposed equipment obsolete as soon as it reaches its twentieth birthday, or possibly before.

So, the opponents conclude, if government did allow the investment to proceed to construction, the installation would become non-economic and "stranded" after a painfully brief period in service. What's the bottom line of this reasoning? It's that the investment isn't a worthwhile commitment of utility customer monies for as long as forty years when the effective service life might be half that time. It must therefore not be permitted.

Grid assets have traditionally remained in-service for multiple decades, not just a couple of decades. So naturally many consider a shorter period of twenty years or so to be insufficient.

Now, this opponent argument depends upon a mighty big assumption that new and better technologies will become available at scale before long. That it will be plainly evident to everybody then, even if it isn't now, that the investment that is being proposed is not worthwhile.

Notwithstanding this argument's leap of faith in future innovations, it often wins the day in the court of public utility regulation. It leverages our confidence in rapid technological development, in an era when technology has indeed advanced at a frenetic pace in all fields.

If many such proposed investments are vetoed by government, it necessarily becomes even more critical that those new, better, and cleaner technologies progress to commercial availability, and do so quickly. Consider this familiar example. For every natural gas pipeline project that fails to make it past the

proposal stage, our dependance on the successful development of long-term energy storage at scale incrementally increases.

This is more so the case since society's demand is growing before our eyes for the continuous supply of electricity without interruption. Regardless of the ferocity of a flood or fire, or anything else Mother Nature or men with ill intent throw at us.

Many project opponents realize this of course. Many of them quite intentionally want to raise our resolve to rush along new, better, and cleaner technologies.

Perhaps we can say that there are heroes on both sides among both the proponents and opponents of projects. What separates them is, in part, how they assess the risks facing us.

Many opponents are committed to substituting as much clean tech for conventional tech as possible, for combatting what they see as the extraordinary risks of climate change. To get there, they're quite willing to accept the risks of somewhat less grid capacity, diversity and redundancy, and thereby somewhat less grid reliability and resilience.

This approach reminds us of the historical strategy of the conquistador Hernan Cortes in the year 1519. He famously scuttled ten of his eleven ships while preparing his modest force of six hundred soldiers and sailors to march on Montezuma's massive empire in central Mexico. Cortez reasoned that his men, unable to flee back to Cuba, would have no choice but to fight for their lives with him.

Some would similarly have us scuttle the ships to cut off any of the routes of retreat from our commitments to a cleaner electricity system. As Cortes might have counseled, we will then have no recourse. We will then install as much renewable generation and energy storage as is needed, wherever it is needed, and as soon as it is needed – or else. Failure will not be an option.

Floods, Fires, Firewalls

It sometimes sounds like a scary Hollywood filmscript. As was said and sung by the protagonists in the classic film, The Wizard of Oz, lions and tigers and bears oh my. Along the electricity industry's journey ahead are floods and fires and firewalls. Plus, hurricanes and ice storms and derechos. Oh my.

On the one hand, our society is destined to become ever more dependent on the uninterrupted supply of electricity. On the other hand, our electricity system is bound to become even more challenged by the storms that the

heroes celebrated in this book, and so many others, have gone to battle against again and again.

Something's got to give. Unless we step up our game in resilience, given these trends in our dependence on electricity and challenges to our system that supplies electricity, the risks to public safety will inevitably grow.

Picture future years in which we get a repeat of a Winter Storm Uri, with a similarly terrible death toll. And picture that an event like this takes place with potentially increasing frequency. Is that tolerable?

To do something about this, to stave off this dystopian story, we had better get started now. Since it typically takes years to develop a proposed investment, win governmental approval for it, and then install the upgrade to the grid.

And we better get it right as to which investments to make. Since if it is an asset, the most common mode of investment, it can be expected to be in service for many decades to come. You don't want to guess wrong about that.

Imagine if a utility invested heavily in a certain kind of supporting structure for many of its overhead lines, only to find out later that this kind of structure won't hold up well in the very high wind speeds of future hurricanes that are predicted. Well, that wouldn't be so good. Imagine if a utility invested heavily in a new substation, only to find out later that forecasted flooding would incapacitate that facility. That wouldn't be good either.

As the climate is changing, vendors are reconsidering the standards of their equipment. Their customers, the utilities that is, are monitoring this closely. What should be the new standards for the equipment we install for the mid-twenty-first century and beyond? The Electric Power Research Institute is partnering with the National Oceanic and Atmospheric Administration, as part of EPRI's Climate READi initiative, to figure this out.

Grid Hardening Art and Science

In materials science, hardness is a measurement of a substance's resistance to any kind of deformation. A diamond in particular is very hard. It's virtually impervious to penetration or scratching. Indeed, that gem's name comes from the Greek word for unbreakable or invincible, adamas.

A peach, at the other end of the spectrum, is certainly not hard. Slicing the tasty fruit is as easy as pie.

Metals can be further hardened. Such as by working a metal, heat treating it, or with an alloy. Then the metal is even more resistant to any deformation.

The electricity system is like metals in this way. It can be further hardened. Yet hardening our very complicated system, with its billions of interconnected parts, is not nearly as straightforward as perfecting a piece of metal.

When we invest in hardening the electricity system, we carefully study where capital is most effectively applied. In other words, which projects would harden the system the most?

There's the what. That is, what type of equipment should we install, that would make the greatest difference in resilience?

There's the where. Where should we install this equipment to materially lessen the extent and duration of prolonged outages?

There's the when. When should we make such upgrades in the sequence of all the other improvements that call for investment capital (and thus impose costs on utility customers)?

These are, it turns out, extraordinarily difficult questions to answer. Because the electric system is composed of so many components that work in concert in the most complex interactions. And because the threats to the system's regular operation of the greatest concern – the ones with the potential to harm utility customers the most – are so many and crazily varied and unpredictable.

Winds and waters and wildfires can slam into the electric system over here, or over there, or way over there. With an intensity of this, or that, or even that. We can only imprecisely forecast the future of storms, that is, where, when, and with what force they will come.

But, considering what's at stake, up to and including the safety of the public, we must harden our electric systems as ardently as the medieval smith worked the metal of his army's shields before battle. Our heroes of the storms are valiant indeed. Their quest – to make power, ultimately, uninterruptible – will be eased if we play our part too.

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About the Authors

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Steve Mitnick has authored four books on the economics, history, and people of the utilities industries. While in the consulting practice leadership of McKinsey & Co. and Marsh & McLennan, he advised utility leaders. He led a transmission development company and was a New York Governor's chief energy advisor. Mitnick was an expert witness appearing before utility regulatory commissions of six states, D.C., FERC, and in Canada, and taught microeconomics, macroeconomics, and statistics at Georgetown University.

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About the Painter/Illustrator

Paul Kjellander, a Senior Advisor at Lines Up, Inc., created the inspiring paintings on this book's cover and those leading off each of the chapters. He served as a Commissioner on Idaho's utility regulatory body from 1999 to 2007 and from 2011 to 2021, retiring as President of that Commission; as Administrator of that state's Office of Energy Resources during the interim period; and as President of the national association of utility regulators from 2020 to 2021.