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*Plus: AEIC Top 10 Awards
Undergrounding Innovation*

Fortnightly Top Innovators 2021



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All of this year's Inspiring Individual and Teams of Innovators, from Ameren Illinois, Ameren Missouri, Arizona Public Service, Avangrid, Burns & McDonnell, California Public Utilities Commission, CenterPoint Energy, ChargerHelp!, CPS Energy, Duke Energy, Electric Power Research Institute, Franklin Energy, Hitachi ABB Power Grids, Jones Onslow EMC, LineVision, Maryland Public Service Commission, Moody's Investors Service, Opus One, PPL, San Diego Gas & Electric, Southern California Gas, Urbint, and Xcel Energy.

44 Association of Edison Illuminating Companies' Top 10 Awards 2021

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PG&E's Landmark RFI to Underground Ten Thousand Miles of Lines.

Cover photo, top row, l-r, Arizona Public Service's Miguel Bravo, Xcel Energy's Nadia El Mallakh. Second row, l-r, Arizona Public Service's Christine Helmuth, CenterPoint Energy's David Mercado, PPL's Horst Lehmann and Eric Rosenberger. Third row, l-r, CenterPoint Energy's Eric Easton, Arizona Public Service's Jim Holbrook, Southern California Gas' Eric Coene, California Public Utilities Commission's Commissioner Genevieve Shiroma. Fourth row, l-r, Southern California Gas' Ron Kent, California Public Utilities Commission's Forest Kaser and Leuwan Tesfai, Southern California Gas' Matt Gregori.

Innovation Imperative

Fortnightly Top Innovators, AEIC Top 10 Awards,
Selective Undergrounding

BY STEVE MITNICK, EXECUTIVE EDITOR

It should be obvious by now that a culture of innovation is an imperative for the utilities industry. If only because the challenges we face, from the threat of climate change to the demand for customer centricity to the complexity of today's grid to the aging of the legacy infrastructure, and so on and so on, require continuous learning, invention, and integration.

Public Utilities Fortnightly started publishing an annual special issue on innovation back in 2017. Each year's special issue has featured the Fortnightly Top Innovators, which uniquely highlights and celebrates individual innovators or small teams of innovators. In the 2021 special issue on innovation herein, the PUF team does this for the fifth year.

In the 2017 special issue, for example, we cited the Electric Power Research Institute's Maria Guimaraes for her wall climbing robot and Andrew Phillips for his line crawling robot. And the New York Power Authority's Emilie Bolduc for her "New York Energy Manager" and Ricardo DaSilva for his utility-wide digital hub.

In the 2018 special issue, again for example, we cited Ameren's Cole Crews for the first private LTE network and Hawaiian Electric's Rebecca Dayhuff Matsushima for her model distributed generation contract. And Commonwealth Edison's Shay Bahramirad and Sandor Williams for

their smart grid pilot in a low-income Chicago community.

In the 2019 special issue, again for example, we cited San Diego Gas and Electric's meteorology team for their breakthroughs on wildfire prediction and mitigation. And Public Service Electric and Gas' Alexa team for their real-time customer service app.

Last year, in the 2020 special issue, again for example, we cited Burns & McDonnell's Zachary Wassenberg for virtual reality wearables. And Xcel Energy's drones team that pioneered remote and distant inspection of wind turbines.

Among this year's Fortnightly Top



Public Utilities Fortnightly started publishing an annual special issue on innovation back in 2017.

Innovators, it's tough to pick one or two particularly accomplished innovators among so many of them. With that said, there's the Arizona Public Service team for their fast-track emergency air conditioning program, the California Public Utilities Commission team for their program to accelerate microgrid adoption, and the CenterPoint Energy systems operations team that creatively coped with the Winter Storm Uri generation system outages, maintaining electric service for Houston area customers with less disruption.

Hold on. There's more in this special issue of PUF on awards that applaud industry innovators.

Thomas Edison founded the Association of Edison Illuminating Companies in 1885. Just three years »

Steve Mitnick is President of Lines Up, Inc., Executive Editor of Public Utilities Fortnightly, and co-author of a new book, "Front Lines to Power Lines," and before that the author of "Women Leading Utilities, the Pioneers and Path to Today and Tomorrow," "Lewis Latimer, the First Hidden Figure," and "Lines Down: How We Pay, Use, Value Grid Electricity Amid the Storm." Mitnick was formerly an expert witness in proceedings before the utility regulatory commissions of six states, the District of Columbia, the Federal Energy Regulatory Commission, and in Canada, and a faculty member at Georgetown University teaching undergraduate microeconomics, macroeconomics and statistics.



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The simulator is said to be an immersive and memorable experience, literally vibrating your chest while you feel the air around you rapidly heating up.


had passed since he jump-started the electricity industry with the opening of the first central power plant, Pearl Street Station. Now in its hundred and thirty-sixth year, AEIC is still fostering collaboration across the industry through its prestigious committees, as Edison intended, particularly in all facets of electric operations.

To further foster collaboration and learning what's working well and what's not working as well, AEIC recognized ten industry innovations this year. They're calling them the Top 10 Awards. Commonwealth Edison earned two of the ten, and the other award-ees were Con Edison, Duke Energy, Eversource, Florida Power and Light, the New York Power Authority, PPL Electric Utilities, Tampa Electric, and the Tennessee Valley Authority.

One of my favorites is the Eversource award. To better detect and analyze momentary electrical outages that customers experience, in its "Give Me a Moment" project, Eversource automated the integration of data from multiple systems to provide a holistic view of the distribution network. They named the new tool ARCHIE, which stands for Analyzing Reliability and Circuit Heuristic Impacts at Eversource.

Another favorite among the AEIC Top 10 Awards is Commonwealth Edison's development of a four-hundred-and-eighty-volt arc flash simulator. It's meant to give utility employees a greater respect for hazards, so they're less complacent going forward when dealing with energized equipment. The simulator is said to be an immersive and memorable experience, literally vibrating your chest while you feel the air around you rapidly heating up.

Check out the details on all the Top 10 Awards within this special innovation issue of PUF. But I cannot resist telling you all about a third favorite of mine. The New York Power Authority is deploying drones to inspect its vast network of lines crisscrossing the Empire State. To pull this off comprehensively and securely, it simultaneously deployed a private LTE network of communications.

And there's more in the special issue, as there is more and more innovation in the utilities industry. There's never been so much invention as there is today in the technology and strategies of transmission. In this issue, we focus on the game-changing advancements in the selective undergrounding of transmission. 



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Fortnightly Top Innovators 2021

Conversations with this year's Extraordinarily Inspiring Innovators:
Arizona Public Service's Jim Holbrook, Miguel Bravo and Christine Helmuth,
California Public Utilities Commission's Commissioner Genevieve Shiroma,
Leuwam Tesfai and Forest Kaser,
CenterPoint Energy's Eric Easton and David Mercado,
PPL's Horst Lehmann and Eric Rosenberger,
Southern California Gas' Eric Coene, Matt Gregori and Ron Kent,
and Xcel Energy's Nadia El Mallakh



UF is excited about the Fortnightly Top Innovators 2021, because their stories are inspiring and uplifting. It's what we all need after a most trying and unusual pandemic time in our lives. It's about looking to the future and making it better.

All the nominations are fascinating, and here we profile in depth six that are representative of this amazing 2021 class of innovators. Arizona Public Service starts off with a targeted fast-track emergency air conditioning program. The California Public Utilities Commission showcases the role microgrids can play for grid resiliency. CenterPoint Energy innovates by finding ways during Winter Storm Uri to automate manual processes for load rotation among customers. PPL becomes the first company to successfully use dynamic line rating technology to address congestion and market efficiency issues. The Southern California Gas RD&D program focuses on technological innovation to decarbonize the natural gas value chain. Xcel Energy addresses customer barriers to electric vehicle adoption and build out of infrastructure with a comprehensive solution in Colorado.

Miguel Bravo, Jim Holbrook and Christine Helmuth Arizona Public Service

PUF's Steve Mitnick: This is a targeted fast-track emergency air conditioning program, a breakthrough for customers. Give an overview of how this idea came up and its purpose.

Miguel Bravo: APS has a long history of service to Arizona, and we take tremendous pride in our commitment to customers and employees. Over the last few years, we've created the APS Promise which states our commitment to our customers, community and each other. So, from a business perspective, we're dedicated to the success of the communities we serve. I wanted to start from that standpoint.

We also believe we have a responsibility and obligation to support community solutions that address key issues that disproportionately affect vulnerable and underserved populations.

That is a priority of ours, to be a catalyst for better solutions. That's how this whole idea came about in partnership with Jim's group and internal business units that are committed to customers and community.

We started to explore this concept and it is building on existing infrastructure in the community, and on longstanding partnership with Foundation for Senior Living. Also, it's looking to address a gap and try a new approach to tackle this significant issue during the hot summer months.

Jim Holbrook: The gap was getting to people quickly in the heat of summer. For traditional programs that provide support for these types of situations, like the federal-state weatherization programs, we have a big backlog. There's a lot of paperwork involved.

It's hard for those programs to go out and help somebody in a day or two. Maybe you get a call, since somebody has a



**At a high level, there's recognition
we need to do more to help
vulnerable populations and customers
get through the summer.**

– Miguel Bravo

health risk, to go fix that air conditioner unit and get them air conditioning, or at least, a temporary unit, or some relief fairly quickly. That's not a failing of those programs, as they weren't



Knowing there are nonprofits we work with, who jumped at the chance to partner with us and figure out how we can help their clients, has been inspiring.

— Christine Helmuth

built for that per se, but that is a challenge, especially as hot as it can be in Arizona.

If your air conditioner has failed, or if you can't afford to fix it, and you just turn it off, we see that as a gap. That was a gap identified by multiple parts of the assistance community in the Metro Phoenix area and in the state. We came up with this approach funded through a consortium of support groups, and it allows more flexibility in the requirements, which was a key part.

We worked with a partner that does weatherization, Foundation for Senior Living, which we call FSL, to handle the onsite work and run the program. FSL knew how to do this, but none of us had a way of doing it quickly, being able to get somebody out and make a decision without all the paperwork and up-front work.

This is a fast-track emergency air conditioner approach that we hope to add on to weatherization and the underlying foundational programs over time. But that's why we started it quickly. We

wanted to try it this year as a pilot and start gathering some experience with it. We've already learned quite a bit, but that was the idea, just getting something that was faster and more flexible.

PUF: This is for people that don't have the financial means, or transportation, to go to a hotel until air conditioning is repaired.

Jim Holbrook: That's correct. We were targeting it at the mobile homes because those are difficult to stay in when you lose your air conditioning, due to the lack of insulation especially. If you happen to be in a 1970s era RV or mobile home, it's probably cooler to go outside and sit under a tree, but there you have a problem as well. There's not a lot of vegetation or shade in low-income communities.

It was this cascading set of problems that needed a quicker and more flexible program. This is our attempt to at least put a band-aid on the lack of air conditioning issue. This keeps people from a life-threatening situation. Each person we can help is one less person that ends up in a critical situation.

PUF: Christine, how do you fit in to this program?

Christine Helmuth: I've been more involved in our other heat relief efforts. Jim and Miguel were the ones who spearheaded the air conditioning program. I work more closely with our other non-profit partners that have been providing cooling stations, emergency shelter, and transportation.

PUF: What's been the reaction from the customers, and third-party groups such as FSL as far as what you're doing and how it can further progress?

Miguel Bravo: At a high level, there's recognition we need to do more to help vulnerable populations and customers get through the summer. We have taken this pilot program concept to a number of partners and have received strong interest.

We have been able to double APS's initial investment in the pilot program by bringing on additional financial contributors, so that is encouraging. We do need to build a bigger budget to be able to continue to make a difference, not just this year, but in years to come.

The response from other entities that are committed to communities, to vulnerable populations, that want to make a difference is they have stepped up. There's potential to bring others on board and we're going to continue to do that, so that's encouraging. They're working with other business units internally, to see how we can build a broad base of support, which is a priority.

We care about getting things off the ground, but we also care about sustaining ideas and projects. In APS, we don't have enough resources to do that on our own. We started small and have been ramping up awareness efforts to make sure that procedures, our process, and the program was ready for more intake.

We have been thoughtful in the way that we have been approaching promotion, to make sure we're able to keep up with the pipeline of applicants and we're able to provide rapid response that we're promising.

PUF: Talk about the lessons learned.

Jim Holbrook: We've learned over time to try and avoid the utility tendency of trying to solve a problem from our point of view. We go out and see what the front-line providers of services need and what the gaps are.

That's why we came up with a comprehensive approach. Christine was talking about the other pieces of this. It was four pieces to the puzzle. Can we fix your air conditioner quickly? If we can't fix the air conditioner, that's a small number of people. What helps a broader group of people?

Are there enough cooling stations to help the people that need it? Then increase the number of cooling stations, but if you have more cooling stations, can they get there? Transportation is also a challenge, so that's where Christine and Miguel got involved with one of our other partners to provide the free transportation using Arizona 211 and Lyft.

Now we can get you there, and if you're in trouble, we can get you out of the house. If you're aware, you make use of the transportation and the other part of it is, what if you don't have a place to stay? We increased the housing with St. Vincent DePaul. It's more housing, more cooling stations, and fixing the AC where we can, because that's the most expensive option.

But you put the whole package together, now you can start to help people. That's how we got there, going back to lessons learned.

What we learned is a lot of these organizations trying to provide this assistance tend to be siloed because of limited assets. You start talking to each other. Now we can leverage each other's strengths and resources and provide a comprehensive solution with less gaps in the process than what we were doing before. That is the key lesson we have learned over time.

PUF: Cite what's been most rewarding about your and APS's participation leadership in this initiative.

Christine Helmuth: I've only been with APS since the start of 2020. Just to see the focus that we have on providing support to customers in whatever way we can, like developing a comprehensive approach to keeping people safe, cool, and comfortable in their homes, has been impressive.

Knowing there are nonprofits we work with, who jumped at the chance to partner with us and figure out how we can help their clients, has been inspiring. I'm seeing that we try and think about problems that might pop up, for example transportation, and try to address those while we're developing this full strategy.

Jim Holbrook: I have a customer comment from where we replaced an air conditioner last month. The family had gone without air conditioning for a year or so. The folks in the home were taking five showers a day just to keep cooled off. They had children in the home as well.

Since we replaced it, that has changed their day-to-day living environment and they were appreciative. They didn't have the



This is a fast-track emergency air conditioner approach that we hope to add on to weatherization and the underlying foundational programs over time.

– Jim Holbrook

money to fix the AC unit themselves. Hopefully, we can get them on billing assistance and help them with their monthly bills, then it's a net positive.

Miguel Bravo: Going back to the APS Promise, our purpose states: As Arizona stewards, we do what is right for the people and prosperity of our state. That means customer impact is always top of mind.

But it's been rewarding to see other funders step up and want to join us. When we developed this pilot program, we didn't know what the community response was going to be.

We anticipated there would be support from other entities that care about the community, but until you make that request, go before those groups, and ask for support, you don't know if there's going to be support at the end of the line. Other entities quickly answered the call and that's been rewarding, to be able to double what APS invested in the program, and that means ultimately, more customers get assistance. ○

Commissioner Genevieve Shiroma, Leuwam Tesfai and Forest Kaser

California Public Utilities Commission

PUF's Steve Mitnick: Give an overview of this resiliency and microgrids team, what it's composed of, and its purpose.

Commissioner Genevieve Shiroma: I have been a regulator for over forty years, so I have worked from the ground up. I could have been one of Forest Kaser's [Supervisor, Resiliency and Microgrids] team members at one point.

The CPUC has a lot going on. We are heavily governed by code, precedent, and evidence. Everyone is working hard.

When a team like Forest's asks, what else can we do with a law that says make microgrids mainstream? We make it happen with inter-connection, tariffs, and all these things. Then they say, in the broader landscape, this statute didn't specifically require resiliency, but it was a natural fit.

Looking ahead for California, what role can microgrids play in the resiliency of the grid in keeping the power on? It's something that isn't always evident in an organization like the CPUC, or regulators aren't necessarily viewed in this fashion, but it is beautiful to see from my perspective.

It's analysts and engineers, plus all of the legal folks coming in and saying, this program can get larger than us. Let's make it happen. That's it as far as utility scale.

So, we wrote it out in a decision and adopted a staff proposal. That was in June of 2020. By the fall, PG&E had launched numerous utility scale microgrid configurations at substations that saved thousands of people's electricity, also during the public safety power shutoffs. In terms of peace of mind, this was phenomenal speed from the time the decision got out to the time the utility implemented it.

Leuwam Tesfai: The CPUC has taken a two-pronged approach to innovating in the area of microgrids to support resilience. On one side, we've taken this approach of authorizing our utilities to leverage microgrids.

That includes leveraging technology at substations to enhance resiliency during public safety power shutoffs. That's an area of



We're trying to build in that equity perspective from the ground up, so we can make sure microgrids are an enhancement to universal access and affordability.

– Forest Kaser

resiliency need in California in order to help mitigate wildfires.

The CPUC included the authorization of the microgrid incentive programs. That's a two hundred-million-dollar program to support microgrids in disadvantaged communities and those hardest hit by the public safety power shutoffs. Those are communities located in areas that tend to have their electricity shut off to mitigate wildfires.

The other side is less focus on utility ownership. It's the development of microgrids by third parties, or non-utility entities. Our approach has been one of streamlining interconnection processes. We've had some existing tariffs that needed refinement, and we're also developing a new tariff specific to microgrids to support commercialization long-term.

These types of refinements create consistency for customers looking to potentially develop their own microgrid. They'll know what the rules of engagement are with the utility and what to expect going forward.

That might be for resilience. That might also be a form of electric bill arbitrage to take advantage of time-of-use rates, to deploy the battery on your microgrid during a time of day when rates are higher, during that peak time of use rate.

We've supported the utilities in microgrid innovation but are also trying to empower third parties and customers to be able to develop their own microgrids.

PUF: Forest, how do you all creatively work through this with the team and third parties, too?

Forest Kaser: We've tried to emphasize as a team throughout the two years we've been working on this, is having an open-door policy for stakeholders. I've always said any stakeholder who calls me or my team member, with ideas, and wants to move the conversation forward in a constructive way, is welcome.

Anyone who calls us up, we will meet and talk with them. We're not in many in-person meetings these days, but pre-COVID, we did in-person meetings.

We have this ongoing working group process where since November of last year, we have a two to three hour working group meeting where Staff presents various topics. Often, we've invited presentations from the public or stakeholder groups, and we talk through the issues to get different perspectives.

We've had presentations from utilities. We've had linemen in to talk about, how do linemen think about safety issues related to microgrids, what new risks could microgrids pose to the workers, and how do we mitigate those risks?

How do we adapt our regulations, policies, and practices to harness the benefits that microgrids will provide, while continuing to prioritize safety, affordability, and equity?

These working group meetings have helped us all build our



Commissioner Shiroma at the Stone Edge Farm microgrid.

By the fall, PG&E had launched numerous utility scale microgrid configurations at substations that saved thousands of people's electricity, also during the public safety power shutoffs.

— Commissioner Shiroma

shared understanding of what the issues are, where the pinch points and challenges are, and hopefully they prepare everyone to better craft proposals when it comes time to submit those into the formal process.

PUF: How big an impact can this be on the people of California and the customer?

Forest Kaser: I see a lot of promise in areas that are high risk for wildfires, called high fire threat districts. There's an effort by one of the utilities, and now a second utility is joining in, to establish remote microgrids and remove distribution lines in certain places altogether.

It's in these remote areas where there might be one building, two buildings, or a handful of buildings and a long distribution line running through a highly forested and very fire prone area. The utilities are looking at decommissioning that line altogether, removing the poles and wires, to one hundred percent eliminate the fire risk from that infrastructure.

They'll be replacing them with small microgrids. The plan and committed tariff requirement are to provide the same power quality and level of service to their customers they would have had otherwise.

It maintains the relationship customers have with their power supplier, whether it's a community choice aggregator or an

New PG&E microgrid in Angwin, California with the linear generator running on biogas and natural gas from Mainspring Energy and NextEra. This is a new microgrid bringing resilience to Napa County during Public Safety Power Shutoffs.



We've supported the utilities in microgrid innovation but are also trying to empower third parties and customers to be able to develop their own microgrids.

Leuwam Tesfai

IOU. It's neutral, so it's to maintain the existing contractual relationships, safety standards, and power quality standards, but it's actually cheaper. The utilities are finding it's not only a reduced fire risk, but at a lower cost. How do you measure the scale of impact?

For those areas, you're potentially moving some high-risk lines, so you've got a lot of positive benefits, even though the total number of people served is small, because it's a small number of homes. But the risk reduction impacts could be significant.

PUF: Because of your work, is there a lot of interest on the part of investor-owned utilities and third parties to say, we want to bring some projects in?

Forest Kaser: Yes. Just in terms of third-party, note that for those remote grids, the utilities are working with third parties to design and build those microgrids, so it's not exclusively an in-house utility activity. There's business development around selling these types of microgrids to the utility.

Some of the rules and regulations the Commission has adopted

in the microgrids proceeding are based on initiatives that other entities have taken, so they're inspired by real world examples.

An example is the Port of Long Beach in Southern California. The Port requested a special permission to provide power across the property boundary to a neighboring facility. One of the rule changes we made was to make it possible, without having to go through a special request process, for parties to be able to do that type of project.

There's a lot of interest by local governments and community groups in looking for projects, and we're hoping the structures we're setting up make that easier for customers to engage with the utilities to move projects forward.

PUF: What lies ahead, especially for the interconnection rules?

Commissioner Shiroma: There's a lot of work ahead. The work is not complete. A team like Forest's, where there is the aspirational, the innovation, and the thinking ahead – what role can microgrids play in the larger picture of our grid? Forest has outlined a number of amazing projects.

Along with that are the fundamentals, the basics of safety, electrical engineering, of the long-standing utility rules and requirements all geared toward safety,

but in that, what have we learned over the years that can be used toward a faster processing?

There is a hunger for these kinds of projects. There's a hunger by the developers, local governments, tribal governments wanting more transparency from the utilities, and so navigating all of those granular particulars is something the team is paying attention to, because, in the end, we want to have a safe grid. There are more pieces to this puzzle ahead.

Leuwam Tesfai: A lot of our work had been focused on California Senate Bill 1339, and we've been able to have a number of short- and long-term wins in relation to that legislation.

Going forward there's still a lot of work to do related to the microgrid incentive program, focusing on communities that might not have the resources to leverage and make their own microgrid. There are some wealthier communities that can do it on their own, so it's making sure we build in equity going forward.

The CPUC in 2019 adopted an Environmental and Social Justice action plan, so we've been working hard, in such a

California PUC group at Stone Edge farm microgrid, with Forest Kaser, front row, second from right and Commissioner Shiroma, front, holding jacket.



technology-centric area like microgrids, to make sure we're able to bring equity in.

Forest Kaser: Something easy to lose track of in this country is how universally available electricity is for most people. There are exceptions worth noting, like tribal communities.

The thing about microgrids is they're inherently exclusive. They're inherently drawing a boundary around who has the power, who has the benefit, and who doesn't.

We've been tuned to this issue, as done wrong, that can exacerbate inequity. We're trying to build in that equity perspective from the ground up, so we can make sure microgrids are an enhancement to universal access and affordability, an essential value proposition of the electric grid.

I'm excited about conversations we've been having with several national labs, including Dr. Bobby Jeffers' team at Sandia National Lab and Joe Eto and Peter Larsen at Lawrence Berkeley

National Lab, about trying to improve our analytical basis for thinking about that equity issue. As we're trying to decide where is the right place for a microgrid, how do we build in access to essential services during emergencies?

Who has better access, who doesn't? Where should you be locating these microgrids strategically so when the broader grid goes down, you make sure everyone can access food and water, shelter, and medicine?

How can we bring a quantitative and rigorous analytical perspective to thinking about the problem? It's building that shared understanding about how we do this in a fair and transparent way so everyone can see the numbers, how we do our analysis, and it's not just an arbitrary hidden decision about who gets benefits and who doesn't.

That's an important key area of analytical and stakeholder work that is ongoing and will continue. ○

Horst Lehmann and Eric Rosenberger

PPL

PUF's Steve Mitnick: What's the importance of sensors for a dynamic line rating and what is DLR?

Horst Lehmann: DLR is just the shortened term for dynamic line rating.

PPL operates the transmission grid in our area. Then there's PJM Interconnection, the RTO that dispatches the generation in this area. It oversees territory from New Jersey out to Illinois and down to North Carolina.

Generators bid on how much they will generate electricity

for, and then PJM Interconnection analyzes the least-cost way to dispatch generation to supply customers.

Sometimes on the transmission system, the transmission lines become limiting factors. The lines cannot handle the flows across them from certain generation mixes. Then PJM has to change what's generating and dispatch more expensive generation because of the overloaded lines.

The DLR frees up some additional capacity on those lines above what the old, ambient or static rating would allow. The old



L-R, Eric Rosenberger and Horst Lehmann at work.

This solution was not just for data, but we can solve a problem and prevent a huge rebuild for a lot lower cost option.

Eric Rosenberger

ratings were based on a set criterion of conditions and included a lot of worst case factors and safety margins to account for the unknowns in operations.

Whereas with dynamic line rating, we're placing sensors on a transmission conductor and bringing back that conductor data and real time conductor temperature, the wind speed, and performance of a line.

We can bring that all back into our system and apply more accurate ratings for the lines to get the full utilization of that conductor. Then that allows for more economical dispatch generation, which results in lower costs for the customers.

PUF: What do these sensors look like?

Eric Rosenberger: They're just little boxes, hanging on the conductor. They're a fully contained set of sensors and communications components. In our case, on the lines that we applied it to through our analysis, we put six of them for each transmission line to give us a good view of all the different spans along the line.

PUF: What do you do with this data?

Horst Lehmann: The sensors are bringing back data measured from the vibration of the conductor, as well as the current flowing through it. Then it sends the data back to the cell network, to the vendor's server or onsite program.

They take that data and apply an algorithm to it, or a calculation, to get the wind speed, and the temperature of the conductor. Based on the information provided, they mix that with the forecasted weather data, and can provide a real-time rating for it, as well as forecast the ratings for the next forty-eight hours for that conductor.

We can operate real time and forecast the ratings so we can set our system for the next day. That's where it ties in with PJM.

That's the big innovation of this project, tying it into the market and using that forecasted data in the market system to forecast our ratings for the next day to allow the most economical dispatch. As far as we can tell we are among the first in the U.S. to be doing this.

PUF: PJM is actually using this and it's making a difference basically in the cost?

Horst Lehmann: We're working with PJM to implement it, so it is not fully operational yet. We have the sensors up, and we're collecting the data. Right now, we're in the stage of analyzing data and implementing those servers and all the connections needed to begin operating the grid to those ratings.

But we have worked within PJM's process, where there was congestion on two of the lines. We were able to remove them from the list of needs to resolve with a rebuild or a reconductor or other



We were able to prove with the data that we can solve the congestion on at least two of the transmission lines.

Horst Lehmann

major capital project. We were able to prove with the data that we can solve the congestion on at least two of the transmission lines.

PUF: How did this project work?

Eric Rosenberger: We had a lot of people involved. When we first identified it as a solution to this market congestion issue that PJM identified, we went out and looked at the different vendors.

There were a handful of vendors that offered solutions. The technology has been around for a while and various utilities have been piloting it and putting sensors out there.

There were a couple different underlying technologies that the vendors were using to take conductor measurements. We selected the one that seemed to use the most accurate of those and what we thought was going to be most maintenance free system.

We went with that vendor and applied the sensors. What we did initially to get this going was we had the vendor stand up the system in a cloud environment that allowed us to get started. All we had to do was install the sensors and then the vendor could stand up the computation system to start crunching the data and calculating the readings in real time.

We're still operating in that environment. But throughout the early part of this year, we designed a system where we're going to bring the computation environment into our on-premises systems where we can fully control and secure it.

That is important when we go to integrate it into our operational environment, because it's on transmission lines and it's affecting the bulk electric system, so we have to be sure to meet all the NERC CIP standards in play, the Critical Infrastructure Protection standards.

We had to protect the data and put a lot in place to make that

work. We have a designed system right now, and we're currently working on building that system on premises and transitioning to the actual operating world.

PUF: How did this idea come about?

Eric Rosenberger: PPL had been watching this technology for some time. We like to think of our team as future proofers – figuring out what could negatively impact operations and use technology or innovation to solve for it.

It's something we were interested in piloting just so we could bring back more data. We hadn't kicked anything off at that point.

Then while Horst was going through the planning studies, getting the results from PJM studies, and looking at problems coming up, that's when he realized this solution was not just for data, but we can solve a problem and prevent a huge rebuild for a lot lower cost option. The dream became a reality. We were like, there is a real business case here.

Horst Lehmann: Yes. We're always looking for new technology, and to leverage data. I was familiar with it from my previous work in the transmission line design group and working with Eric's group in Standards.

When I moved into the Planning group it was, okay, we can apply DLR to these market efficiency congestion issues because DLR's operation provides the exact type of benefits needed. It doesn't work as well for a normal planning type overload. It's the real-time operations and day-ahead forecasting that plays perfectly into the market efficiency and congestion issues on transmission lines.

We're always willing to pilot new things, take the next step, and push it, instead of just putting the sensors on and saying, let's

do a science project. Let's get these on the line and into operation. Let's get them into market, show their impact and provide real benefits to our customers.

PUF: What's been the most rewarding or fun thing that came up in this project?

Eric Rosenberger: The most rewarding part for me was the number of challenges to overcome to make this a reality. I mentioned the NERC CIP impacts. Going through the standards and trying to figure out how the system fits into that was a challenge.

We even brought in ReliabilityFirst, which enforces the NERC standards for us and makes sure we're compliant. We brought them in to help because it was a bit of a vague implementation, and they agreed the standards didn't fully anticipate this type of system as they were drafted.

We had to navigate through that in our design of the integrated system. It was that, and the other challenge of working

with PJM and pioneering the processes that were needed.

There was no process established for getting the system up and then how to integrate and operate it. Working with them and developing those standards to make that work was a rewarding and challenging experience.

Horst Lehmann: I liked initiating a project, working with different groups, getting the technology, and then going out in the field and seeing it get hung on the transmission lines.

That's always neat for me when you take it from the beginning to installation. Then it was great, once we started collecting the data and all the analysis I did to prove it can actually solve the problem on two of these lines, and work with PJM to implement the analysis solution.

It's taking something from a conceptual level and proving it's going to work and then seeing the data showing it's getting the results you expected. That's the rewarding part when it comes together how you've planned it to. ○

Eric Coene, Ron Kent and Matt Gregori

Southern California Gas

PUF's Steve Mitnick: What is the SoCalGas Research Development and Demonstration program?

Eric Coene: We believe that innovations and the rapid development of technologies are vital to meeting the climate goals of our state. To that end, we're focused on technological innovation that seeks to decarbonize many aspects of the natural gas value chain.

Ron Kent: We're blessed in the state with many challenges, but the state has also equipped us to develop solutions. The RD&D program is supported with enabling legislation. Our RD&D program is actually codified.

They did that to continually improve safety, efficiency, and environmental quality. In order to get to where we want to go, we need to fund the research to help make that happen. We're unique in that for a lot of what we work on, other states have not cared about as much, at least in the past.

Therefore, we needed our own RD&D program. We have one of the few programs in the country like this. It's the only program of its kind in the state of California because we're a gas-only utility. We've got different challenges than the combined utilities.

PUF: Do you have help?

Matt Gregori: The team is larger. We have a number of project managers, and we have some other groups. The RD&D groups span the entire value chain of the gas system.

Ron's been my mentor since I've been on the team for about five years. He's got a long history in this space and has spearheaded a lot of the advanced technologies for what we're showcasing today.

Those have been in the works for years. He's been a leader

in developing the relationships, projects, and technologies we're seeing come to fruition because of a lot of hard work.

We have a whole group of subject matter experts in various areas. SoCalGas set a mission to be the cleanest, safest, most innovative energy company in America, which is an audacious goal. As an RD&D group, we're a small component of the gas company of large utility.

We're on the cutting edge trying to identify the technologies that are going to get SoCalGas in California to achieve those goals. We're out there looking for the newest technologies that are going to decarbonize our energy system.

PUF: Do you each have a specialty?

Eric Coene: I don't necessarily have a specialty like Matt or Ron. They have more of a technical background than I do. For the last few years, I have been in more commercial and finance-oriented roles.

That's my background and the perspective I bring to the team. I look at the potential projects that we may participate in and then how we or others could commercialize them down the road so our customers can access the technologies we are developing.

Across the value chain there are many types of projects that our team looks at. But if you take a step back, what we're looking to do is larger than both our team and our company.

We are attempting to help California evolve from its current energy structure to one that predominately uses clean energy in the form of both clean molecules as well as clean electrons and is much more decarbonized. What we're doing is we're making

the seed investments in RD&D today that will hopefully lead to that reality down the road.

Ron Kent: I focus on what we call low-carbon resources. That's what I think of as two sides of the same coin. One side is a transition to hydrogen. To some extent it's also renewable natural gas because we can put renewable natural gas in our pipeline now.

We are not allowed to put hydrogen in yet.

It's kind of hydrogen RNG on one side of the coin. The other side is carbon dioxide capture and utilization, preferably turning it into something valuable to prevent it from ever going into the atmosphere.

Whether it's worst-case scenario or not, you can return it underground where it came from. But preferably we turn it into some solid material. Let's say it's roofing materials, as that is a huge market, and that sort of thing. If we can take our carbon dioxide and put it into various building materials, that would be a huge step forward. Those are the two, hydrogen RNG, and then carbon capture utilization and storage.

Matt Gregori: Ron's working on the supply side. He's making the renewable gas and the renewable hydrogen, to put it in the pipe. Then most of my projects are on the demand side. It's figuring out, how do we put that to use for our customers, whether it's in power generation, transportation, or a thermal application.

Hydrogen is a big deal right now. We're seeing a lot of work on fuel cells in stationary applications for power gen and in the transportation space. We're trying to push that forward to decarbonize those sectors. Then it's how can hydrogen play a role in stationary or building appliances and help decarbonize that sector?

As far as our group dynamic, Eric is the leader. He's got a commercial development background and he's trying to keep us on track, focused, and help us develop new technologies so they will be commercially viable.

Ron is the visionary on the team. He's looking out ten or twenty years, trying to think about things other people are not thinking about yet. I'm the process person. If there's paperwork to be pushed through, I will get that put together.

PUF: What's a typical day like, and how'd you get to this point?

Eric Coene: There isn't a typical day in our department. But one aspect that I enjoy, and something we spent some time developing is our project concept review committee meetings. That's where our program managers bring forth proposals on technologies, research or demonstration proposals they're looking to undertake.

It's a broad discussion about the merits of a particular proposal, and how well it fits into what we at SoCalGas are trying to do, but also more broadly into what California is trying to do. Does it align with California's initiatives for decarbonization? How does the project seek to improve on the current



I look at the potential projects we may participate in and then how we or others could commercialize them so our customers can access the technologies we are developing.

Eric Coene

state of the art? How does the project provide a benefit to our customers and especially those in communities that are the most impacted by pollution?

For me, it's witnessing the thoughtfulness that goes into the proposals and taking part in the ideation that occurs during that meeting that is truly enjoyable.

Ron Kent: What's interesting about what we're doing is it's highly creative and interactive. We're not getting our hands dirty in a lab, sadly. But we collaborate with third parties, the national labs, leading universities, and research institutes, like JPL and Caltech.

It's critically important that we also work with special purpose companies or startups that become commercialization channels for the technologies we create. Ultimately, getting technology to customers is key.

We spend a lot of time interacting with technology developers and commercialization partners.

Then, we take time to step back and think about what is important. Matt told me once that we do thesis-based investing, and I thought that was a good way of describing it. We have a thesis, and we pursue that.

We have certain things we want to accomplish, and we



One thesis is that our natural gas pipeline system is going to be essential for the future of renewables in the state. We're dedicated to finding ways to repurpose the gas grid to deliver and support renewable energy.

Ron Kent

try to focus on those. We try to go find technology solutions rather than wait for them to find us. One thesis is that our natural gas pipeline system is going to be essential for the future of renewables in the state.

Many people don't believe that, but we do. We're dedicated to finding ways to repurpose the gas grid to deliver and support renewable energy.

Fifteen years ago, we were thinking, carbon dioxide is going to be important. Maybe we can envision a pipeline system where natural gas goes one direction and carbon dioxide goes the other direction.

It goes back into the ground where it came from. We've been at it for a long time and now it's beginning to pay off.

Based on those strategic constructs, we then go find the technologies. I worked in different parts of the company before coming this position. One thing that was an important threshold event was working in the development of the natural gas vehicle program.



I was one of the few people here involved in that at the beginning. It was an important lesson about the impact a utility can have. We didn't have any natural gas buses for example, in Los Angeles in the 1980s. By 2011, LA Metro had retired its last diesel bus.

All of them are running on natural gas now and the air along those bus corridor is measurably cleaner. That had a lot to do with SoCalGas working to develop technologies and working across the country with other utilities to make that happen.

Maybe the end of the story ultimately will be hydrogen, but it certainly is a good lesson that utilities can have a powerful impact.

Matt Gregori: One of the technologies we talked about in our submission was Twelve, which is an electrochemical carbon

dioxide reduction. We found them at the rocket fund pitch competition at Caltech.

It's the startups giving five-minute presentations, but that happened to align with one of our theses, which is using electricity to make renewable natural gas. We helped them develop their technology around that.

We're always out with the technology incubators at the national labs, talking to startups, and researchers at universities. We're talking to community-based organizations to understand the needs of our customers.

We're meeting with folks within SoCalGas and other utilities to say, what are the challenges we're facing as utilities, but also what are our customers facing? They need to decarbonize, and we need to help them. Our job is to find the technologies that are going to help our customers meet the requirements set forth by the state or the country, even the world at some point.

It's a fun job. Most of my career I've been in clean energy technologies. I was mostly in fuel production. I ran biodiesel plants for a long time.

I went to business school and while I was there, I was talking about how I wanted to diversify and look at other clean energy technologies, be able to expand my portfolio.

One of my classmates said, you got to meet this guy named Ron Kent with the gas company who's doing amazing work in this space. I interned for Ron ten years ago.

I did a couple years in renewable natural gas after business school, but then came on board six years ago to the RD&D group because it was a great opportunity to look at so many different technologies. ○



One of the technologies we talked about in our submission was Twelve, which is an electrochemical carbon dioxide reduction. That is using electricity to make renewable natural gas.

Matt Gregori

David Mercado and Eric Easton

CenterPoint Energy

PUF's Steve Mitnick: Talk about the CenterPoint Energy Real-Time Operations team that worked so diligently through winter storm Uri with you.

David Mercado: We have a team of forty-four employees in our various subgroups within Energy Real-Time Operations. It's mostly our controllers, who operate the grid twenty-four hours a day. To prepare for and respond to the winter storm, they had to leave their families and support the control center during that difficult time.

Our controllers work in shifts, so we had a large group of employees that rotated during the winter storm to support management of the grid. We also had engineering support personnel present to provide operational support to our operators to make decisions and improve our situational awareness.

PUF: Upstream generation and fuel supply were affected, but

that's especially challenging because CenterPoint Energy, by Texas law, is an electric transmission and distribution company only. You can't control the other parts. Did that make it more difficult?

David Mercado: Yes. CenterPoint Energy is what we call a Transmission and Distribution Service Provider, so we are responsible for transmitting and distributing power. CenterPoint Energy does not generate its own power, and outages due to the lack of generation availability during Winter Storm Uri were out of the company's control.

Since then, the Texas Legislature passed a law allowing TDSPs to lease and operate facilities that provide temporary emergency electric energy or mobile generation under certain conditions during widespread power outages, but that was not the case during Winter Storm Uri.

What we are responsible for is our infrastructure – transmis-



The efficiency and efficacy of this load rotation effort increased substantially by this innovative effort. It's otherwise a manual effort. We included additional automation to safely speed up that process.

David Mercado

sion and distribution lines and substations – so we can get that power from generators to our end-use customers. Our systems and equipment fared well during Winter Storm Uri, and once power was available to be delivered, we delivered it.

We also have a responsibility for shedding load per the Electric Reliability Council of Texas' orders so we can keep that balance of generation and load intact and help protect the overall grid.

To shed load means to reduce the amount of demand for electricity, the load on the system, by turning off circuits to meet the required ERCOT reduction amount. This is done when there isn't enough electricity to be delivered, to avoid a state-wide blackout. In other words, if you don't do enough controlled reductions, the system will collapse on its own – in an uncontrolled way – a complete, state-wide blackout.

The winter storm was a challenging situation, and our operators did a great job in managing our part of the electric grid and making sure load was back in service as soon as generation was available.

PUF: Talk about what was distinctive that you were making up as you went along and were innovating.

Eric Easton: During the winter storm, we were trying to find new ways to rotate load, and it required us to use a lot of manual processes. Some of what we had to do during the storm was to find ways to automate those manual processes.

For example, we built databases that allowed us to match the load, because when you're doing load rotation, you can't add any more load than you are trying to rotate. It has to be a zero-sum game, or we start to eat into the reserves that ERCOT is counting on for the power system to function properly.

In order for our system controllers to not add more load as they rotated, we were able to create databases that allowed them to quickly match load. As we shed, for example, five megawatts, we wanted to add five megawatts back.

We were able to automate that process to allow us to perform that task a little quicker. I wouldn't quite say we were making it up as we went along, because we prepare for different types of events, so we are adaptable when events occur.

David Mercado: The efficiency and the efficacy of this load rotation effort increased substantially by this innovative effort. Our controllers had to manually choose a particular distribution feeder and try to match it with a similarly loaded distribution feeder that was already online to be able to rotate load.

For those customers who were out for longer periods of time, we wanted to make sure we gave them an opportunity to heat up their homes and get back online as much as we could.

This innovative approach sped up that process. It's otherwise a manual effort that our operators engaged in. We included some additional automation to safely speed up that process.

Eric Easton: It's important we recognize that this is a multi-bucket approach. We have different buckets of load within our system.

Essentially, we have three different buckets of loads that we're all rotating manually and coordinating among three different desks to ensure we don't violate any of the ERCOT orders, and we're having to do all that manually.

The team's effort was tremendous – we were able to successfully coordinate from console to console. When we went back after the event, we were able to show that we, indeed, did meet all the ERCOT orders.

PUF: If you're under pressure, rotating manually, what's the dynamic of everybody working hard, but saying, I can try this. Describe that.

Eric Easton: We have a collaborative team and a company

culture of innovation. We have always strived to find new ways to do tasks in a more efficient manner. What we espouse as a company is continuous improvement, so we look at how we can find solutions, and drive them to completion.

In this case, we had to do that on an expedited timeline. As we were thinking about the public, our families, and everybody else we care about in the greater Houston area, we felt compelled to figure out how we could safely do more, because our communities are depending on us. That's how we came together as a team and said, how do we do this faster?

The number one issue was we could not risk the stability of the overall power system. A statewide blackout could have resulted in twenty-six million people in Texas without power for a month or more.

Careful consideration had to be taken as we innovated. But once we got consensus among the team that we could safely take certain actions, we then circled back to our incident command center and had them give us their perspective, since they were stationed outside the control center where we were to double-check our thinking.

Once we did that, we pressed forward as quickly as we could to start that process. We always put in a series of checks to make sure that as we solved a problem, we weren't creating a new one, but we also want to foster and encourage innovation, as we did in this instance.

PUF: How does one build that culture of working under high pressure?

Eric Easton: It comes from the fact that we have a team of individuals that are highly capable but also humble. There's no task that's too small. There's no task that somebody would say, that's not my job. This is an all-hands-on-deck experience.

David can attest to that. As this event was going on, he was sitting on a console with a system controller doing whatever that controller needed to assist in their tasks.

The whole team is focused on how we get things done. It's part of our culture of being collaborative, solutions-oriented, and focused on our customers. It's do what we've got to do for our customers.

David Mercado: Collaboration is key within this team that worked together during the winter storm. As Eric mentioned, no task is too small.

During the Winter Storm, I was a manager of engineering support. I reported to the control center and assisted where I could.

Additionally, the Energy Real-Time Operations team members jumped in where they could. Some of the trainers who typically don't support from a control and operations standpoint had that experience and jumped in and helped, so it was a good



During the winter storm, we were trying to find new ways to rotate load, and it required a lot of manual processes. We had to find ways to automate those.

Eric Easton

team effort, and that's one of the things that made it successful.

PUF: Looking forward, are there some lessons learned?

Eric Easton: Yes. Part of it is around reinforcing some of what we already do and highlighting the importance of training. One of the organizations that reports to David is the training organization, so we're regularly drilling and looking at different scenarios.

Through that process, we have the logistics piece that we drill on. We have the operator training we're required to do. One of the big takeaways is to continue to evolve your imagination in terms of the scenarios that might happen.

We've done a good job in our training in stressing our processes and looking for ways to challenge them. We'll continue that and continue to challenge ourselves with more extreme scenarios.

We're collaborating with our peers around what are the scenarios they're thinking about. As we do joint training, we'll incorporate lessons learned from other utilities.

It reinforces what we do in terms of training and how we perceive what are the risks and how would we mitigate those risks. And we're working with our state officials and regulators on how to help our entire state be better prepared for the future.

David Mercado: Every event is different. We had a winter storm in 2011 here in Texas. It was different than Winter Storm Uri. Both were different than Hurricane Harvey with water and Hurricane Ike with wind. We strive to plan and be prepared for all types of events.

It's important to think with a continuous improvement

mindset. Don't be comfortable with the status quo; look for opportunities for continuous improvement. There are things you can do in advance of events like this to prepare. Even during an event like Winter Storm Uri, you need to think outside of the box, be flexible, and look for opportunities for continuing to improve. ○

Nadia El Mallakh

Xcel Energy

PUF's Steve Mitnick: What's distinctive about the innovative work your team is doing in transportation?

Xcel Energy's Nadia El Mallakh: It's a comprehensive approach that we're taking. It started with our vision.

Let's go back in time to August of 2020. First summer of the pandemic, and before the new federal government administration. Before we had seen a lot of the automakers move toward commitments to phase out internal combustion engine vehicles, like we've now seen with GM, Jaguar, others.

We took a big step back asking, how do we continue the momentum with our clean energy leadership? In December of 2018, we had announced our target of eighty percent carbon reduction by 2030. And a hundred percent by 2050, on the electric side of the business. We were also thinking that transportation is now the largest source of emissions in the United States.

If the fuel of the future is our clean affordable energy, we can help. We can step up and help our communities that are asking, how do we deal with this? Because the utility industry has been making significant progress. But we haven't seen that in transportation.

So, let's put a marker out and say, we truly see this as the next frontier of our clean energy leadership. We can move the needle and greatly reduce carbon emissions from the transportation sector. And save our customers money while doing it.

That's how we ended up in August of 2020 saying, this is our vision, which is kind of an odd time if you think about it. We want 1.5 million EVs in our footprint by 2030.

That was step one. Okay, this is great, this is ambitious. But we don't make the cars. We don't sell the cars. How do we structure ourselves to make this a reality? We do it with partners because we can't do this alone. It is different than



We worked with a lot of stakeholders to create this Colorado initiative. We will have about 20,000 EV plugs. Some will be in homes. We're working with multifamily housing and public charging.

our carbon reduction targets related to Xcel Energy's generation, which we have much more control over.

Thinking about what's unique, also I would say, from the

typical way we organize things in the industry and around EVs, was the creation of a five-pillar structure. We organized ourselves around key customer segments, including our residential and commercial customers, which each have a pillar. Two other pillars cover critical foundational areas of infrastructure and policy/regulatory activities.

A whole pillar of the team is focused on building strategic partnerships. With communities, manufacturers, governmental entities, and other related to EVs and beyond.

That allowed us to promote, retain, and attract some amazingly diverse candidates to the team as we grew. We were investing heavily in the team.

The EV ecosystem is diverse. We have team members from all walks of professions and life. Some worked for car manufacturers, some national retail, oil and gas, and some utilities. You name it. We have a diverse and exciting team.

When it comes to our programs, we're focused on equity and ensuring this transition is available for all our customers.

Our Colorado plan that was approved in March of this year is a great example of this. Fifteen percent of that one hundred million dollar plan is targeted toward income qualified customers.

Like rebates on a new or used car that you buy or lease. Some unique and innovative things like that. I'll stop there. I get jazzed about this.

PUF: Talk about the scale of this initiative.

Nadia El Mallakh: We worked with a lot of stakeholders to create this Colorado initiative that we been talking about. When we're all done, we will have about twenty thousand EV plugs. Some of those will be in homes, in the owner's garage.

If you live in an apartment, you should be able to get charging there. That is why we're working with multifamily housing.

And then of course there is also public charging. We have what we call EV supply infrastructure programs. Our commission has allowed us to invest beyond the meter.

We put in the infrastructure and others handle the charging. We also have the ability to own and operate some high-speed chargers and customer chargers if they so choose.

From a utility perspective, these rebates are treated as traditional utility investments. That was an important piece of the innovative regulatory framework.

PUF: You have programs to change the calculus on the part of the consumer.

Nadia El Mallakh: It's important for drivers to see charging infrastructure out there. We know that helps alleviate range anxiety.

A big piece of our portfolio is advisory and education. What we tell people is, did you know that it's the equivalent of a dollar per gallon or less to fuel up at the plug versus the pump? Their eyes get big, especially with gas prices the way they are right now.

When we reach our vision, we're going to be taking five million tons of carbon out of the environment every year, out of the transportation sector's share of emissions. That's an impressive number.

That moves a lot of folks too. I can save money out of my total energy costs, buying electrons versus fueling up at the plug, while I help reduce emissions.

There are some cool things about the cars right now. There're more models coming. There's a youth market, and a pre-owned market developing. That education, that outreach is important.

And rebates, if you do get a charger in your home, you get a five hundred dollar wiring rebate. Our customers are eligible for that. If you have to upgrade your wiring, if you're income qualified, that's thirteen hundred dollars.

We ended up in August of 2020 saying, this is our vision. We want 1.5 million EVs in our footprint by 2030.

PUF: You haven't been doing this program by yourself.

Nadia El Mallakh: We couldn't make it happen without the team. We were small, but mighty. Now we've grown, more than doubled our size.

One thing for sure, everyone who is on the team is a hundred percent passionate and committed to what we're doing. They are here because they love this. They see the transition to electric is the future.

They firmly believe in the benefits it's going to deliver for our communities, our customers, the environment. Even though we're all virtual still, we're having a lot of fun together.

PUF: How do you keep the team innovating and creating?

Nadia El Mallakh: We're trying to continue fostering the organic ideas from the whole team. It's not just our team. I want to give a shout out to our distribution group, operations, sourcing, contracting, business systems to name a few.

We had to bring a lot of folks with us on this journey to be able to get regulatory approvals. We just launched a suite of residential programs a few weeks ago and are planning some additional launches in September. That takes almost everyone in the company, to be quite honest, if you think about all the different parts EVs touch, to come on this journey with us.

To keep up that innovation, what we do is get together, work, and think about what's our next challenge. How do we do it better, faster, and more optimally for our customers?

The EV space is so hot right now. There are so many developments. Keeping up with all of it keeps your juices going. It's a highly competitive space. You have to stay on your toes. ○

2021 Individual and Teams of Innovators



(L-R): Ameren Missouri Customer Advocacy Team members Shontae Fluelen, Customer Advocacy Associate, Constance Taylor, Customer Experience Strategic Initiatives Manager, and Mykinna Howard, Supervisor Energy Assistance.

Ameren Missouri's Customer Advocacy Team connected customers to financial assistance by launching their first-ever online assistance program, the COVID-19 Income Relief Program. Working in partnership with the United Way of Greater St. Louis, the team designed, launched, and administered an online application to route eligible customers to the Low-Income Home Energy Assistance Program and customers over income levels for LIHEAP, but dealing with a sudden loss of income, to the Ameren Missouri COVID-19 Income Relief application. They worked with Ameren Missouri Communications to reach customers through a variety of channels, assisting two thousand customers with five hundred thousand dollars of allocated funding, and connecting thousands more to LIHEAP and other programs. The Customer Advocacy Team includes Constance Taylor, Customer Experience Strategic Initiatives Manager; Mykinna Howard, Supervisor Energy Assistance; and Shontae Fluelen, Customer Advocacy Associate.

Shey Segelhorst, Ameren Illinois Corporation, Engineer – Distribution System Planning, recently developed an in-house sub-transmission hosting capacity tool using Python. The tool is a key component in the further development of the integrated distribution grid and will allow Ameren to create Hosting Capacity Maps for their sub-transmission system. Segelhorst works on development of this sub-transmission hosting capacity tool in addition to his responsibilities as planning engineer for Ameren Illinois' South Electric Region.



Adam Shaw, Ameren Illinois, Records Specialist – Gas System Excellence Team, implements process safety improvements to Ameren Illinois Gas Operations and Emergency Response to uncontrolled blowing gas events resulting from excavation damages to the gas system. He recently developed a mobile application for real time communication across the organization, resulting in consistent visibility of the impact of excavation damages on the gas system and the operational response. He has also trained and supported the field users on the application and took feedback from field supervisors and senior leadership to implement enhancements.



Ameren Missouri Customer Advocacy Team members, l-r, James Dillon, Nicholas Crowder, and Ken Woolcutt



Ameren Illinois' Energy Efficiency Team partners with local contractors across its service territory to bring Ameren's award-winning Energy Efficiency Program to customers. These specially trained Program Allies form a statewide network that delivers energy savings to customers and service communities. The Ally Training Program focuses on the Small Business Direct Install Initiative, enabling Ameren to partner with diverse small business contractors to recruit, mentor, and train others. Their collective efforts have created new revenue streams, one delivering the largest savings ever for a single project at eight hundred fifty thousand kilowatt hours. The Energy Efficiency Team includes Ken Woolcutt, Manager – Energy Efficiency; Nicholas Crowder, Energy Efficiency Advisor; and James Dillon, Senior Manager – Energy Efficiency Operations.



Stephen Goodson, Vice President of Corporate Communication and Business Strategy – Jones Onslow EMC, leads his team working with Apogee Interactive to deploy digital solutions for onboarding customers and increase operational efficiency. After the initial six-month pilot, Jones Onslow EMC achieved measurable improvements in customer satisfaction and operations and Apogee's personalized Welcome Series solution. This included an over ten percent increase in program participation and increased open rates and click-thru rates compared to their prior program.

Ameren Missouri's Smart Meter Program Team – Ameren Business & Corporate Services recently delivered an industry leading program that increased choice and drove digitization while maintaining an excellent customer experience for nearly one million residential electric customers. With this program in place, customers now have five core rates available and seven total options. The team also developed a customer communications plan to ensure customers remained informed throughout the process and to enhance digital channels to drive self-service, minimizing impacts to contact centers and customer support teams. Collectively, these efforts have led to the successful rollout of one of the nation's most progressive residential rate offerings across utilities on an aggressive six-month timeline. The Smart Meter Program Team is a joint venture between Ameren Missouri and Ameren Digital and includes Amanda Barbieri, Senior Manager – AMI Strategy & Implementation; Page Selby, Manager – Customer Programs; Katie Dorge, Supervisor – Customer Experience; Amanda Humphrey, Customer Solutions Analyst – Customer Experience; Jeni Hagen, Communications Executive; Jeff Willey, Project Manager; Clark Allen, Senior Manager – Digital Program Management; Dianna DeWitt, Senior Business Analyst; Robert Horner, Project Manager; Mike Ross, IT Programmer Analyst IV; Celeste Settles, Senior Business Analyst; Andi Hoffman, Manager – Software Engineering; Jeronica Jenkins, Senior Manager – Digital Customer Experience; Kim Donley, Scrum Master – Digital Customer Experience; and Dawn Jones, User Experience Designer.



APS employees from left to right: Keyla Bonilla (APS summer intern), Dave Valenzuela, Kevin Hubler, Brandon David, James Nebrich, Shawn Young



Arizona Public Service (APS) has worked to integrate the company's cable tracking mobile solution into their Transmission & Distribution department, developing the platform in coordination with the vendor, Fulcrum. A year-long pilot program created to field-test Fulcrum and develop substation reporting resulted in immediate cost savings of approximately two hundred hours per year by reducing non-value add activities through the entire organization. Fulcrum reduces report writing time by over eighty percent and reduces the risk of error in the report writing through automation. The APS System & Cable Improvement team has doubled production, installing more wire by May 2021 than in all of 2020. APS personnel on this project includes Kyle Woolfolk, Manager; Michael Shaw, Construction Supervisor & Sponsor/Designer; Christian Schroeder, Construction Planner & Subject Matter Expert/Designer; Meagan Petariou, Material Coordinator & End User; James Nebrich, Construction Wire Pulling Foreman & End User; Kit Roney, Senior Predictive Maintenance Technician & End User; Christina Cloer, Utility Arborist & Subject Matter Expert/Designer; Chris Odonal, Contract Construction General Foreman; and Andrew Rable, Manager – Forestry and Special Programs & Project Sponsor.

Arizona Public Service, in partnership with DIREXYON Technologies, has developed and deployed a unique solution enabling its Transmission & Distribution (T&D) System Health department to use machine learning for predictive modeling. The advanced financial modeling solution digitizes transmission and distribution asset investment planning strategies and provides complex, predictive analytics and critical decision support for nearly one and a half million individual assets across thirteen asset classes. Utilizing data from various sources across the enterprise and leveraging the scalable platform, APS created a comprehensive and easy-to-use model of the distribution system. Team members on this project include Mike Melaragni, IT Executive Sponsor; Kim Wagie, IT Sponsor; Sanket Adhikari, Project Sponsor; Anuya Sheorey, IT Stakeholder – Digital Experience; Pat Kelly, Product Owner; Eric Fleming, Lead Data Scientist; Murali Sankaran, Data Engineer; Pritam Rajagopal, Solutions Engineer; Abhishek Singh, Solutions Engineer; Randall Booze, Design & Spatial Management Solution Engineer; Raed Hamzeh, Enterprise Architect; Antranik Tatian, Stakeholder; Maria Mueller, IT PM & Scrub Master; Tony Tewelis, Business Executive Sponsor; Rinly Moolakatt, Business Sponsor; Mike Adams, Business Stakeholder; Ryan Fulmer, Lead Business Subject Matter Expert; Jeremy Garcia, Business Stakeholder; and Christopher Fathauer, Lead Business Subject Matter Expert.





Miguel Bravo



Jim Holbrook



Christine Helmuth

Arizona Public Service (APS) introduced a targeted fast-track emergency air conditioning program in 2020 to support vulnerable customers with heat relief if their air conditioner failed and they could not pay for repairs or leave their home. APS, in conjunction with the Foundation for Senior Living and Three Cubed, designed a solution and built a streamlined process from the customer perspective, bringing the Heat Relief program together in under three months. APS also leveraged relationships with other electric utility providers and philanthropic organizations in Arizona to raise one hundred seventy-five thousand dollars in funding. In 2021, APS has partnered with the Foundation for Senior Living, St. Vincent de Paul, The Salvation Army, Solari, Inc., and Lyft, to provide various heat-relief assistance for the state's vulnerable populations and help with air-conditioning repairs and replacements, emergency shelters, eviction protection, hydration stations, and transportation services. Innovators from APS include Miguel Bravo, Manager of Strategic Partnerships; Jim Holbrook, Supervisor of Customer Assistance Solutions; and Christine Helmuth, Senior Corporate Giving Specialist, from APS, along with Carrie Smith, Chief Operation Officer, Foundation for Senior Living.

Mansur Ali Mohammed, AVANGRID, Senior Manager – IT Architecture & Innovation, has led the implementation of the pilot and proof of concept solution Automated Overhead Network Inspection using Internet of Things and Edge Computing. His work with this innovation's edge data capture and deep learning uses edge computing to automate vision-based power line inspections, improving both speed and accuracy, as well as reducing costs. As head of IT Innovation, Mohammed is redefining IT, promoting digital transformation, and creating innovative data-driven IT strategies to deliver value-generating solutions.



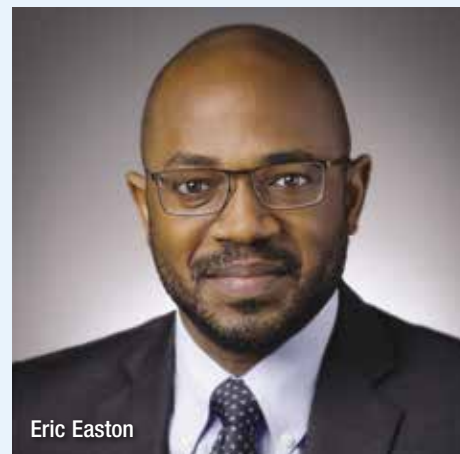
Teddy Menke, Burns & McDonnell, Product Engineer, leverages 3D technology to rapidly capture and create models with high-resolution images and depth data, enabling a virtual design collaboration of the physical world. As part of the innovation team within the Transmission & Distribution Group, Menke manages the program to use Matterport cameras to conduct 3D scans of a site and edit 2D photography to create an immersive, realistic 3D space without any manual postproduction. This technology has reduced engineering hours to complete projects by twenty-five percent or more.

Solar Microgrids Group at the Blue Lake Rancheria tribe's microgrid in Blue Lake California in Humboldt County



The California Public Utilities Commission's Microgrids and Resiliency Team develops and executes regulations, tariffs, and programs for microgrids to enhance resiliency of the electric grid and reduce barriers for microgrid deployment. Their efforts have spanned growth in both utility owned infrastructure and privately owned microgrids, including the development of programs in disadvantaged communities to support environmental and social justice. Their work has streamlined the interconnection process to ease customer burdens for microgrid installation while maintaining the safety of customers and utility workers, and empowered local and tribal governments looking to leverage microgrids as part of their resiliency planning. The Microgrids and Resiliency Team includes Genevieve Shiroma, Commissioner; Leuwam Tesfai, Chief of Staff; Colin Rizzo, Administrative Law Judge; Forest Kaser, Program and Project Supervisor; Joyce Steingass, Senior Utilities Engineer; Jessica Tse, Senior Analyst; Rosanne Ratkiewich, Senior Analyst; Patrick Saxton, Senior Utilities Engineer; Daniel Tutt, Utilities Engineer; Christina Tan, Advisor; Anand Durvasula, Advisor; Elizabeth Dorman, Attorney; Andrew Dugowson, Advisor; and Julian Enis, Utilities Engineer.

CenterPoint Energy's Real-Time Operations (RTO) Team is responsible for continual operations of the company-owned portions of the electric transmission network. During Winter Storm Uri and the power generation shortfall, the team of forty-four helped protect the Texas electric grid and prevent a statewide blackout, by complying with the Electric Reliability Council of Texas's orders to shed load. They simultaneously worked to restore electricity to customers and devise innovative ways to rotate power outages among customers. The RTO team is comprised by the following members: David Mercado, Director – Real-Time Operations; Tamme Chilton, Manager – Grid Training; Kevin Tanzi, Manager – System Operations; Everett Charles, Supervisor – System Operations; Marcos Garza, Supervisor – System Scheduling; Michael Nunn, Supervisor – System Operations; Stephen Osborne, Supervisor – System Operations; Conrad Troncoso, Supervisor – System Operations; Al Woodard, Supervisor – System Operations; Michael Cruz-Montes, Lead Electric Grid Trainer; Dante Jackson, Lead Electric Grid Trainer; Nate Perio, Lead Electric Grid Trainer; Ronny Reed, Lead Consultant – Transmission Policy; Muhammad Ashraf, Senior System Controller; Shane Herrera, System Controller; Joseph Scott, System Controller; Robert Wegner, Staff System Controller; Chris Arbing, Staff Transmission Outage Scheduler; Mark Bazmore, Staff Transmission Outage Scheduler; Victor Dominguez, Staff Transmission Outage Scheduler; Joe Harris, Senior System Controller; Brent Jordan, Staff Transmission Outage Scheduler; Eddie Wallace, Senior System Controller; Josh Likens, Senior System Controller; Joe Osorio, System Controller; Jason Pena, System Controller; Rayburn Williams, Staff System Controller; Paul Barnwell, System Controller; Brandon Fullerton, System Controller; Mike Hall, Staff System Controller; Gordon Jonic, Senior System Controller; Paul Keys, Senior System Controller; Robert Rodriguez, Staff System Controller; Timothy Rumfield, Senior System Controller; Pete Williams, Senior System Controller; Scott Green, System Controller; Jim Plourde, Staff System Controller; Daniel Rumfield, System Controller; Brandon Sole, Senior System Controller; Maribel Khayat, Consultant Engineer – Electric; Ward Jablonski, Senior Engineer – Electric; Jessica Hernandez, Engineer – Electric; Tim Sullivan, Director – Substation Operations; and Mike Pakeltis, Director – Transmission Operations.



Eric Easton



David Mercado

Kameale C. Terry, ChargerHelp!, Co-Founder and Chief Executive Officer, leverages her experience, including her roles as Director of Programs and Head of Customer Experience, to create a more efficient and productive experience with the EV charging infrastructure. Offline chargers offer no recourse to investors. This means that these structures lose value and miss the opportunity to provide investors valuable data that could otherwise be tracked. Terry's work with ChargerHelp! ensures that investments made by organizations, especially utilities providers, can extract intended value from their electric vehicle infrastructure.

Evette Ellis, ChargerHelp!, Co-Founder and Chief Workforce Officer, works to collaborate with local Workforce Centers and use her skills Workforce Development/Outreach to bolster employee infrastructure. Her work creates partnerships to train and hire from local communities. Her company has implemented practices and training curriculums designed to ensure all applicants have a fair opportunity to join the team, overcoming the skills gap and recruiting quality, underutilized, reliable, high-performing professionals.



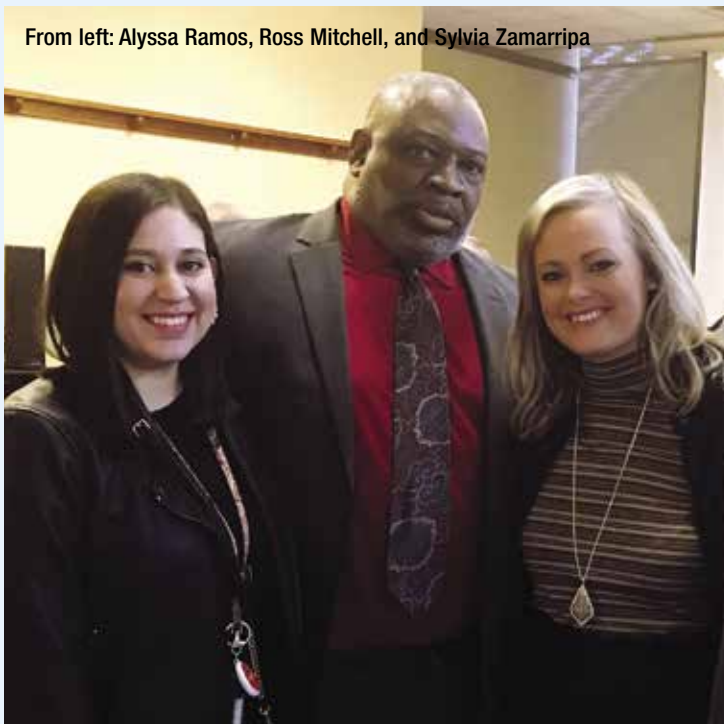
Kameale C. Terry (left) and Evette Ellis



Rudy Garza, Chief Customer & Stakeholder Engagement Officer, is standing with members of the Customer Success Team.

CPS Energy's Customer Engagement Team

has spent the last year launching and implementing their Customer Outreach Resource Effort (CORE). The program's goal was to proactively engage with customers using team members from Customer Success, Community Engagement, and Customer Value Optimization to ensure the team reached all segments of customers, including Residential, Small/Medium Business, and Commercial & Industrial. After a full year of outreach, the team has had a sixty-two percent success rate in speaking with customers called as part of the CORE campaign. Of those customers spoken to, ninety percent have signed up for a payment arrangement and/or received agency assistance referrals. Team members have made eighty thousand calls to customers, connecting them with twenty-nine million dollars of assistance or referring them to needed resources and support agencies.



From left: Alyssa Ramos, Ross Mitchell, and Sylvia Zamarripa

CPS Energy's Supplier Development Team conducted virtual outreach events over the last year to keep the community abreast of contracting opportunities when obstacles to in-person events reduced access to local and diverse vendors in the area. This increase of virtual outreach resulted in a fifty percent surge in new vendor registrations. They also implemented a new Supplier Management System portal, making it easier to submit proposals and pricing with a one-stop, self-serve portal for supplier registration, supplier profile updates, and access to CPS Energy bid opportunities. The team continues to hold monthly virtual community outreach events to share current and upcoming contracting opportunities, also inviting local agencies aligned with the same mission of local investment as special guests each month. The Supplier Development Team includes Sylvia Zamarripa, Manager – Business Management & Analytics; Ross Mitchell, Manager – Supplier Development; and Alyssa Ramos, Coordinator – Supplier Development.

Duke Energy's Enhanced Customer Solutions & Power Quality, Reliability, & Integrity Team

designs custom engineered software solutions to improve the flow of timely outage information and the efficiency of restoration operations. In March of 2021, the team delivered the Street & Area Light Repair tool, Duke Energy's first ever customer-facing public cloud application, for reporting and tracking street and area light repair requests. Leveraging cutting-edge technology, the team modernized and improved the customer experience while simultaneously improving operational efficiency in the repair process. Since launch, nearly one hundred five thousand streetlight and area light issues have been reported through the system. The team's members include Adam Anderson, Product Director; Eric Klein, Senior IT Manager; Brad Cone, Lead Product Analyst; Allyson Rosado, Senior Software Engineer; Sam Saylor, Senior Software Engineer; Scott Pham, Software Engineer; Urvesh Patel, Senior Software Engineer; Dinesh Lawrence, Senior Software Engineer; Sally Huang, Senior UX Designer; John Mitropoulos, Sr. Solution Architect; and Srinivas Gagganapally, Data Architect.

Duke Energy's Supply Chain

Team has conceptualized, developed, and launched their OneSource tool in the past year with record speed. The team delivered savings and created a working Minimum Viable Product in three months, releasing OneSource to a pilot group of Maximo sourcing specialists in six months. The team also conducted sixty interviews and listening sessions to collect user input and feedback and later hosted contract upload days, training coaches within each team on Supply Chain and leading a creative gamification effort to inspire activity in the tool. This team includes Joshua Martin, Director – Inventory Management, Tech Support, Process; Carmen Holmes, Director – Supplier Diversity and Sustainability; Ann Orton, Manager – Sourcing; Cameron Houston, Product Analyst; John Potts, Lead IT Software Engineer; and Expo Santana, Senior UX Designer.



John Mitchell,
Liz Escobar-
Fernandes,
John McGuire,
Skyler Cai,
Matt Prangley,
Josh Painter,
John Diasparra,
Alan Hourmand,
Steve Sickles,
Jake Ross,
Sarah Wade,
Brandon Brown,
Naisla Barreto



Duke Energy's XR Lab, an in-house development team of virtual reality (VR) and augmented reality experts, delivered immersive, interactive VR training experiences and fully 3D-modeled training environments that enabled teammates to safely learn and collaborate during the COVID-19 pandemic. Within the last year, these VR programs have been used to train wind technicians to operate substations and natural gas technicians to inspect rights-of-way for leaks, encroachments, and other hazards. This innovation creates a safe space for frontline workers to safely repeat training sessions without any inherent risk until they achieve mastery of a covered task. To date, the technology has been used to train over one hundred natural gas technicians and evaluate twenty-one technicians. The team is currently piloting the capability to turn CAD drawings of a future generation facility into a virtual space that can be toured in VR before construction. The team at the XR Lab includes John Mitchell, Managing Director – Cloud Architecture and Application Transformation; Liz Escobar-Fernandes, IT Manager; John McGuire, XR Lab Technical Lead; Skyler Cai, Scrum Master and IT Software Engineer; Matt Prangley, Senior VR Software Engineer; Josh Painter, VR Software Engineer; John Diasparra, Senior Software Engineer 3D VR Artist/Designer; Alan Hourmand, 3D VR Artist/Designer; Steve Sickles, 3D VR Artist/Designer; Jake Ross, VR Software Engineer; Sarah Wade, 3D VR Artist/Designer; Brandon Brown, 3D VR Artist/Designer; and Naisla Barreto, Product Owner.



The Electric Power Research Institute (EPRI) recently investigated whether the implementation of AMPs for systems, structures, and components (SSCs) could be enhanced by a consistent and sustainable framework to optimize inspection, repair, and mitigation activities recommended to manage the potential impacts of aging effects in nuclear power plants. EPRI developed a first-of-its-kind Framework, an integrated approach to applying and leveraging available knowledge of degradation mechanisms and existing risk tools to optimize AMP implementation. In

two pilot studies, the EPRI Team guided nuclear industry subject matter experts at Ameren and Exelon to evaluate the effectiveness and limitations of the Framework when applied to nuclear power plant AMP implementation. Each pilot determined the likelihood of degradation and combined it with insights from existing risk tools including Probabilistic Risk Assessment methodology results, to evaluate the consequences of specific SSC failure. Team members on this project include Emma Wong, Team Lead and process co-developer, EPRI, Principal Technical Leader – Innovation; Fernando Ferrante, Framework co-developer and Risk Tools Expert, EPRI, Principal Project Manager – Risk and Safety Maintenance; Andrew Mantey, Aging Management Expert Cable Aging Management, EPRI, Principal Project Manager – Plant Engineering Electrical Team; Pat O'Regan, Risk Informed Tools Expert, EPRI, Technical Executive – Non-Destructive Evaluation Reliability Team; Dylan Cimock, Aging Management Expert Selective Leaching Aging Management, Principal Technical Leader – Plant Engineering Mechanical Team; Jessica Bock, Aging Management Engineer Cable Aging Management, Ameren (Callaway), Engineer – Cable Program; Justin Hiller, PRA Engineer, Ameren (Callaway), Supervisor – Licensing; Barry Thurston, Aging Management Coordinator, Engineer – Exelon; Seth Rios, Fleet Buried Piping and Tanks, Selective Leaching Subject Matter Expert, Senior Engineer – Exelon; Deven Strabala, Limerick Buried Piping and Tanks, Selective Leaching AMP Owner, Engineer; and Nina Lacome, Fleet Risk Management Engineer, Exelon.

Brandon Fitchett and Rajasekhar Pulikollu, EPRI, Generation Research & Development, led implementation of innovative wind farm performance efficiency tracking techniques at utilities representing over ten gigawatts of wind energy and identifying opportunities for increased efficiency of wind turbines, increasing cost effectiveness and reliability of wind assets. Working on collaborative R&D with over eight utilities to support their individual application, they implemented a performance monitoring solution with readily available wind turbine data that can reveal underperformance, guide condition-based maintenance to improve performance, and reduce operational costs.



Jason Hollern, Program Manager, and Jeremy Lawrence, Principal Technical Leader, for the Cyber Security for Generation Assets research program at EPRI in the Generation Sector,

developed hardware-based secure interactive remote access product using innovative principles to provide access by a remote user to an operational technology environment. Both Hollern and Lawrence identified security gaps in current systems and tools and equipment in the marketplace providing partial solutions. Working with technology providers to develop a lab-scale demonstration of new technology products based on the use-cases and requirements, they developed a pre-production proof-of-concept to install in the EPRI labs as a working demonstration to utility stakeholders.



Michael Bolen, EPRI, Program Manager, has worked to improve safety and understanding of DC arc-flash hazards by inducing arc flashes at three commercially operating photovoltaic power plants and measuring associated hazards. Each of three field tests, performed in 2017, 2019, and 2021, required about one year of preparation and coordination amongst multiple organizations, including utility site hosts, national laboratories, academia, standards development bodies, engineering firms, first responders, and more. The tests found that most existing incident energy calculations are overly conservative. Lower levels of PPE can sufficiently protect field workers from an arc flash, increase their productivity, and increase safety through avoiding heat stress.



Lea Boche, EPRI, Technical Leader – Generation Sector (Artificial Intelligence initiative), led development, testing, and work with key industry stakeholders to provide tag data for testing the “Tag Whisperer” tool, a software tool that facilitates the process of unifying tag names by using machine learning techniques to filter and standardize OSI-Pi tag naming. The tool eases the search for data points and equipment across a unit or fleet, contributes to an understanding of how plant assets are operating, and improves modeling capabilities at a fleet level.





Prayag Parikh, Technical Leader in the Generation Sector at EPRI for the Monitoring and Advanced Data Analytics Research Program, is sector lead for the development of the Continuous Online Monitoring (COLM) Guidebook and the associated COLM Equipment Guides. Parikh collaborates with the Nuclear Research Sector to develop and revise these guidelines, providing utilities with a playbook for improving data analysis through process upgrades and equipment installation. He has led the effort to publish an eight-volume guidebook, the COLM equipment guide development process, and either led or supported the development of over twenty-five equipment guides.

Tapasvi Lolla, EPRI, Senior Technical Leader – Generation Sector Materials & Repair Program, has led the development, standardization, and execution of procedures in the metallurgical laboratories. His work has improved efficiency, preparation procedures, overall understanding of primary damage mechanisms, unique methodologies to enhance obtained datasets, and next-generation training. Additionally, his efforts have directly led to a clearer understanding of active damage mechanisms in failure investigations, a better appreciation for the contributing factors to failures and the identification of previously not-well-understood details which continue to deconvolute the complexity in flexible plant operation.



Nils Johnson, Principal Technical Leader Modeler with EPRI's Energy Systems and Climate Analysis group, is a leading expert on energy economy modeling and the technoeconomics of emerging technologies. His research activities include development of cutting-edge analytical tools to explore the potential for end-use electrification, assess the economics of renewables, energy storage, and other low-carbon technologies, and understand pathways to deep decarbonization. The tools developed as part of Johnson's analyses have been incorporated into EPRI's REGEN model and are being used as part of ongoing research with other utilities. Johnson is currently working on a new model to explore the economics of decarbonizing industrial sectors, including both electrification and other mitigation opportunities using low-carbon fuels, and is also leading a study to understand the potential role of long-duration energy storage.



Eric Bauman, Principal Technical Leader at EPRI in the Occupational Health and Safety (OHS) program, has worked in the utility industry for forty-two years and has a long-standing passion for worker safety. He spearheaded numerous projects focused on safety improvements at utility companies, including safety of Augmented Reality technologies, quantifying safety management practices impacts on injury rates, heat stress, fatigue managements, ergonomics, identifying SIF precursors using Artificial Intelligence, and driving safety. He has developed the R&D work with a network of collaborators to execute research and apply and disseminate results.



Ralph King, Program Manager – Cyber Security Insider Threat Management Project at EPRI, monitors cyber threats exposure risks to systems and infrastructure that support power delivery. Over the past year, he collaborated with seven EPRI utility members (Alliant Energy, Con Edison, Cooperative Energy, FirstEnergy, New York Power Authority, Southern Company, and Xcel Energy) to create new resources to provide defacto standards for electric power utilities to manage and understand insider threat risks. Through the collaborative model employed for this EPRI project, the seven utilities have received the Insider Threat Management Guidebook and Risk Personas for ten to fifteen percent of the cost of executing this project on their own.

Franklin Energy's Innovation Lab Team, led by Danielle Marquis, Vice President of Product Management, has spent the last year ideating virtual solutions with and for utilities. The Team has developed prototypes and conducted user testing to refine these prototypes into full-scale products, launching two new virtual products in Fall 2020 and Winter 2021. These products, a multi-path energy audit participation module and a personalized kit module, are in start-up or implementation with nine utility clients. Both were designed to improve customer service and user experience, while shifting traditional program designs to virtual formats that could be safely implemented during the pandemic and beyond.





Hitachi ABB Power Grids North America's Fabio Luiz, Service Manager – High Voltage Products; Renato Milanese, Product Manager – High Voltage Service; and Kenneth Bryar, Digital Specialist – High Voltage Service manage the Collaboration Center (CoCe), based at the High Voltage Product Service Center in Mount Pleasant, Pennsylvania, supporting remote services for high voltage products. The CoCe is a centralized, multi-media control room equipped with video conference equipment, augmented reality devices, secure connections and redundancy, and multiple displays to seamlessly connect service specialists with the company's library of resources. Through this set up, the team offers the same capabilities and expertise customers expect from onsite service, remotely and in real-time. Their work with the CoCe proves how technology facilitates remote services effectively and efficiently.



Alfonso Valdes



Abhiroop Chattopadhyay



Peter Sauer



Reynaldo Nuqui

Reynaldo Nuqui, Senior Principal Scientist, Hitachi ABB Power Grids, recently introduced an innovation that provides an additional layer of defense for Flexible Alternating Current Transmission System (FACTS) assets against incorrect command resulting from human error or potential cyber-attack. While probability of such incidents is low, extreme scenarios can result in grid oscillations, or even destabilization. The innovation is currently in a proof-of-concept stage but results of experiments and simulations suggest it could significantly improve the security of FACTS stations interacting with wide area controllers and other utility systems. Members of Nuqui's team include Abhiroop Chattopadhyay, PhD Student – University of Illinois at Urbana-Champaign; Alfonso Valdes, Principal Research Scientist – University of Illinois at Urbana-Champaign; and Peter Sauer, Professor – University of Illinois at Urbana-Champaign.



Hudson Gilmer



Jonathan Marmillo



Nathan Pinney

LineVision's founding team of Hudson Gilmer, CEO; Nathan Pinney, Chief Scientist; and Jonathan Marmillo, Vice President of Product provide electric utilities with the real-time monitoring and predictive analytics needed to secure the future of the grid. Their platform is rapidly deployed at scale without the need for scheduled outages, live line work, or specialized installation equipment, helping utility partners lead the energy transition with enhanced grid flexibility, resilience, and security. The company recently developed a solution addressing the need for utilities to have ultimate visibility into what's happening on their transmission lines. With the data and analytics created by LineVision's patented non-contact sensor systems, utilities can increase the integration and utilization of renewable energy resources to unlock additional capacity on existing lines, provide insight into conductor health, and detect anomalies and risks.



Derek Vadala, Moody's Investors Service, Chief Executive Officer of VisibleRisk, helped form VisibleRisk, a joint venture between Moody's and Team8, to develop a next-gen cyber risk quantification platform for assessing and managing enterprise-wide cyber risk. This first-of-its-kind cyber risk quantification methodology automates the collection and analysis of a wide range of data and translates it into financial terms with the first ever cyber resilience rating. The system's methodology is automated and transparent and can be applied across all types of organizations. Using a tools-based approach to collect and analyze a variety of internal and external data types, Vadala's platform provides a validated and high-fidelity illustration of risk, while reducing workload.





The Maryland Public Service Commission Transportation Division recently designed, developed, and implemented a new Transportation Network Company (TNC) regulatory process. The team established operating rules and regulations for, designed, and implemented this electronic licensing process for more than four hundred thousand vehicles and drivers. The streamlined TNC electronic licensing process also allowed the PSC to assume regulatory authority over a burgeoning segment of Maryland's for-hire transportation industry, increasing its number of regulated entities by a factor of more than ten. The team worked collaboratively with TNCs and the PSC's IT Staff to develop a process that is efficient, transparent, and responsive to consumer and industry demands.



Joshua Wong, Opus One Solutions, CEO, founded his company to create an enterprise software platform, GridOS, now the industry's leading Distributed Energy Management Platform. GridOS enables utilities to transform their physical grid into a digital, controllable, and economic platform for distributed energy resources. This platform approach alleviates not only technical constraints, but also constraints around economic signals and regulatory structures associated with incentivizing DER adoption. GridOS is recognized as a critical enabling solution for a one hundred percent decarbonized energy system and has been independently assessed to attain a cumulative emissions reduction potential of over thirty thousand million metric tons of carbon dioxide equivalent (MMTCO_{2e}) by 2041.

Eric Rosenberger, PPL Electric Utilities, Senior Engineer in T&S Asset Management,

researched and identified the best vendor with which to partner for Dynamic Line Rating (DLR) technology. He also developed engineering standards for implementing the sensors onto PPL's system. Since installation, Rosenberger has led an IT project team implementing the technology into operations and assisted in determining a complete system architecture compliant with the North American Electric Reliability Corporation (NERC) standards. Partnering with Reliability First and internal IT experts, Rosenberger and his team were able to develop an on-premise system design that would be a secure, reliable, and compliant solution.



Horst Lehmann, PPL Electric Utilities, Senior Engineer in Transmission Planning,

is responsible for recognizing that Dynamic Line Rating (DLR) technology could be used in a new way to address line congestion issues on transmission lines. When it came time to test DLR on PPL's lines, Horst led the engineering and field installation of the sensors. After, he performed continuous analysis on the system and coordinated an analysis solution for PJM to integrate the DLR system data into PJM's future-looking market efficiency analysis. Horst's contributions helped PPL become the first company to successfully use DLR to address congestion and market efficiency issues.



San Diego Gas & Electric's Gavin Worden, Director – Cloud & Infrastructure; Jonathan Woldemariam, Engineer; Ted Reguly, Director – Portfolio and Project Management; and Nick Moran, Director – Electrical Engineering are working to build a communications network that will enable forward looking initiatives. In preparation for the onslaught of connected devices that will increase the efficiency and resiliency of the grid, they've pursued both nine hundred megahertz and Citizens Broadband Radio Service for wireless spectrum, ensuring that evolving needs and opportunities are met. Their current focus is on a Falling Conductor Protection system, which relies on low-latency communications to detect the status of a line and de-energize it before it hits the ground, and private LTE with the various spectrum the team has secured that will enable actions in the future.



The Southern California Gas Research, Development, and Demonstration Program Team develops and demonstrates products and technologies that promote decarbonization across the natural gas value chain and a diversified portfolio of clean energy sources, distributed networks, tools, and applications. In the last year, SoCalGas RD&D had three hundred eighty-six active and one hundred six completed projects and initiated one hundred four additional projects. Some key innovations the team has worked on are a biomethanation reactor project in collaboration with National Renewable Energy Laboratory and Electrochea, a technology created in collaboration with SunLine Transit to produce hydrogen from renewable natural gas for fuel cell vehicles at prices competitive with gasoline, and another technology, developed in collaboration with HyET Hydrogen, that simultaneously separates and compresses hydrogen from a blend of hydrogen and natural gas and can be easily and affordably transported via the natural gas pipeline system.



Xcel Energy's Electric Transportation Team, led by Nadia El Mallakh, Area Vice President of Strategic Partnerships and Ventures, works to address customer barriers to Electric Vehicle adoption and build out EV infrastructure. Over the last year, the team has worked to approve and implement their industry-leading Colorado Transportation Electrification Plan. Approved by the Colorado Public Utilities Commission in early 2021 and aligned with Colorado's goal of putting nine hundred forty thousand EVs on the roads by 2030, the three-year, one-hundred-ten-million-dollar plan includes installing about twenty thousand EV charging plugs in homes, buildings, and public spaces throughout the state. The plan also informs customers about cost savings and environmental benefits of buying/leasing EVs via educational and advisory services and lowers upfront costs of EV chargers, infrastructure upgrades, and purchasing EVs for income-qualified customers through rebates, make ready programs, and the like. The team's leadership includes Deb Erwin, Director – Policy and Program Planning; Jean Baptiste Jouve, Director – Strategic Partnerships and Ventures; Huma Seth, Director – Fleet Solutions and Commercial & Advisory Services; and Alisa Sobczak, Director – Residential Management & Advisory Services. **PUF**



Lindsay Jenkins, Urbint, Senior Vice President, Strategy and Technical Operations, spearheaded the ideation, development, and launch of Urbint Lens for Worker Safety, a first-of-its-kind AI-powered worker safety technology that identifies safety threats to workers in the field and enables supervisors to immediately take action. The tool takes what was once a manual process of recording and analyzing spreadsheets, to highly targeted, risk analysis using machine learning that factors in crew history, schedules, worksite and environmental conditions, and more. Since the solution was announced in 2020, Jenkins has played a pivotal role in introducing it to the market, now working together with the first utilities to deploy the solution, to calibrate it to their needs.

Lewis Latimer, The First Hidden Figure

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Association of Edison Illuminating Companies' Top 10 Awards 2021

Conversation with AEIC Chair and Cleco CEO, Bill Fontenot,
and AEIC CEO Steve Hauser.

From the association Thomas Edison founded in 1885, this year's Top 10 Awards:
Commonwealth Edison for advanced distribution protection and for an arc flash simulator,
Con Edison for its safety leadership system,
Duke Energy for its customer delivery builder concierge,
Eversource for its Give Me a Moment tools to address momentary outages,
Florida Power & Light for tackling human error in switching,
New York Power Authority for private LTE network applications,
PPL for vegetation management risk modeling,
Tampa Electric for its BlockEnergy distributed energy system,
and Tennessee Valley Authority for its safety blitz process.



When the historic and prestigious Association of Edison Illuminating Companies gets together for its annual meeting, as it shall in November, the industry's most senior leaders responsible for operating the country's electric systems will be in the room. Just counting those on AEIC's board of directors, there's the CEOs of American Transmission Co., Cleco, FirstEnergy, Jacksonville Electric Authority, and Orange & Rockland Utilities, the COOs of Arizona Public Service, ComEd, Eversource, Oncor, PowerSouth Energy Co-op, PPL Corp., and Tampa Electric, and several utility EVPs and SVPs. Herein we celebrate this year's AEIC Top 10 Awards for operational innovation.

Bill Fontenot and Steve Hauser

PUF's Steve Mitnick: Why is the Association of Edison Illuminating Companies an important organization for our industry in the present day?

Bill Fontenot: AEIC holds a unique and important position in the industry. We are a place where the industry's leading operations experts from utilities across North America come together to share knowledge and provide guidance to the industry that is essential to achieving operational excellence in all aspects of generation, transmission, distribution, and storage of electric power.

With that said, the Edison business model that was put in place for utilities in the late 1800s and early 1900s, remains intact today through the AEIC. Utilities may get innovative in their day to day operations, but for turbines, boilers, transformers, and other equipment and technologies, we rely on OEMs, or technology providers to provide solutions.

Your modern-day Edison companies, or OEMs like GE and Siemens, all provide technology to electric utilities today. When the Edison franchisees were put in place, Edison was the technology provider to the franchisees, to Commonwealth Edison, Southern California Edison and the other Edison companies which are today's modern-day utilities. It was fitting that they would meet at least once a year at the AEIC meetings to talk about technology, and they still do so today.

Why is it so important? Because that business model put in place over a century ago is important today to sustain the business. Though back then, they were just illuminating. Today, we're not only heating and air conditioning, as so many other essential services depend on electricity.

That business model, established more than one hundred years ago, is much the same today. In fact, the AEIC power generation committee still meets with the OEMs – the modern-day major technology providers – to give feedback and insight on their products, what's good and bad, and what's needed for the future, all with the perspective to improve the business.

At one point, I was part of the AEIC PowerGen Committee. It's very structured and still provides great feedback to the modern-day Edison companies. I'm not sure how this was done in the AEIC formative years, but it's very well done today.

The AEIC power generation committee still meets with the OEMs – the modern-day major technology providers – to give feedback and insight on their products.

– *Bill Fontenot*

Now, there's a formal survey for each technology provider, which is evaluated by the PowerGen Committee. AEIC member utility companies score each of them. The OEMs know where they stand on everything from customer service to maintenance, to emerging technology. Every technology provider also has the chance to provide insight on their products,

PUF: Steve, what's your take on the importance of AEIC?

Steve Hauser: My background has been largely focused on advanced energy technology for the past several decades. Then I found myself in the last ten or so years helping to implement policy changes in Washington D.C. through the GridWise Alliance. GridWise was based on educating policymakers on the innovative technologies that were and are transforming this industry.

What I've found over the last few years is that the policymakers and CEOs have a loud voice, but the operation aspects of a utility don't have a loud voice in Washington D.C. with regard to policies, even though they're the ones largely having to implement those policy changes. I'm excited to be leading AEIC and increasing their visibility on critical issues.

AEIC is an organization that collects the expertise of the people that operate the system around the country, including Canada, and identifies opportunities to make changes and improvements, develop best practices, and share those with each other and key decision makers.

With federal legislation, technology innovations, and industry-wide initiatives focusing attention and resources on significant investments in electricity infrastructure and grid modernization, the need for and value of AEIC's technical committee



AEIC is an organization that collects the expertise of people that operate the system around the country, including Canada, and identifies opportunities to make changes and improvements, develop best practices, and share those.

— Steve Hauser

work has never been greater. These transformational initiatives require AEIC's expertise and leadership to ensure investments are strategically aligned with both current and long-term grid infrastructure objectives.

My goal is to do more of that. That's the main reason that AEIC's board hired me earlier this year. They saw a vacuum in the debates that are going on nationally, and AEIC needed a bigger impact and voice in what's being debated around the country and the rapid changes taking place.

The leadership of board members like Bill and the other members of the Executive Committee, Jim Greer from Oncor and Werner Schweiger from Eversource, are critical in reaching our vision for AEIC.

PUF: Bill, it seems like the leaders want AEIC to have a more prominent role.

Bill Fontenot: There are some incredibly important committees that are part of AEIC. It began with something that looked somewhat like the PowerGen Committee but has grown to provide a lot of quality information and interaction among utilities, far more than the original Edison meetings.

Not many people know that these teams are actively working together, especially with respect to power delivery. After Hurricane Sandy, EEI and the federal government realized that our industry had many mutual exchange organizations that focused on sharing crews to help restore power during catastrophic events.

These groups were all working individually, and yet if there was a storm large enough to require more resources than a single mutual exchange organization could provide, there was not collaboration. The EEI approached AEIC to form an RMAG, or Regional Mutual Assistance Group, to work collectively to restore services across affected regions. In cases like this it's bigger than just New York or the Southeast.

Who did they look to? It was the AEIC Power Delivery Committee. Few knew what AEIC was or what it stood for. We've been this almost secret organization for decades.

However, the Power Delivery team delivered a solution that stands to support national storm restoration today. In fact, our AEIC team is launching a new mutual assistance software tool to greatly improve the sharing of work crews in recovering from a major storm.

We have access to the nation's best operating people, and we know we should have a louder voice in the changes taking place in our industry. That is the AEIC leadership goal for the future; to leverage this expertise for the benefit of our industry.

It is collaborative. Very few utilities aren't part of our organization. Whether it's cooperative, investor-owned, or public power, we have most of the industry represented.

We brought Steve in earlier this year to bring a different perspective. We don't want to disrupt what we have, but we can take it to a new level.

That's what we're challenging Steve to do, to develop a plan for how we can leverage this collaborative operating group, the best in the business, and do something better, whether it's serving

EEL with more operating information, driving better public policy or improving service to the nation's customers. AEIC can do more, but that's what we're trying to figure out.

PUF: Talk about AEIC's top ten awards this year. Why is that important?

Steve Hauser: I've been impressed with the quality of projects as we went through the selection process this year. The nominations were all submitted in the spring, about the time I joined AEIC. There were sixty-three nominations from forty utility companies.

To judge all of those was a challenge, they were all good nominations, from safety practices to new technologies for supporting improved operations. Quite a variety of projects were nominated.

We decided this year to go with the top ten, because we felt like we couldn't just pick one or two. We needed to recognize the cream of the crop.

We are pleased to have PUF feature these winners in this issue. We will be giving out those awards in person at our annual meeting the first week in November in Palm Beach. We're excited about that. We're going to be looking for other ways to recognize the good work going on across the industry.

PUF: Bill, talk about those top ten awards. Why are they important?

Bill Fontenot: It's a combination of reasons including recognition of AEIC and branding. In some ways, the awards support trying to get our secret out. Receiving an award is great, but who recognized the recipient and what are their credentials?

We came up with the idea to build on the AEIC brand, but it's also to recognize those companies and their efforts to better the industry. If you've got branding and the recognition, you're getting better participation in the organization. In many ways, it was about telling more about AEIC's value and contributions to the industry.

PUF: Talk about the value of an AEIC meeting for you.

Bill Fontenot: Coming from one of the smaller utilities in the country, networking alone is a tremendous value. At Cleco, we've got a relatively small generation portfolio of about seven thousand megawatts. Yet today, through my experience with AEIC, I can grab my cell phone, and call NextEra, which is managing the largest generation fleet in the country to get advice.

You can network, whether you're the biggest or smallest utility, and you have access to the top executives in the industry. It doesn't take long to figure out that the key leaders in the industry participate in AEIC.



We have access to the nation's best operating people, and we should have a louder voice in the changes taking place in our industry. That is the AEIC leadership goal; to leverage this expertise for the benefit of our industry.

– Bill Fontenot

When Puerto Rico was destroyed by storm a few years ago, these same leaders out of the AEIC Power Delivery Committee came together. They were the first people in this nation called on to go figure out how to fix Puerto Rico's power distribution problems.

AEIC has representation from utilities that can lead the industry to the operating world, whether it's generation, transmission, or distribution, or good old-fashioned cable specifications.

PUF: Steve, what's going to be most rewarding to you?

Steve Hauser: Not surprisingly, in 2021, putting a meeting together is a challenge in the midst of a pandemic. We're doing

our best to get the right people in the room. Traditionally this has been a “must attend” event for our members. The value continues to be in meeting and developing the relationships Bill mentioned, plus learning about the latest critical issues, networking, and building trust among each other.

I’ve been challenged to look at the brand, communication strategies, and the effectiveness of the organization in meeting our goals. We’re excited to announce a few things at our annual meeting that are going to improve what AEIC looks like going forward. Stay tuned.

PUF: Bill and Steve, when asked, what do you say as to why it’s good for folks to get involved and active in AEIC?

Bill Fontenot: I’d say, if you have an up and coming executive, or an operating person who’s got potential, you can’t ask for a better forum than AEIC. They will meet individuals in the industry, through networking. You will get to interact with the real players in this industry, understand how they’re thinking, and have access to them for the future.

One of our members said it best recently when they said, our member companies send their best people to work on AEIC’s committees.

Steve Hauser: There are a number of AEIC long-time participants who have been promoted up through their organizations

in large part because of their involvement in AEIC. I’m sure there are other factors involved, but it seems to be an excellent training ground for leaders and managers.

They have an opportunity to provide leadership in the committee structure. They could become a vice chair or a chair, and then they come onto our board, and many have.

You’ve seen them over the years be involved in the committees, get on the board, and take on leadership positions within the board. I can’t think of another group that provides that kind of a training ground for the industry’s future leaders, at least in the operational space.

Bill Fontenot: If you just attend the meetings of AEIC in any committee, you’re going to see different perspectives. You can use those perspectives to make differences in your company and your organizations going forward.

It’s invaluable. The dues are more than reasonable. My question is, now, what do we do with that knowledge and expertise now that we’ve shared it?

We must leverage AEIC to truly make a difference in individuals, companies, growth, and knowledge transfer across the industry. With all the changes taking place in our industry, what else can we do to have a lasting impact the way AEIC has over the past century? ○

This Year’s AEIC Top 10 Awards

Edison Would Have Been Proud of Them

From the organization that Thomas Edison himself founded in 1885, the Association of Edison Illuminating Companies, this year’s Top 10 Awards are summarized herein.

These are notably achievement awards presented annually to an individual or groups of individuals from AEIC member companies, committees, or subcommittees who have clearly demonstrated significant contributions to advancing the operations of the electricity industry.

The awards are the association’s most prestigious awards. They are not intended as service awards, for long-term service on the AEIC board of directors, committees, subcommittees, or at member companies.

Commonwealth Edison: Advanced distribution protection

ComEd is the first utility to deploy an improved passive optical network – that is, a fiber-optic telecommunications technology for delivering broadband access

– with redundant paths and failover to transform their electric distribution system into a resilient network capable of addressing the requirements of the evolving grid. Such as the need for improved power quality and the ability to accommodate two-way power flow resulting from distributed renewable resources.

Vendor-neutral, low-latency fiber optic communication between distribution automation devices and substation protection equipment enables ComEd to

take advantage of advanced protection schemes incorporating the protocol IEC 61850. This is a standard of the International Electrotechnical Commission for intelligent electronic devices at electric substations.

The approach taken by the ComEd’s relay and protection, distribution automation, smart grid, and renewable energy advanced control and telemetry systems teams eliminates the need for protective devices to operate on the same overcurrent setpoints. Thereby avoiding unnecessary momentary outages caused by reclosers overtripping for faults outside their zone of protection. In addition, fault energy can be removed significantly faster, which reduces material failures in cabling, transformer windings, switchgear, etc., and reduces the energy produced by arc flash.



New York Power Authority applying private LTE networks.



Commonwealth Edison: Arc flash simulator

ComEd's safety, distribution engineering, and smart meter operations teams collaborated to develop a four-hundred-and-eighty-volt arc flash simulator. It was meant to provide a way for the utility's

Employees who have seen the flash have a greater respect for the hazard, and thus are less likely to become complacent when dealing with energized equipment.

employees to safely experience such an arc flash. Employees who have seen the flash have a greater respect for the hazard, and thus are less likely to become complacent when dealing with energized equipment.

The arc flash simulator is an immersive and memorable experience. The roar of the phase-to-phase blast vibrates a person's chest, while they feel the air around them rapidly heating up.

The most difficult challenge was safely creating an arc flash. The simulator's basic

design is a series of linear actuators in a customized electrical enclosure that lift a copper conductor into an energized four-hundred-and-eighty-volt three-phase bus.

Con Edison: Safety leadership

"Safety leaders are essential," says Con Edison. The company has developed the Safety Leadership System, or SLS. It's an innovative and dynamic platform, to develop leaders that push safety beyond the limits of the traditional standards of the Occupational Safety and Health Administration.

The SLS began as a grassroots endeavor that included traditional and non-traditional members producing fresh ideas. The system collects and analyzes leading and lagging safety indicators with a risk-based methodology. The goal is to establish a safety performance rate metric that provides a more comprehensive, three-hundred-and-sixty-degree view of organizational and individual safety performance.

Implementation of the SLS has produced the best OSHA safety performance in company history. And a sixty-seven percent reduction in operating errors over the past year.

The SLS was also selected by the Chief Environmental Health and Safety Officers,

a global organization of health and safety leaders from hundreds of public and private corporations from sixty countries, as the front-runner in the use of data analytics to prevent injuries. Furthermore, the system has been submitted for a provisional patent due to its unique and innovative approach.

Duke Energy: Customer delivery builder concierge

In 2018, Duke Energy's largest builders expressed their concerns regarding the need for more specialized services and more options for doing business with Duke. The builders' issues included having to make multiple calls for assistance and experiencing long wait times for responses.

In response, Duke Energy piloted a new Concierge specialty team for the largest builders in the Charlotte, North Carolina area. Duke established a special direct phone number (bypassing the automated phone system), email address, and a builder portal. The goal was to enable these customers to access a small team staffed with customer service and engineering employees who could handle all the builders' needs from construction process applications to meter set.

Following a very favorable response to the Concierge team, Duke Energy



expanded the Concierge pilot program to a permanent service offering in all its jurisdictions utilizing existing staff. Duke now offers builders and developers services beyond construction, including bill reconciliation, payments, credit terms, outages, etc. It's increasing customer satisfaction and making the entire process more efficient for all.

Eversource: Addressing momentary outages

Eversource has embarked on a new analytics initiative that will result in improvements in the detection and analysis of momentary outages. It is expected to help address business challenges in areas such as reliability, regulatory reporting, customer satisfaction, and asset management.

The resulting tool was Archimedes, or also ARCHIE (which stands for analyzing reliability and circuit heuristic impacts at eversource). This tool addresses the previously inefficient processes, resource-intensive approaches, and the need to access and reconcile data across multiple systems by providing a holistic view of the electrical network to identify momentary outages.

The humans at the center approach

Eversource has embarked on a new analytics initiative that will result in improvements in the detection and analysis of momentary outages.

employed in ARCHIE's development provides Eversource with the ability to look at data from multiple perspectives. Including time, region, devices, circuits, and customers.

Initially developed with engineering as the primary users, Eversource has socialized ARCHIE across the operations organization. And it has brought in new use cases, for example, including weather data and the effects of vegetation in its analysis.

ARCHIE presents users with the ability to analyze assets by manufacturer, age, and weather impacts as a standard part of outage analysis. It is also an important tool for customer account executives to manage their accounts proactively.

Florida Power & Light: Tackling human error in switching

Traditional methods of communication when performing switching operations to reroute the power grid – written switching orders, back-and-forth telephone calls, remote field locations, and manual logging

by control center dispatchers – leave enormous room for human performance error. Switching errors can result in safety concerns, extended outages, reduced customer satisfaction, and equipment damage.

FP&L has developed the iSwitch app for the iPad to reduce the potential for human errors by:

1. Using a simple step-by-step procedure to walk field personnel through the switching process.
2. Enforcing a mandatory, built-in safety tailboard process prior to switching.
3. Putting real-time stops in place to prevent proceeding too quickly and making mistakes.
4. Providing the ability to review job orders during job planning before site visits.

The STAR technique (which stands for stop, think, act and review) is embedded in the app via pop-up windows that ensure intent to proceed. Three-way communications between dispatchers and field personnel are enabled, allowing switching



TVA Wheeler Hydro Safety Blitz Team.

personnel to verify order numbers, dates, and times before proceeding.

iSwitch has resulted in a sixty percent reduction in switching errors. And the app continues to improve over time as features such as voice playback of the switching steps are added based on feedback from field personnel. The most popular feature of iSwitch is safety.

New York Power Authority: Private LTE network applications

The New York Power Authority intends to become the nation's first end-to-end digital utility. To further its progress toward that goal, NYPA is piloting a private LTE network with a seamless path to next generation 5G for both its generation and transmission facilities. This is expected to enhance operational and programmatic capabilities. And to leverage the benefits of the evolving innovations in wireless technology.

The application of a private LTE network focuses on several use cases. Including drone inspection and workforce mobility.

NYPA currently employs a fleet of helicopters and pilots to perform visual inspections of transmission lines throughout upstate New York. The narrow transmission paths and rugged terrain present challenges. Including the potential for catastrophic damage to the network, long-term outages, severe economic costs, and

the devastating loss of human life in the event of an accident.

This first-of-its-kind drone inspection confirmed that high-definition visual and thermal imaging live streaming technology

The application of a private LTE network focuses on several use cases. Including drone inspection and workforce mobility.

gies enable unmanned, detailed inspection within proximity of in-service transmission lines. And it showed that a private LTE network meets the strict performance requirements for drone control and image transfer.

These technologies are expected to enable NYPA, and other utilities as well, to achieve enhanced safety, reliability, and efficiency.

PPL Electric Utilities: Vegetation management risk modeling

PPL Electric Utilities has developed a rigorous risk-based quantitative approach to vegetation management. Implemented in 2020, despite experiencing more severe weather that year, vegetation reliability, SAIFI, improved by fourteen percent.

The vegetation management team



Tampa Electric's Block Energy solution.

identified a hundred and eighty-seven separate grids from thirty-six different circuits that had a very high probability of experiencing a vegetation-related outage. A model assigned risk levels. Pink is for high, orange for moderate, yellow for low, and translucent for keep safe.

The team used a concept called residual analysis that took shared characteristics from the utility's feeders and grid to model the expected performance of various components. It provides an understanding of how many outages would occur on one feeder or grid based on these characteristics.

Tampa Electric: Distributed energy system

Tampa Electric and Emera Technologies are piloting a program, which they named BlockEnergy. It's to develop a utility-owned business model to address the migration of customers toward behind-the-meter technologies such as rooftop solar, local backup, and microgrids to protect their critical loads. The goal is to bring more value and reliability to customers seeking greener energy solutions.

BlockEnergy is a rate-based alternative for distributed energy solutions. The program was approved by the Florida Public Service Commission in May of 2021.

In the pilot program, thirty-seven homes will have four levels of energy assurance: rooftop solar, local battery

(Cont. on page 74)

Lines Underground Innovations

They're Innovating Undergrounding, by PUF's Steve Mitnick

Conversations with Dominion Energy's Les Carter,
Florida Power & Light's Jerry Cook, Pepco's Jaclyn Cantler and Donna Cooper,
Southern California Edison's Raj Roy, Thuan Tran and Angel Brito,
and TECO Energy's Dave Plusquellic

PG&E's Landmark RFI to Underground Ten Thousand Miles of Lines

They're Innovating Undergrounding

Now a Twenty-First Century Resilience Strategy

BY PUF EXECUTIVE EDITOR STEVE MITNICK

It began snowing on Sunday night. By Tuesday, which was the thirteenth of March, back in 1888, twenty-one inches had fallen on New York City. With winds of nearly hurricane force, drifts of snow were as high as thirty feet.

Most terrifying to New Yorkers were the collapsing poles with their many cross arms from which the wires of Western Union Telegraph Co., Gold and Stock Ticker Co., and four competing electric companies – United States, Metropolitan, Brush, and East River – were hung. Gyrating wires hissed and sputtered. Fearing electrocution, people stayed indoors.

The one exception were the lines of the Edison Illuminating Co. Thomas Edison buried his company's wires underground in conduits he called "subways."

A few months afterwards, the mayor demanded that all the companies' wires, not just Edison's, be buried underground. According to the author of a book about the Great Blizzard of 1888, whose name was Mary Cable coincidentally, "the poles began to fall like forest oaks, and wires were rolled up and taken away... Crowds followed the workmen and cheered and cried 'Timber!' as the poles hit the ground."

Despite the undergrounding that was completed in New York quite resolutely, by the summer of 1889, distribution lines across the rest of the United States are generally uninsulated wires strung along wooden poles. This has been the model our industry has closely followed since its earliest days.

It was natural for the first electric companies to adopt the overhead standard in the late nineteenth century. For the telegraph companies had been stringing uninsulated wire along wooden poles since the first half of the century.

The first electric companies also copied how the gas industry worked in the Gilded Age. A gas company built a network of pipes to reach individual homes and businesses throughout

"The poles began to fall like forest oaks, and wires were rolled up and taken away... Crowds followed the workmen and cheered and cried 'Timber!' as the poles hit the ground."

gone further, in copying the gas companies. Like the Edison Illuminating Co. in New York, they could have built underground networks. But the electricians did not end up doing this, of course, except in some densely populated urban areas. Why is that?

It has been less costly to string uninsulated wires along wooden poles, to distribute electricity within communities. Doing so is also faster. Though poles and overhead wires do all too frequently fail and fall in extreme weather, they have been easier to repair because the problems Mother Nature causes are clearly visible. Wooden poles were also favored in electric distribution over stronger concrete or steel poles, because of cost and safety (wood doesn't conduct electricity and does give way a little to the occasional crashing vehicle).

Yet, as we have experienced the effects of innovation in all aspects of our industry, so too has innovation revolutionized the conversion from "overheading" to undergrounding. Converting selected overhead wires to underground cables has consequently become a compelling option for utilities across the country. Particularly those utilities that are in a seemingly endless war against the ruthless enemies of overhead distribution – high winds, heavy snow and icy rain, intrusive vegetation, wildfires.

Notice my use of the term conversion. It has always been true, and it remains true today, notwithstanding the innovations that have slashed the costs of undergrounding, that erecting an overhead distribution wire is cheaper than burying an underground cable connecting the same two points. But so what? The decision facing utilities in the twenty-first century is rarely, should we

a community, supplying the pipes with gas from a central pumping plant. An electric company similarly built a network of lines to reach individual homes and businesses throughout a community, supplying the lines with electricity from a central generating plant.

The electric companies could have

Well before he began leading Public Utilities Fortnightly, in the years 2002 through 2005, **Steve Mitnick** was the CEO of the New York-based transmission development company, Conjunction LLC, founded in collaboration with three utilities. The Empire Connection project attempted to build a 500-kV DC underground cable from upstate New York to New York City mainly along a state right-of-way. Despite broad environmental, community and financial support, and regulatory approvals, the lack of support by the state's governor ultimately brought the project to a halt.



A crew trenching a street for an underground line.

connect these two points with overhead or underground. Rather, the decision facing utilities these days is far more commonly, should we convert the connection between two points from overhead to underground.

Therefore, and this is such a critical point to understand, it doesn't matter that the installation costs of undergrounding are x number of times more costly than overheading. Typically, a distribution line under consideration for undergrounding is already in operation as an overhead. What does matter is how the installation costs of converting that overhead to underground compare with the risks and costs of the overhead failing and falling in extreme weather. Including the resultant disruption to the life and well-being of the local community.

Once one understands that selective undergrounding is all about converting some overheads to undergrounds, then our focus shifts, as it should, to how have innovations in undergrounding broadened the number of potentially attractive underground projects for a utility's customers? That is, to what extent have innovations made such projects more beneficial, whether from improvements in underground installation costs, installation time/community inconvenience, operations and maintenance costs, reliability, resilience, regulatory policy, and analytics (to select the most beneficial overhead to underground conversions)?

Underground conversions have become significantly less costly to install. The innovations have come in both the materials

As we have experienced the effects of innovation in all aspects of our industry, so too has innovation revolutionized the conversion from “overheading” to undergrounding.

of underground cable systems and the methods for emplacing them in the field. Material science deserves much of the credit. So too does cable design. As does enhancements that every aspect of the construction industries have embraced. Especially the use of prefabricated components that are trucked to a work site, simplifying on-site work, and reducing the required skilled and unskilled workforce there. It's cheaper and faster.

There have been major advancements in the semiconducting and insulation materials of cables. Not only have these cut costs directly but the product of the advancements includes longer useful life, to as much as a hundred years, larger reels, reducing the number of manholes, splices and terminations, and greater water resistance. Indeed, on that last point, I was fascinated to learn that modern underground cable systems are essentially fully submersible and thus capable of withstanding flooding.

In cable design, the amount of the conductor copper that

is used has been cut. This not only substantially reduces cost, but it also improves power transmission performance by better controlling a cable system's heating. Likewise, the adoption of cross-linked polyethylene cable jackets and range-taking shear-bolt conductor connectors have made a big difference.

Operations and maintenance costs were already moderate for underground cable systems. That's always been an advantage of undergrounding (which doesn't for example require overheading's intensive vegetation management programs). But critics in times past have pointed out, justifiably, that when an underground system does need attention that can be costly. But the application of sensors and sensor data analytics means that problems in modern cable systems are now pinpointed and far more easily addressed.

These and other innovations have made undergrounding even more reliable and resilient, absolutely and in comparison to overhead wires, for a broader range of environmental and operational conditions and events, and for a longer useful life. But what I find most interesting are the innovations in regulatory policy and analytics.

Just as the regulatory world recognized that modernization of the aging networks of the water and natural gas utilities (an imperative for customer and worker safety and environmental quality), called for a multi-decade program to smooth any impact on customer rates and to facilitate regulatory oversight of the work, it's become better understood that the same approach should apply to modernization of electric distribution networks. Even the selective conversion of overhead wires to underground cable would be a large expense for any utility. But if spread

over two or three decades, this might become manageable for utility customers.

Lastly, analytics have arrived here too, in a utility's planning of undergrounding and in the review of utility proposals by regulators. In my interviews of experts around the country, I heard stories about analyzing as many as a hundred years of detailed weather data in depth to model and determine where an undergrounding conversion would have the most beneficial impact on customers.

The selective conversion of overhead to underground would be a large expense for any utility. But if spread over two or three decades, this might become manageable for utility customers.

The innovations of undergrounding have a special meaning for me. Not long ago, the local utility in the Washington D.C. area where I reside and work was poorly per-

ceived by the public, with a high frequency of electric service outages, which were occasionally lengthy. With the support of utility regulators, Pepco Holdings invested approximately a billion dollars in a comprehensive conversion of overhead wires to underground cable. The impact on reliability has been marked and the rate impact has been minimal, as had been the construction disruptions. Thanks Pepco. ○

Les Carter

Dominion Energy

PUF's Steve Mitnick: What's the overall strategic mission of this program?

Les Carter: The idea behind this program is to reduce the total length of restoration from specific storms, from any kind of catastrophic event. That's the objective. That's what we looked at when we were planning this program in 2013.

We were asking, what's the best way of doing that? The best way is to find the most outage-prone zones and put them underground.

If you've ever worked storm, and I worked storms in the early and mid-2000s, you know where to go. You go back to the same places every time.

It's big trees. It's single phase. It's old infrastructure. You go back time, after time. The only answer that makes sense is to

put it underground. We place it underground, and we usually bring it front lot, but not always.

When we were looking at the statistics around our single-phase overhead in Virginia, we identified that roughly four thousand miles, or about a fifth, accounted for almost two-thirds of our outage events.

We thought, if we could underground those four thousand miles, what would that do? We looked at how they performed in some earlier storms. Snowmageddon and Hurricane Irene were a couple of events we looked at. We figured out don't look at the customer restoration curve, but the work request completion restoration curve, which is different.

You see most of the tap lines we were going after would be repaired in the last half of the storm. You're doing the emergency

services first, then main lines. Then you'd get to the tap lines and the end of the line stuff in the second half of the storm.

We looked at that and said, if we could stop these from going out, and some do get restored in the first half, but most get restored in second half. If we could stop it, we could in theory, if the storm went to the right geography, which is where we had converted most tap lines, reduce the storm restoration time by up to fifty percent.

We have experienced storms since we started doing this and we're trending in that direction when we do a post-mortem on the storm. Our aim is to convert four thousand plus or minus miles of single-phase overhead.

Some multi-phase is coming in now. In Virginia, we're closing in on halfway to the four thousand miles. We will have two thousand miles converted in about June of next year. Four thousand miles would take us until about 2029; we're currently doing close to three hundred miles a year

PUF: How is it going in terms of the newer equipment, and with newer methods in undergrounding?

Les Carter: First of all, we use directional drilling. We don't trench. We directional drill, install conduit and pull cable through. That does add to the cost.

From an innovation perspective, when we were planning this, it was important for us to step back from the way we had done business in the past. We used to send designers out to get easements. That's not their core competency.

We created a new job at Dominion Energy. We have Marketing and Communications Coordinators, MCCs, and it's that person's job to be the touch point between the customer and Dominion Energy.

The MCC's job, in part, is to facilitate easement acquisition. These people do a fantastic job. When we think about innovation in terms of this program, the number one thing is making it customer centric, because if you don't have the customers on board, you have no program.

We still cancel between twenty to twenty-five percent of our projects mostly because we can't get easements. Now and again, there's a technical or operational issue you can't resolve, but it's mostly easements. Dominion Energy used to obtain roughly two thousand easements on an annual basis, however we have secured way over fifty thousand easements since we started in 2014.

The second, when it comes to innovation is how we got the program off the ground quickly. In 2011 and 2012, we had two big storms. Hurricane Irene and a derecho. When I was working those two storms, I would be in the system storm center.

The system storm centers are crazy from four in the morning until about eight or nine. Then it goes quiet until about four in the afternoon and then gets busy until eight or nine in the evening. During that time, you're sitting, monitoring what's going on. We

would talk about, if the big one came through, and we rebuilt this all again, how would we rebuild?

On the second storm, Marla Decker who used to be the Commonwealth Secretary for Public Safety, came to our storm center. She asked, what would it take to accelerate restoration? I said, if we could underground a bunch of lines, we could take the nine-day storm and make it into a five-day storm.

She suggested working with the legislature to pursue the concept. I said, that sounds like a great idea. I didn't think more about it, but there were people there who did.

In the 2013 general assembly, we started to talk about it. Then at the 2014 general assembly, a law passed that said we could implement a program and file for a rate adjustment clause.

Then a couple of years later, we had to revise it a bit in order to make sure we put some guardrails around cost, which was something the State Corporation Commission and the Attorney General's office were interested in seeing, and that's fine.

The idea behind this program is to reduce total length of restoration from specific storms, from any kind of catastrophic event. The best way is to find the most outage-prone zones and put them underground.

We came up with a metric where we said, what we're trying to do is drive events off the system. We're not necessarily trying to reduce SAIDI, the System Average Interruption Duration Index. It will happen, but events on the system are the problem.

You have to have a customer count element to it. If you are just going off the SAIFI, the System Average Interruption Frequency Index or frequency, our viewpoint is, if we have to roll a truck out to a location for one customer or thirty customers, it's still a truck roll.

Thirty customers out are worse than one, but we take care of that in our restoration process anyway, by going after the big customer numbers first. For strategic undergrounding we often have six to eight customers on a zone, not big numbers.

We decided to rank by events per mile. If you had a mile long tap and it had ten events in a ten-year period, that's ten events per mile. If you have a half a mile and it has ten events, then you get twenty events per mile.

The reason we did that partly was in order to make sure where we undergrounded gave the most bang for your buck in terms of event reduction. This is simple math, but a lot of people struggled with this. I would ask, if I have a one-mile zone that has fifteen outage events on it, or I have a half a mile zone that has ten events on it, which one should I do?



Dominion at work undergrounding transmission lines using boring.



The answer is the half a mile.

We take the other half a mile cost that you're not doing and go find another one that has ten events. Now you've done twenty events and not fifteen. All of our tap lines and protection zones

have an events per mile score. In the legislation, it calls for subsets to aggregate to nine events per mile or more, and that's an event count over a ten-year period.

In almost every one of our filings right now, we've been around

fourteen. So, we're well ahead of that number. Events per mile drives you to convert the most troublesome lines. Second, it drives you to convert those in the most economic fashion.

PUF: What about reliability and resilience of the undergrounding? How have these cables been performing?

Les Carter: They're fantastic. Dominion Energy has been replacing underground cable for a long time because we started putting cable underground in the sixties, and of course that cable has failed.

Twenty to thirty years is what you would previously expect in terms of life. Our expectation is that the asset life we're using in our depreciation schedules of thirty-nine years, based upon new materials and installation practices, is about right.

In terms of performance, if you look at the SAIDI, SAIFI, CAIDI prior and post, there's no comparison. You've got SAIDI numbers that are up over three hundred minutes, and you convert and for the same customers, you have SAIDI numbers that are around one minute. There's no comparison.

One important point is about the difference between local and system wide benefits. That's been hard to pin down. Mark Christie, former Virginia SCC Commissioner said, it stands to reason that if you convert a line to underground, there'll be fewer outages. Nobody's disputing that.

The dispute comes around whether or not there are other advantages for customers who've not been converted to underground or who were already underground, because we are socializing the cost on everybody's bill.

If we don't have to send resources to some lines, they're going elsewhere. Are you going to maintain the same set of resources on your system during catastrophic storms that you would otherwise? Even though we've done strategic underground and other reliability programs?

Yes, in storms you beg, steal, and borrow resources from anywhere you can. The reality of storm restoration is we don't skimp on resources. We're looking at it saying, we are going to obtain as many resources as we possibly can to get the power back on as quickly as possible, without regard to any of the programs we've done.

Those programs, in a world where we have equal resources, will have an impact because there is not as much work to do. If you have twenty-five percent less work, it takes twenty-five percent less time, all other things being equal.

The benefits that accrue to other customers, either those who are still overhead or those who were underground prior, is that their lights will come back on faster, or they won't go out. But mostly, their lights will come back on faster.

PUF: For the companies that have not started undergrounding, what advice would you give them?

Les Carter: I'd tell them to call us. We sat down with Duke, Pepco, Georgia Power, FP&L, Tampa Electric, and San Diego



When we think about innovation in terms of this program, the number one thing is making it customer centric, because if you don't have the customers on board, you have no program.

Gas and Electric to name a few. Some of them have said, it's interesting, but our regulatory compact doesn't help us. Some, like Duke, have implemented their own similar program.

The customer is critical. If we have a large project, we're going to have an introduction meeting, a pre-construction meeting, we're going to walk their property, and tell them everything we're doing.

We've come up with an augmented reality app on our iPads, and when we have to talk to people about siting transformers, we can take the iPad and virtually put a transformer in the picture. It is geospaced in the sense you can be in someone's front yard, and put that transformer in. Then you go inside that house, stand by their kitchen window and say, this is what it's going to look like from here.

When you make it more customer-centric, you open yourselves up to having those conversations. But also, we've changed routes because we've sat down with customers and they've said, how about you take it over here. Sometimes we'll say, we can do that. If you don't do the customer touch, you will not have a program. ○

Jerry Cook

Florida Power & Light

PUF's Steve Mitnick: What are some of the interesting innovations FPL is applying to its undergrounding pilot?

Jerry Cook: We will have completed more than five hundred neighborhood undergrounding projects by the end of this year as part of our pilot and we learn with each one. There's no substitute for real-world experience. As we've gained more experience, we have identified more efficient design and construction practices and learned better ways to handle permitting and contracting, traffic-control measures, and other processes that will help us with future undergrounding.

We use the latest horizontal drilling technology – directional boring and missile boring equipment – to minimize disruptions to customers' properties. Our crews also use handheld ground-penetrating radar devices to detect underground obstacles. We also try to reduce inconveniences to our customers by putting lines, where it's feasible, in public rights of way rather than private property.

We've also begun putting more smart grid technology underground to enhance reliability. FPL is already a leader in using

We use the latest horizontal drilling technology – directional boring and missile boring equipment – to minimize disruptions to customers' properties.

automated lateral switches, automated feeder switches, and other intelligent devices on overhead lines.

Now we're installing automated lateral switch technology on underground projects. These devices help us detect potential issues before they become problems and speed restoration if there is an outage.

We've also learned a lot about our customers and the best ways to communicate with them. During the early stages of the pilot in 2018 and 2019, we conducted a lot of face-to-face meetings with community groups and individual customers to explain the program and answer their questions.



FPL uses directional boring to minimize disruptions when installing underground power lines in its Storm Secure Underground Pilot Program. When complete, FPL restores property to its previous condition. This is in Hialeah.



A crew works on a transformer in a neighborhood in Tequesta, Fla., as part of FPL's Storm Secure Underground Pilot Program.



Extensive customer outreach, in-person or virtual, is a key component of FPL's Storm Secure Underground Pilot Program. This meeting was in 2019 in Palm Beach Gardens.

But COVID-19 pushed us toward more videoconferencing and electronic communication – even things like e-signatures and e-notaries for easements and junction box agreements, which turn out to be more efficient than paperwork.

PUF: How have these innovations affected cost and reliability?

Jerry Cook: It's hard to single out any one big innovation. There are probably two dozen things we've learned, developed, and refined during this pilot that have improved efficiency and reduced costs.

As far as reliability, we have seen that underground lines are far more reliable than overhead lines, both in severe weather and under blue-sky conditions. During Hurricane Irma, underground neighborhood power lines performed eighty-five percent better than overhead lines. During day-to-day operations, underground lines are more than fifty percent more reliable.

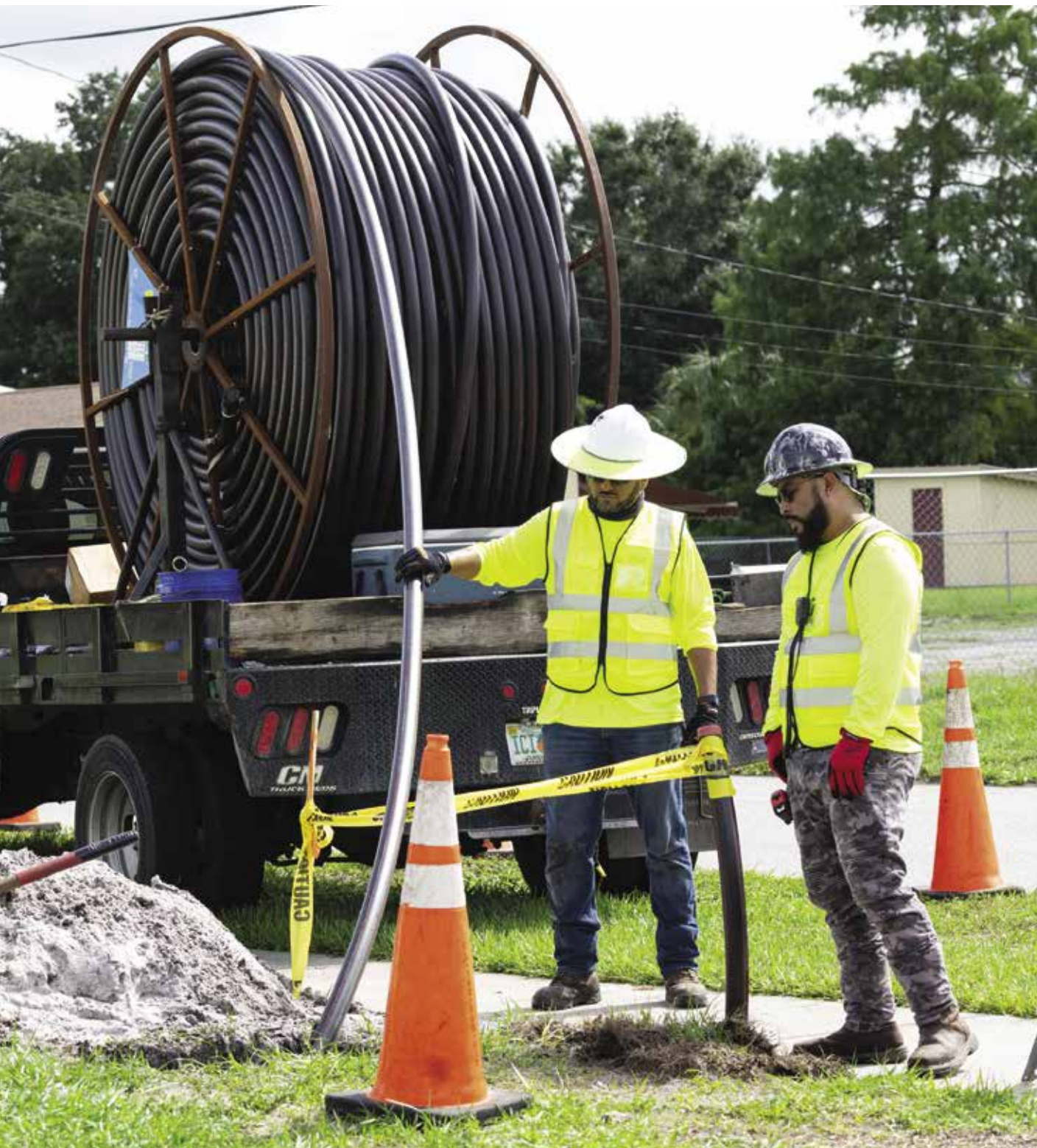
PUF: What has been the response to the pilot by customers and other stakeholders?



A crew feeds conduit as part of a Storm Secure Underground Pilot Program project in Sarasota.

Jerry Cook: Customers have been overwhelmingly positive. Before we begin any digging, we do extensive customer outreach so people understand what we're doing and how it will benefit them. We give them an opportunity to ask questions and raise any concerns.

We work with people on the location of pad-mounted



transformer boxes and other concerns they may have. Some people are hesitant to have a transformer in their yard.

To help address that, we have an augmented reality tool we can use so customers can visualize how the transformer will look on their property. The boxes are usually twenty-six inches tall and not as obtrusive as people fear.

Once we begin construction, in addition to minimizing disruptions to each customer's property, we emphasize to our crews the importance of being courteous and professional. When the construction is done, we restore the property to its original condition or better.

We've had customers tell us it's like we were never there. After

the underground service is connected, customers appreciate the improved reliability.

For example, there's a customer in Martin County whose lines were put underground more than two years ago, and he has sent a couple of emails since then just to thank us because his lights stayed on when a storm went through that might have caused outages in the past.

PUF: How is a particular project selected, designed, and undertaken?

Jerry Cook: One of the most common questions we get is from people who see other communities benefiting from undergrounding and ask, how can my neighborhood become a part of the program? We get asked that by homeowners and elected officials.

We select neighborhoods for the pilot based on data – outages during Hurricanes Mathew or Irma; a history of vegetation-related service interruptions; and other reliability metrics. Our work plan is approved each year by the Florida Public Service Commission. So, a community can't lobby FPL to get moved up the list, even though many would like to.

We've been selecting projects based on reliability data for each neighborhood power line or lateral. We chose that approach so we could get experience working on a wide variety of projects throughout our service area, even though we knew that working on one lateral over here and another one over there isn't always the most efficient way to mobilize and demobilize crews and equipment.

Now we are beginning to evaluate the data based on main power lines or feeders, each of which supplies power to multiple laterals. With the feeder-based approach, we expect to improve efficiency because crews will be able to focus work on a more concentrated area at a time.

PUF: What are the benefits in terms of resilience?

Jerry Cook: After the historic hurricane seasons of 2004-05,

FPL set out to build a stronger, smarter, more storm-resilient energy grid for our customers. Undergrounding neighborhood power lines is one piece of that, along with strengthening transmission structures and main power lines to withstand stronger winds; increasing our pole inspections and tree trimming; adding flood-protection measures at substations; and installing more than a hundred and seventy thousand intelligent devices along the grid.

We've seen impressive results. Because of the hardening program we began after Hurricane Wilma in 2005, we were able to get people's lights on much faster when Hurricane Irma hit in 2017, even though Irma was a bigger, more powerful storm. The average customer outage for Wilma was 5.4 days but for Irma it was only 2.1 days.

We have an augmented reality tool we can use so customers can visualize how the transformer will look on their property. The boxes are usually twenty-six inches tall and not as obtrusive as people fear.

These hardening measures also provide benefits in good weather. Our day-to-day reliability has improved nearly forty percent since 2006 and last year FPL ranked best in reliability among major utilities in Florida. We also won the national ReliabilityOne award from PA Consulting for the fifth time in six years.

Because we have a culture of continuous improvement at FPL, we're never satisfied and are always looking for ways to improve service to our customers while keeping bills below the national average.

That's how the neighborhood undergrounding pilot started.

Even though we had that big improvement in restoration time from Wilma to Irma, we saw that we could do more.

The leading cause of outages during Irma was vegetation blowing into overhead power lines. Putting more power lines underground provides a direct reliability improvement for the people who get undergrounded. It also benefits all our customers because it reduces restoration time for everyone.

We've learned a lot from this undergrounding pilot over the last three-plus years. As we continue to bring the benefits of undergrounding to more of our service area in the years ahead, we will keep leveraging technology and improving and becoming more efficient to benefit our customers. ○



Jaclyn Cantler and Donna Cooper

Pepco

PUF's Steve Mitnick: What's been Pepco's experience in selective undergrounding?

Jaclyn Cantler: I'm the vice president of project and contract management for Pepco Holdings, which includes Pepco, Atlantic City Electric, and Delmarva Power. At Pepco, particularly in the District, we have a long history with underground feeders.

Half our customers in D.C. are served by our underground system. It's a robust network system, so we've had a lot of experience. We've coupled that experience with a large program called D.C. PLUG – District of Columbia Power Line Undergrounding – where we are undergrounding up to thirty feeders within the District.

It's through a partnership with the District Department of Transportation or DDOT and D.C. government. We're excited to use our history here and move forward with this project.

Donna Cooper: I'm the Pepco region president. The undergrounding of additional feeders for the District of Columbia had been a subject that has come up intermittently.

This was not a project related to aesthetics. It was about resiliency and reliability. The poles continue to be needed for telecommunications and other infrastructure that is attached.

– Donna Cooper

Then we experienced the derecho in 2012. We had so many customers impacted across the region, with customers experiencing multiple day outages.

That event furthered the need to increase the resiliency of our system. About three-quarters of our infrastructure is underground in the District of Columbia. However, it's largely the downtown footprint.

We have Wards three, four, five, seven, and eight, which are similar to districts in other areas that are served by overhead feeders, primarily. These are the communities where many residents live.

We also have a large tree canopy. The 2012 derecho and its strength brought down many of our power lines and transformers, and trees toppled our infrastructure.

Following that event, we came together with the District of Columbia government. The Mayor called on Pepco to partner with the District and we committed our resources within engineering, operations, etcetera, to work collaboratively to develop a plan.

Our president and CEO co-led the Task Force with the City Administrator. The focus was on making our system more resilient in the face of increased weather events, with an emphasis on undergrounding electric power lines. The District of Columbia Power Line Task Force worked collaboratively for over a year to reach consensus on an approach to undergrounding power lines.

PUF: What were the benefits for Pepco customers? How was the response by customers and other key constituencies?

Jaclyn Cantler: We're taking these overhead facilities and putting them underground. The facilities

Pepco crew installing cable underground.





Pepco at work underground.

We have tailored our project schedule to coordinate with other work going on as much as possible in an attempt to reduce the impact.

– *Jaclyn Cantler*

that will be placed underground are what we call the primary overhead conductors, which can include multiple conductors along main roadways and individual or single conductors that branch off as laterals.

By placing them underground, there's less of an impact when major storms hit. The overall result has been positive. The project's inaugural feeder is one hundred percent complete and in service as of the end of 2020.

You're going to see much improved reliability at the end of this six-to-eight-year program. Our community relations, and government and external affairs group are actively involved in the effort.

Because clearly when you're working in the street, it can be disruptive. We have focused on making sure we have a solid customer and stakeholder engagement strategy.

We're keeping customers informed on when we're going to be in their neighborhoods, and what to expect. That outreach has helped them understand that, while there may be community impacts as we go through construction, the improved resiliency and reliability is worth it.

PUF: Talk about the reaction of customers, and other constituencies too.

Donna Cooper: We had diverse stakeholders at the table to

move this initiative forward – the Office of the People's Counsel, Public Service Commission, key District agencies and departments, residents, the Council of the District of Columbia.

We collectively filed a customer education plan with the Public Service Commission of the District of Columbia, which is transparent and ensures that our customers are aware of the initiative, its purpose and benefit.

The plan also outlines actions to engage customers throughout the project. It looked at milestones regarding the project, and how we can effectively communicate. We are adhering to that, as well as adjusting as necessary based on experience.

You will receive feedback from the communities, and we must always have a process in place to mitigate any concerns that may arise. We have a mailbox that is monitored and a process to ensure timely responses.

We execute community meetings and open houses to provide updates on the project and to receive customer and community feedback. Due to COVID-19, these meetings are executed virtually.

PUF: People in the communities felt that this project is protecting the trees. Because beforehand, there was a lot of, why are you cutting back our beautiful trees?

Donna Cooper: Vegetation management is important to



The model selected, addressed the cost of undergrounding that is often too prohibitive. This construct has been successful and is something others should examine.

– Donna Cooper

ensure there is appropriate clearance between trees and power lines. Undergrounding power lines helps to mitigate tree limbs from coming into contact with the lines that deliver service to customers. This helps to prevent and decrease outages.

This project will not result in all lines being placed underground because the methodology focuses on those lines that have had the highest number of outages, considerate of the impact of weather events, as well on outages. Therefore, we will continue to manage the infrastructure and appropriate clearances in areas that continue to have overhead infrastructure or partial underground infrastructure.

However, we have arborists who are committed to vegetation management practices that adhere to standards and codes. We work with our local forestry departments as well.

But we have arborists who are committed to working with our local agencies.

We've always executed our work in a way that is responsive and recognizes the importance of protecting the tree canopy, as this is critical from an environmental perspective.

PUF: This area for a major undergrounding project, of relating to communities and different constituencies, that's a key innovation?

Donna Cooper: One of the things we had to underscore, because we mentioned community, and this triggered it for me, was that this was not a project related to aesthetics. It was about resiliency and reliability.

Therefore, questions do arise. Will poles be removed? In many cases, the answer is, no. The poles continue to be needed for telecommunications and other infrastructure that is attached.

Education and engagement are key to ensuring that our customers and communities are aware of the actual scope of the project and its purpose. When we have the opportunity to engage, there is always greater understanding from our customers and communities.

Jaclyn Cantler: When we talk about the benefits of the partnership among Pepco, the District, and DDOT, we also looked at what other projects are happening at the same time. We have tailored our project schedule to coordinate with other work going on as much as possible in an attempt to reduce the impact.

There's a lot of thought that goes into it, and having those three entities at the table, communicating about current and future plans, helps to make the impact of all this construction more streamlined.

PUF: What innovations in undergrounding were helpful? Talk

about some of these technical issues that matter in terms of how fast you can do it, cost, and reliability.

Jaclyn Cantler: Our number one priority is safety. On the innovation space, we're deploying equipment underground that we can work with from above ground with specific tools.

These are special transformers that are being installed underground, and you can work on them from above. They require less maintenance, so you don't have to address them as frequently as you would overhead facilities.

A person can stand on the street with a hot stick and intercept a piece of equipment, which goes to making sure our solutions are promoting safety. Due to less maintenance, you're putting workers in the line of danger less frequently.

We also leverage fault detection devices, which can help expedite the troubleshooting when there is an interruption associated with an underground facility. We're leveraging all of our experience with our extensive underground system in this new program.

PUF: Talk about the policy innovations.

Donna Cooper: That was one of the first unique aspects about this project, is that it is enabled through legislation. There are various policy interests outlined in the legislation.

There is a focus on advancing economic benefits; contracting opportunities for local and diverse business enterprises; employment opportunities for local residents and affordability.

The Task Force also advanced equity regarding undergrounding power lines, meaning equity regarding the number of power lines that would be underground in each ward. The methodology ranked the feeders based on performance as well as equity.

The financing construct was also critical. There is a fifty-fifty construct, with resources advanced by the District of Columbia Government and Pepco's traditional debt/equity structure.

This construct, along with the amortization period, resulted in the initiative being more affordable for customers. We had to answer the questions: How do we execute a project to achieve meaningful outcome, while not resulting in significant costs to customers? What is the best framework? We had to consider multiple variables.

All stakeholders recognized that significant weather events result in extended outages, and this is a cost to residents and the District. It was clear for all parties that the benefits of the final plan outweighed the costs, as there are losses when you have an outage.

The model selected, addressed the cost of undergrounding that is often too prohibitive. This construct has been successful and is something others should examine.

PUF: What advice would you offer to utilities around the country as they consider undergrounding projects?

Jaclyn Cantler: Importance of participation by all impacted entities, and stakeholders that were included – the District,

DDOT, and business owners. Everybody having a seat at the table. It's what is helping this program be successful.

This is one of the many investments we've been making in Pepco over the years since the derecho to make the system more reliable. We increased our reliability of the system over the last ten years by about sixty-eight percent.

That's just not a product of putting facilities underground, it's also installing auto-sectionalizing devices, and upgrading aged equipment. In 2020, Pepco had the best reliability year ever. On average, we see about one outage per customer a year now in Pepco, based on reliability improvements we've been investing in.

Donna Cooper: Every utility is making investments in, and upgrading infrastructure, so there needs to be a hard look and evaluation of the of the upgrades they're making, and how their system is performing, as well as the vulnerabilities they have identified.

Everybody having a seat at the table. It's what is helping this program be successful.

– *Jaclyn Cantler*

These entities have their independent data and they also receive feedback from their customers, the Commissions, and other interests. As a regulated utility, we report on system performance and there is ongoing evaluation regarding plans to improve reliability and resiliency.

A question that is consistent is, what more can be done to improve service to customers? Utilities have to respond to the questions. What is that more? Is it undergrounding? What is the cost? What are ways to mitigate the impact? Does the cost outweigh the benefits?

Climate change is real, and we're seeing more significant weather events. It's not a matter of whether we will experience significant weather events, but a matter of when. We have to ensure, as utilities, that we are providing the highest level of service to our customers and balancing costs.

With increased weather events, we must have a focus on resiliency. Therefore, engaging multiple interested stakeholders, with our customers being foremost, is critical. We must build partnerships, share information, and make informed decisions, collaboratively.

For other utilities, it's bringing stakeholders forward and into the planning process. It's being proactive, advancing where there are vulnerabilities, and building partnerships to advance plans to ensure resiliency.

Too often, we will come together during an event, and after the event, the planning ceases. It requires a commitment after the event passes. ○

Rajdeep Roy, Thuan Tran and Angel Brito

Southern California Edison

PUF's Steve Mitnick: What are some of the experiences you've had or projects with selective undergrounding?

Rajdeep Roy: While there are many different reasons why electric companies underground power lines, I'd like to focus on targeted undergrounding for wildfire mitigation.

For us in California, wildfire mitigation has been one of our top priorities as we face increasingly extreme weather conditions. We have a portfolio of system hardening strategies to make our overhead power lines more resilient to wildfire risk, including targeted undergrounding and replacing bare wire with insulated wire, which we call covered conductor.

I mention covered conductor because, considering SCE's diverse geography and terrain, it is currently the best mitigation that can reduce the greatest amount of wildfire risk in the shortest amount of time at the most affordable cost for our customers.

Much of our high fire risk areas have rocky, granite terrain.

California has diverse weather, topography, and vegetation. Utilities serving each region of the state have to take customized approaches to wildfire mitigation.

– Rajdeep Roy

When you have power lines that go over mountains, undergrounding those lines can sometimes be infeasible.

Also, converting overhead to underground lines can result in longer lines and higher costs. Often times, overhead and underground lines cannot travel along the same routes, resulting in additional routing that extends the length and higher cost per mile for the overhead line replaced.

California has diverse weather, topography, and vegetation.



Southern California Edison crew at work for undergrounding power lines.

Utilities serving each region of the state have to take customized approaches to wildfire mitigation.

The biggest driver of an ignition risk we see on overhead lines in our service area is contact from objects, and covered conductor is estimated to be about seventy percent effective in mitigating this risk. We complement this effort by inspecting our highest risk structures more frequently and managing trees and vegetation around our poles and equipment, so they don't grow or fall into power lines.

When overhead lines are placed underground, the type of construction involves longer lead times and more resources, reducing the amount of infrastructure that could be hardened within the same timeframe compared to installing covered conductor. While there's incremental risk reduction, you still have that additional remaining risk every year that covered conductor could have mitigated earlier.

2020 was a record year for wildfires, and this year has already seen more acres burned than last year to date, which is a direct effect of climate change. This requires urgent actions to reduce the risks that are increasing each year.

However, targeted undergrounding does have a role to play in our portfolio. We focus on areas where we believe covered conductor wouldn't sufficiently mitigate the wildfire risk. Considerations for undergrounding include locations that have limited egress or ingress, areas that experience extremely high windspeeds and are subject to frequent Public Safety Power Shutoffs, areas with a lot of high density tall trees, and/or areas where risk of overhead conductor failure is primarily from factors other than contact from objects. Our targeted undergrounding strategy continues to evolve and may lead to additional locations in the future.

Thuan Tran: Based on our current risk analysis, undergrounding is estimated to reduce about ninety percent of wildfire risk,

while covered conductor is estimated at about seventy percent.

There are two ways of undergrounding – installing underground cable in new development areas or converting existing overhead lines to underground cable in established neighborhoods, which is more challenging.

To gain significant mileage of undergrounding conversion, we are looking at ways to transform our undergrounding methodology, standards and construction methods, and incorporating new technologies to help improve deployment speed and affordability.

Angel Brito: Under Rule 20, we've been working with communities on undergrounding projects for both aesthetic and non-aesthetic purposes, such as new demand growth.

Based on our current risk analysis, undergrounding is estimated to reduce about ninety percent of wildfire risk, while covered conductor is estimated at about seventy percent.

– Thuan Tran

In 2019, we began targeting specific areas that would benefit most with undergrounding for wildfire mitigation purposes. This year is the first year we're starting construction for the projects that we began scoping in 2019. We plan to learn from this initial deployment and incorporate lessons learned going forward.

There's typically about a twenty-four- to thirty-six-month lead time for undergrounding projects, depending on the topography, local jurisdiction, permitting and other factors that play into the cycle times.

To be able to convert to undergrounding quickly, you not only have to deal with the construction but also permitting and potential environmental requests.

PUF: There's been much learning at your company and throughout the industry to where these methods are more reliable and cost-effective. Talk about those.

Rajdeep Roy: Even with targeted undergrounding, we want to see if there's a more appropriate way to do it and if there are technologies that are available that can facilitate faster deployment.

For many years until the early 2000s, we used cable-in-conduit. That was our undergrounding standard, where you're pulling cable with the conduit, trenching and installing at the same time.





Southern California Edison crews doing undergrounding work on Lambert Road.

There's typically about a 24- to 36-month lead time for undergrounding projects, depending on the topography, local jurisdiction, permitting, and other factors that play into the cycle times.

– Angel Brito

We realized over the life of that technology that there are potential reliability issues when you just lay the equipment in the ground. It can bend among the rocks and soil and be susceptible to dig-ins. When faults occur, it can be difficult to locate the issue and result in longer outages because the underground cable is not secured like our current standards.

Our engineering team benchmarked with other utilities at that time and decided to pivot. We transitioned to rigid conduit with duct bank construction. The duct banks are enclosed in concrete encasement with conductors pulled through the PVC conduit, which makes it sturdier. Every so often, we have structures, manholes or vaults where we can get in after a fault occurs, pull the cable out, and put a new one back in.

Compared to the longer underground cable segments with cable-in-conduit, the shorter segments with duct banks makes it easier to identify faults, resulting in shorter outages and better reliability. That being said, some time has passed and that is why we are benchmarking again with other utilities on the latest technology and methods to underground our infrastructure.

PUF: Thuan, for benchmarking, as you're looking around for advances around the country and best practices, what are you finding?

Thuan Tran: From an engineering perspective, we benchmark nationally and internationally.

We went as far as Australia, Europe and East Asia to learn about their construction methods and standards for covered conductor. Then we tested the technology, established our engineering and construction standards and continue to monitor the system and make improvements from lessons learned.

For undergrounding, we're benchmarking with industry groups like EPRI and EEI and other utilities like Dominion Energy and WEC Energy Group.

We also benchmark with construction companies, suppliers, and contractors. In the last three decades, folks who built fiber optic lines have been doing the most undergrounding in the country. We are learning from the cable manufacturers, the same companies that helped us redesign the new generation of robust covered conductors.

We are learning about new technologies, including the new generation of cable-in-conduit. We will be using this learning and benchmarking to review and revamp our underground standards, the same way we revamped our overhead system standards to accommodate covered conductor.

For example, we learned that for excavation, trenching and drilling technologies, there is no one-size-fits-all approach. It's a combination of several technologies.

When you think of trenching, you typically think of using a backhoe machine. But there are additional methods and new technologies to explore. We've learned about rockwheel trenchers that can cut into most types of rock at a relatively fast speed. Horizontal directional drilling technologies that can drill under flood channels. Plowing methods that can open trench and install a conduit at the same time. We're also researching new undergrounding technologies such as an emerging drilling technology that uses plasma technology to cut through granite.

With cable-in-conduit, we've seen improvements of the thickness of the conduit material and the cable design.

For example, today's version of cable-in-conduit design uses a swellable tape under the jacket of the cable. Typically, if the jacket is broken, there's an increased chance of water intrusion

that would cause corrosion on copper neutral wires. But with the swellable tape, it will fill up the crack and impede water intrusion.

Undergrounding may seem appealing because it's, out of sight, out of mind. But it comes with challenges. It is more difficult to locate underground cable failure and perform repairs, which results in longer outage time for customers.

That's why we are exploring ways to improve how we locate underground cable faults. We're benchmarking with WEC Energy Group, a utility in Wisconsin that has been using a GPS sensor to map out their underground cable.

The sensor automatically uploads cable location data to their map and server. If the cable fails in the future and requires locating a fault, the GPS-based mapping information would help locate the cable.

Rajdeep Roy: We continue to learn from our industry peers and improve our undergrounding practices system-wide. However, I'd like to highlight that in terms of reducing wildfire risk, we have yet to find a technology solution, at least right now, that would make the undergrounding costs and deployment speed hurdles change so dramatically that we would shift away from pursuing covered conductor first before undergrounding, except for targeted locations that meet some of the criteria I mentioned earlier. ○

Dave Plusquellic

Tampa Electric

PUF's Steve Mitnick: How is your department structured to support the Storm Protection Plan?

Dave Plusquellic: The formation of the Storm Protection Plan team started in late 2019. Once we identified our goals and targets, we began building the internal team and defining the roles we needed to support those targets. The targets also allowed our contractor partners to build their teams to support the long-range goals of the program.

We started with a small start-up team with people in the roles we thought were critical for launch in 2020. We knew we would need to grow strategically throughout 2021 and 2022, and we needed time and experience to identify the most efficient structure.

In early 2021, we secured a dedicated warehouse with a full-time team. We're currently adding to our design and project management teams. Throughout late 2021 we'll be launching a full construction management team.

PUF: What are your goals with this team?

Dave Plusquellic: The goal has always been to make sure we do our absolute best to invest money wisely and cost-effectively to the benefit of our customers. Specific to SPP, it's to ensure



we're making sound investments that will result in more reliable service during extreme weather and to lower the overall time and costs associated with restoring power after those extreme weather events. We're fortunate to have this opportunity, and we're equally passionate about the responsibility that comes with it.

PUF: You have to be strategic and selective about what you're undergrounding. How did you narrow it down or determine what to prioritize?



Tampa Electric crews (above) dropping overhead lines, and (below) measuring for undergrounding.



The program required a comprehensive look at benefits versus costs, with a focus on extreme weather events, so we conducted a thorough and robust data-driven analysis.

Dave Plusquellic: Yes, you have to know what your goal is before you can start prioritizing and tackling the operational hurdle of standing up a program to bury lines. The question for us wasn't just, where do we see frequent outages?

It was focused on where are we most likely to have expensive, prolonged, difficult-to-repair outages from extreme weather events – those are the places we need to address, to provide our customers better reliability during a storm and to avoid lengthy delays and costly repairs after a storm.

The program required a comprehensive look at benefits versus costs, with a focus on extreme weather events, so we conducted a thorough and robust data-driven analysis.

PUF: Talk generally about the culture of Tampa Electric.

Dave Plusquellic: Tampa Electric's core value is safety – of employees and customers. It is part of everything we do.

In addition, it is one of the most forward-looking companies I've been affiliated with. If you look at what we've done to our Big Bend plant, where we're modernizing it by converting it from

coal to gas, if you look at our solar ambitions, we are the biggest solar generator in the state per customer.

We've also invested in projects like smart meters, or AMI, automated meters. We're doing a lot in these technical areas to advance the grid and technology. Putting that into context, the investments we're making in our system are impressive when you consider our size. We have eight hundred thousand customers and are smaller than many of our peers in the region.

The company has been supportive of the Storm Protection Plan, because once you have a certain part of the system hardened and undergrounded, it benefits all customers after extreme weather events, such as a hurricane.

PUF: How are customers reacting, and how's it going overall?

Dave Plusquellic: Overall, the customers like the idea of lines being underground, and most customers have been very positive. The biggest challenge we have is getting easements for the primary route and equipment.

We have a diverse service area. We've got some areas that are a bit more rural, and the lot sizes are bigger. Customers in these areas are generally more receptive to providing an easement.

When you go into a denser, more metropolitan area where the yards are smaller, the homes are closer together, and the area is more congested than the rural areas, it has been more challenging to obtain easements.

Our view is that the SPP is a customer experience program as much as it is a construction program. We have a small internal team dedicated to customer communications that is focused solely on how we provide the right information to our customers at the right time.

Our goal is to continually improve that process for the customer and to ensure each customer has the information they need to make the right decision about an easement on their property.

We have a small internal team dedicated to customer communications that is focused solely on how we provide the right information to our customers at the right time.

PUF: Where do you think this is going in three to five years?

Dave Plusquellic: We are about eighteen months into our Storm Protection Plan, and momentum and excitement are starting to build. We expect the project will grow to install about one hundred miles of underground lines every year. The SPP is part of our goal to create value for our customers, which we will achieve by increasing reliability and improving the customers' experience. ○

PG&E's Landmark RFI to Underground Ten Thousand Miles of Lines

'We Want Partners in Thought and Action, With Courage and Conviction'

On the twenty-second of July, Pacific Gas & Electric announced its commitment to underground ten thousand miles of its power lines to help reduce wildfire risk and address climate change. Then, on the twelfth of August, the company issued a Request for Information, an RFI, seeking approaches to what the company termed "this feat."

By the end of September, PG&E met with firms that responded to the RFI, each of which presented their approaches to accomplish this unprecedented project, and necessarily implement a range of innovations to succeed. We do not yet know the outcome of these monumental steps in strategic undergrounding, but given the importance for the entire electric utility industry, the PUF team provides herein the key excerpts of the RFI.

RFI's Purpose

On July 22, 2021, the company announced its commitment to underground 10,000 miles of electric lines beginning in High Fire Threat Districts across our service area to help reduce the risk of

major wildfires and address the challenge of climate change. The scale of our plan is unprecedented, and the strength of our commitment is unparalleled. This represents the largest effort in the U.S. to underground power lines as a wildfire risk reduction measure.

We know that we cannot do this alone – we need help. We want partners in thought and action, with courage and conviction, that will challenge us, share our commitment, and co-create what will become the country's most modern and expansive underground electric system. As such, PG&E is inviting your response to this Request for Information (RFI) to seek creative approach(es) to achieve this feat; however, this is more than just a Request for Information – it is an invitation for industry-leading Imagination, Ideas and Innovation that will provide safe and reliable energy to California for generations to come.

Participants are requested to submit four (4) elements within their response: (1) general company overview, (2) recommended approach(es), (3) response to supplemental questions, and (4) relevant project examples. Responses are due no later than 4PM

PT on Thursday, September 2nd, 2021. Information submitted in this RFI will be used to identify participants with whom PG&E is interested in furthering discussions around the proposed approaches and innovative ideas.

Thank you in advance for your interest in partnering to help us achieve this audacious and ambitious goal on behalf of our more than 5 million customers.

Twenty-Four Questions for Responding Firms

1. Work Sequencing. We are looking for the most practical way to mitigate wildfire risk as quickly as possible with this plan. Describe the strategy you would utilize to optimize sequencing of the work. Consider factors such as local geology, environmental, cultural, permitting, etc.

2. Safety & Quality. Based on your approach, what innovative safety and quality practices, management system(s) and tools would you utilize?

3. Work Delivery. What is your perspective on an effective structure to manage safety and quality? Please incorporate experience from programs of similar scale in your response.

4. Cost. Based on your approach(es), provide an estimated cost per mile range (e.g., \$X - \$X) for the below scenarios. Please include an estimated breakdown of equipment, materials, labor, OH and other cost elements: (a) optimal scenario (best results possible), (b) optimistic scenario, and (c) most likely scenario.

4a. Cost. Based on your response to question 1, clearly specify what conditions and elements would need to be present to enable (a) optimal scenario, (b) optimistic scenario, and (c) the most likely scenario.

5. Cost. Which cost model(s) would you recommend utilizing

for this program? Describe the pros and cons of each model if multiple options.

6. Contracting. Based on your approach, what performance-based contracting methods would you recommend?

7. Resources. Describe how your company and PG&E would partner to secure and maintain talent, ensuring success throughout the duration of the program.

8. Resources. Based on your approach, would you have internal

Where do you see the greatest opportunities to use innovative, commercializable technology (emerging and/or existing) to improve pace, quality, cost, or other performance of the undergrounding program?

capacity to complete independently, or would a joint venture/partnership structure be required? Please provide additional detail to support your response.

9. Alternative Work Delivery Methods. Describe any additional work delivery methods (not included in your approach) that you would consider in delivering this work. Describe the pros and cons of each.

10. Application. Have you applied any key elements of your recommended approach to work elsewhere (including in other industries)? If so, describe the general outcomes achieved and lessons learned. »

FORTNIGHTLY INNOVATORS EVERY YEAR

This is the fifth consecutive year that Public Utilities Fortnightly has asked the utilities industry for nominations for our annual Fortnightly Top Innovators and published a feature in the fall highlighting and celebrating the most distinguished individual and teams of innovators. The November 2017 issue of PUF featured for example two innovators from Ameren (Steven Ewens and Alex Rojas), one from American Electric Power (Jeff Fleeman), two from CMS Energy (Andrew Bordine and Holly Bowers), two from Edison International (Vibhu Kaushik and Erik Takayesu), two from Entergy (Randy Hickman and Shannon Watts), two from Exelon (Sonya Harbaugh and Brian Hoff), and two from Hawaiian Electric (Earlynne Maile and Lani Shinsato). And from not just investor-owned utilities, but David Ranallo of Great River Energy, Bud Ajdukovic of Kissimmee Utility Authority, Lizette Miranda of Sacramento Municipal Utility District, and several more. Plus a whopping six from the Electric Power Research Institute, quite naturally, those being Ron Domitrovic, Jessica Fox, Maria Guimaraes, Andrew Phillips, John Simmins and retired EPRI CEO Mike Howard.

The November 2018 issue of PUF featured for example Cole Crews of Ameren, Shay Bahramirasd and Sandor Williams of Exelon, Eric Mastroianni, Edwin Perez, Jennifer Moy and Mike Salerno of Con Edison, Jamie Duncley of EPRI, Rebecca Dayhuff Matsushima of Hawaiian Electric, Nicholas Jewell of PPL Utilities, Chris Spears, Catherine O'Dell and Tom Butler of North Carolina Electric Cooperatives, Brian D'Agostino, Steve Vanderburg and Katie Gianecchini of Sempra Energy, and Mark Lantrip of Southern Company.

Last year's was a distinguished class of Fortnightly innovators as well. For instance, Jessica Fox of EPRI repeated her 2017 honor with her continuing work in environmental protection. And there were honorees from PPL Utilities, Xcel Energy, Poudre Valley Rural Electric Association, First Solar, Sempra Energy, Edison International, Ameren, Hitachi ABB Power Grids, and Burns & McDonnell.

11. Equipment. Describe any specialized and/or innovative equipment (emerging and/or existing) that would drive safety, quality, and efficiency of this work.

12. Materials. Describe any specialized and/or innovative materials (emerging and/or existing) that would drive safety, quality, and efficiency of this work.

13. Technology. Where do you see the greatest opportunities to use innovative, commercializable technology (emerging and/or existing) to improve pace, quality, cost, or other performance of the undergrounding program? Please provide additional detail to support your response and incorporate perspectives from other industries in your response, where applicable.

14. Organizational Structure. Based on your approach, what leadership/governance structure would you recommend for a program of this nature? Please specify your potential role as a prime, the role of subcontractors, PG&E's role, and the role of other parties (suppliers, external stakeholders, etc.)

15. Execution. What is your perspective on an appropriately ambitious ramp up of constructed miles, by year, to achieve 10,000 miles?

16. Project Management. Based on your approach, how would you effectively apply project management practices, tools, and methodologies to execute work under this program. Include detail on project management system(s).

17. Land Rights. What is your perspective on private land rights acquisition and, in particular, how and when such activities should occur when pursuing a program such as this? Please incorporate detail from experience on other programs of similar scale.

18. Risks. What are the top five (5) risks you see in executing a program of this nature? What innovative mitigations would you use to minimize or eliminate these risks?

19. Information Technology. If applicable, describe any experience you have with the following and whether your recommended approach has considerations for the below areas. If no experience for one or multiple of the below, please indicate such. (1) Undergrounding fiber optic cables in conjunction with electric conductors / conduits; (2) Accommodating SCADA electronics and communications connectivity to underground assets; (3) Splicing and terminating fiber optic cables (underground vaults, pad mount cabinets, overhead to underground transitions, etc.)

20. Stakeholder Engagement. PG&E would like to understand your approach and experience with stakeholder engagement. Describe your approach, from an organizational perspective, toward stakeholder and community education/engagement and permitting.

21. Project Planning and Implementation. Based on your experience and knowledge of PG&E, what changes should PG&E make to how it runs, plans, and implements projects to successfully underground 10,000 miles?

22. Company Culture. In one paragraph, describe your company culture.

23. Responsibility. Given your responses above, detail how you would demonstrate your commitment to diversity and inclusion throughout a program of this nature.

24. Supply Chain Impact. Given your responses above, what would be the impact and anticipated ramp time to scale the supply chain in response to your proposed solution. Which products would likely present the highest impact (in terms of lead time) to the project schedules? Please consider the development of new technologies, and/or capacity enhancements in existing markets. [PDF](#)

AEIC Top 10 Awards 2021

(Cont. from p. 51)

storage, community generation, and grid-operability capability. There are no up-front costs for participants, who will be charged standard Tampa Electric rates.

Each of the houses will have a BlockBox unit containing battery storage, an inverter, and a controller that communicates with the other controllers on a seven-hundred-and-fifty-volt DC bus and shares energy. The system also includes a central energy box with supplemental storage and a grid interconnection.

The BlockEnergy proprietary control network is the hub of all the distributed energy resources within the system, employing the dynamic pricing model of game theory to optimize system operation. The system can operate both grid-connected and islanded resources.

Tennessee Valley Authority: Safety blitz

TVA's generation services health and safety committee developed and implemented the "safety blitz" process. Safety blitzes are a combined effort with the generating sites to drive employees' focus on the utility's 4 Vital Behaviors and to foster a safety culture.

The 4 Vital Behaviors are:

1. Identify hazards before every task.
2. Take actions to remove hazards and reduce risks.
3. Protect yourself and others. Intervene when necessary.
4. Take pride in safety and be involved.

Safety blitz observers work closely with site personnel to conduct site walk downs including observations of in-progress work. If possible, identified issues are corrected in the field when identified.

In fiscal year 2021, that ended last March, forty safety blitzes were completed. Serious and recorded injuries have fallen substantially. [PDF](#)

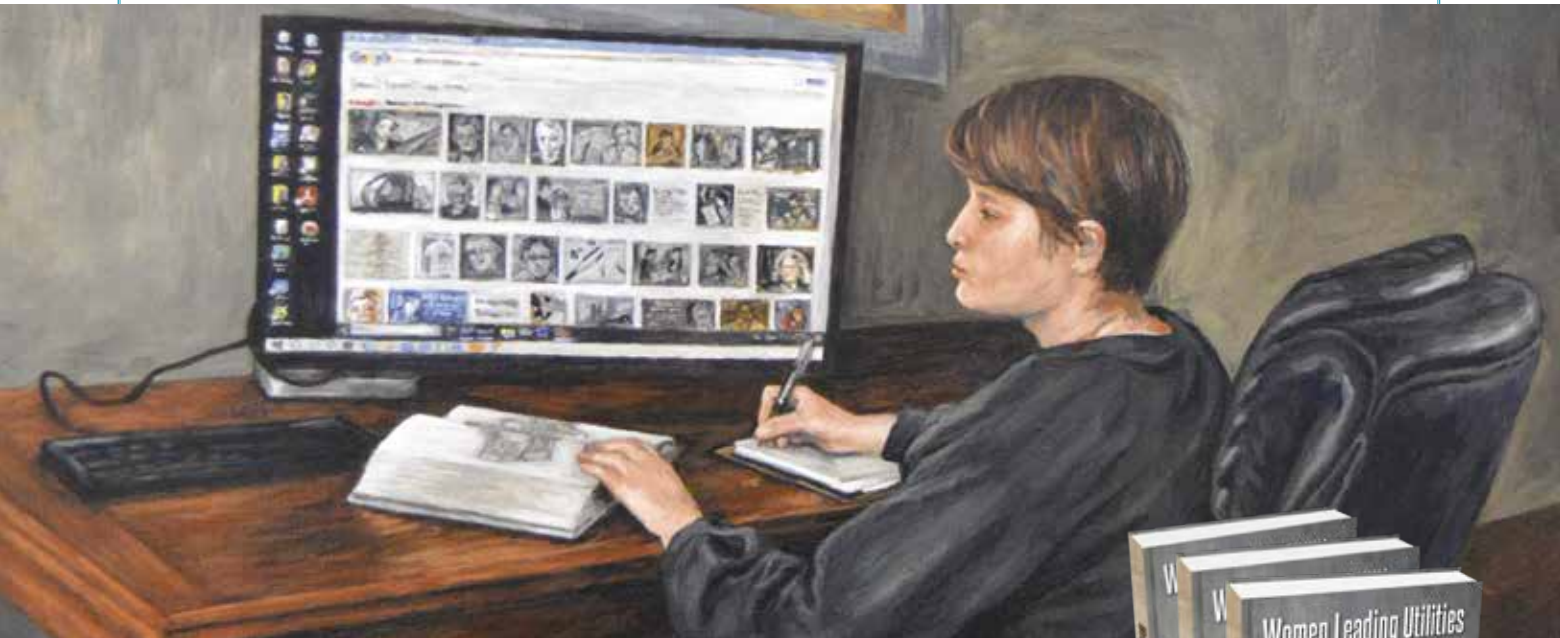
Authored by PUF's Steve Mitnick

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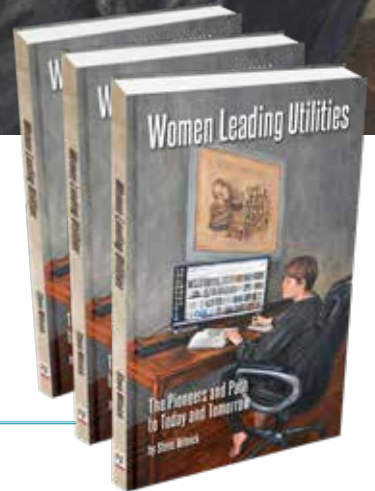
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Utilities, utility associations, commissions, professional firms, vendors, etc. may purchase a number of the beautiful hardcovers of Women Leading Utilities to provide to employees and other internal and external constituencies.

100 hardcovers at \$4,000 for example.

Contact Alex Revel for details, arevel@fortnightly.com.



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