# 10 Key Technologies

## Essential tools and devices for enabling the distributed energy grid

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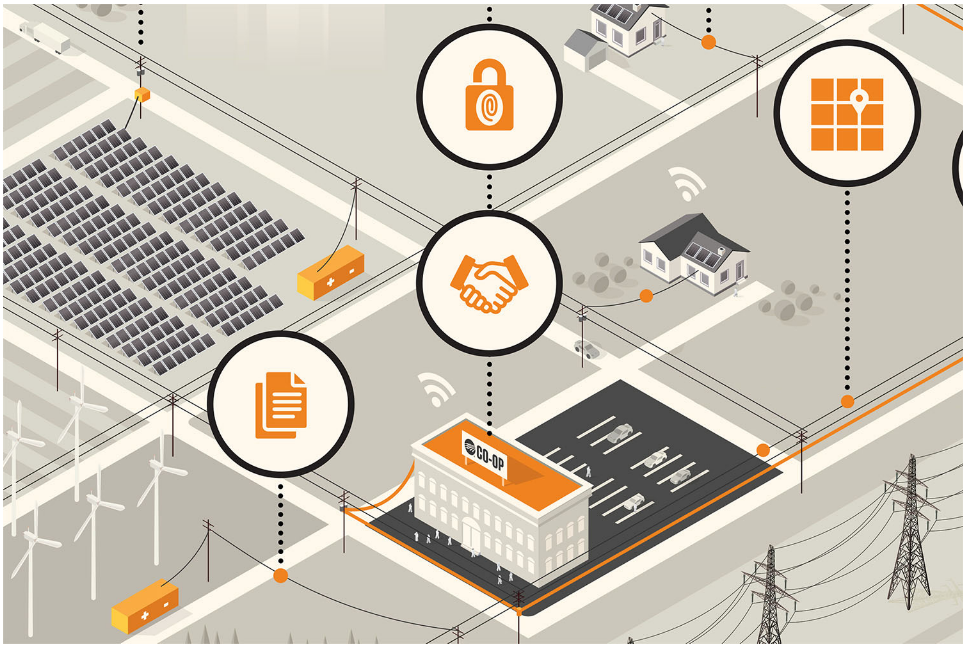


**From advanced inverters and broad-band to interactive homes, RE looks at the top ten key tech trends co-ops must embrace in order to enable distributed energy resources and the evolved grid.**

It wasn't long ago that the U.S. power grid resembled a relatively simple one-way street, with power flowing from central generating plants through transmission lines to distribution systems and, finally, to consumers of all kinds.

No more.

Central-station power continues to play a vital role, but it's increasingly complemented by distributed energy resources (DER), which are turning the grid into not just a two-way street, but more of a neighborhood of two-way streets, with electricity moving in and out from locations big and small throughout the day. Microgrids, capable of operating independently, are also part of the mix.

"It's all leading to a grid that's a mesh rather than a single hierarchal entity," says Craig Miller, NRECA's chief scientist.

The inexorable nature of this evolution is compelling utilities to examine what's driving the change and which technologies and strategies will help ensure their systems keep pace.

Most experts agree that central-station generation—fueled by coal, natural gas, hydro, nuclear, or utility-scale solar and wind—will remain the core of the system for the foreseeable future. However, DER—decentralized smaller-scale generation coupled with energy management—is expanding rapidly. A recent study by Navigant Research found that U.S. DER capacity is expected to nearly double from 2018 to 2024, reaching about 65,000 MW. Most of this will come in the form of distributed generation, such as residential and industrial-sized solar or microturbine wind power.

Whether it's behind-the-meter or utility-scale solar and wind, renewable energy is the fastest growing segment of the U.S. electric portfolio. By 2026, the Energy Information Administration foresees it trailing only natural gas in total electricity output.

Demand response and energy storage technologies are expected to play a significant role. Energy storage deployments in the U.S. grew by 232 percent from 2018 to 2019 alone, according to an analysis by Wood Mackenzie, with nearly half coming behind the meter, including business and home battery systems and electric vehicles.

"As the grid has evolved, our generation is moving to small chunks, and so the grid itself isn't as inherently stable," Miller says. "It has to be increasingly actively managed."

Managing the grid, both at the transmission and the distribution level, in the midst of this change requires rapid two-way communication, a massive increase in data analytical capability, and sophisticated solid-state control technology.

"The challenge is now to pull all of the information together: what the state of the grid is, what controls we can implement, what decisions are optimum," Miller says. "It's about deriving value from the new control technology. It's the synchronization, utilization, and coordination of everything that's happening to get the best of this new agile grid."

What follows is a look at 10 technologies that will enable the future grid. The list is not exhaustive. New innovations arise nearly constantly. But through interviews with industry experts, a consensus emerged that these 10 are among the essential advances for expanding the multi-directional grid and helping electric cooperatives meet the shifting consumer expectations that will accompany this future energy landscape.

## Advanced Inverters


**California's Anza Electric Cooperative began efforts to "island" its grid with solar, battery storage and advanced inverters after wildfires caused outages in 2018. (Photo courtesy Anza Electric Cooperative)**

If any distributed energy resource is to feed electricity to a home, business, or the grid, that power must first be converted from DC to AC. This is the task of standard inverters, which are relatively simple devices that for decades have been used to integrate solar arrays and batteries.

"Advanced" inverters, which are standard equipment on most new DER installations, go even further, providing benefits like communication capabilities, sophisticated monitoring and control functions, and autonomous operation.

The National Renewable Energy Lab has identified three significant advantages of advanced inverters for DER integration:

- "Ride-through" capability: Advanced inverters can direct a distributed generation system to stay online during relatively short, minor frequency or voltage disturbances.

- Two-way interaction with the grid: Variability in the power output from distributed generation can make it difficult for grid operators to keep frequency and voltage levels within the required range. The capability of advanced inverters to feed electricity into or take electricity from the grid can help maintain system stability by keeping voltage and frequency level within specified limits.

- "Soft start" after outages: The ability of advanced inverters to stagger the timing of the reconnection of distributed generation to the grid after an outage can help avoid spikes in active power being fed into the grid, limiting the risk of triggering another disturbance.

Advanced inverters will be essential as industry interconnection standards for DER proliferate. The IEEE 1547-2018 standard requires that distributed resources provide an array of grid support functionality, including communications and control and voltage and frequency ride-through regulation.

Anza Electric Cooperative in California is deploying solar, battery storage, and advanced inverters in order to "island" its grid and improve resilience. These efforts come after suffering a series of outages in 2018 caused when wildfires and other events cut off their sole supply of electricity.

"This system will provide resilience, but it will also address capacity constraints," says Anza General Manager Kevin Short. "The inverters, functioning in tandem with the battery, will provide ancillary benefits, including voltage and frequency stabilization and VAR support."

**More Resources on Advanced Inverters:**

- *Cooperative Utility PV Manual, Volume II*
- *SUNDA Final Report*

## Broadband

**New grid functions increase the need for operational fiber, and cooperatives have the ability to leverage existing above-ground infrastructure to minimize installation cost. (Photo By: Preston Keres/USDA)**

Electric cooperatives have been investing in connectivity for system operations for years, recognizing that two-way communications are fundamental to making use of smart grid technologies.

But as the grid evolves, the need for faster and higher-capacity backbone networks will increase. A 2018 NRECA/NRTC report on the value of operational broadband estimates new grid devices and functions will drive a 100,000-fold increase in utility data to be managed. How much value the co-op can extract using this data depends in part on the robustness of the communications infrastructure.

"I think more co-ops are going to get involved [in operational broadband] because they're going to see the value of this for their electric operations," says Joseph Goodenbery, lead economist in NRECA's Business and Technology Strategies group. "Co-ops are realizing that operational broadband unlocks the value of emerging grid technologies."

Higher-bandwidth, lower-latency communications systems will allow broader and deeper use of existing smart grid components, enabling both the movement of large amounts of data and more precise control over downline devices. But new grid functions will also be increasingly dependent on the highest-quality communication platforms. Real-time integration of renewables and other distributed energy resources, voltage optimization, serving connected homes and businesses, managing electric vehicle charging—these all will hinge on fast, reliable, accurate data exchange.

The 2018 report by NRECA and NRTC notes that until now, wired, wireless, or hybrid backbone systems have sufficed. But fiber optic cable likely will become the standard, with high-speed wireless-point-to-multipoint solutions used for "unwireable" regions.

The report points out that cooperatives have the ability to leverage their above-ground infrastructure to minimize the cost of installing operational fiber. Aerial installations range from $13,000 to $17,000 per mile, where undergrounding can reach $45,000 to $55,000 per mile.

Cooperatives are also expanding broadband backbones beyond their operations, offering fiber internet service to members (where state law permits) or providing access to a third-party provider. Such projects can enable many of the consumer-side advancements of the modern grid, like energy use monitoring and internet-of-things, in addition to creating new revenue streams for the co-op.

"We are increasingly seeing our members leverage the broadband facilities they have been deploying for electric operations and use them to also offer broadband to their member-owners," says Brian O'Hara, NRECA senior director for regulatory issues.

More than 100 electric co-ops are now offering broadband to the public, either alone or in a partnership with a telecommunications company, he notes, with up to 200 more exploring the possibility.

**More Resources on Broadband:**

- *The Value of a Broadband Backbone*

## Cybersecurity

**Colorado's Tri-State Generation & Transmission's Crisis Management Center participating in a national biennial drill by NERC of utility cyber and physical security. (Photo By: Tri-State Generation & Transmission)**

As the grid becomes more complex, the reliance on sophisticated control software and digital communications platforms will make grid assets more attractive targets for cybercrime or cyberterrorism.

The U.S. Department of Homeland Security has recorded multiple incidents of foreign entities probing U.S. utility systems for weaknesses and gaining access to information on control systems. The department's Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) recommends utilities design their network architecture so their ICS is separate from their enterprise network (often referred to as an "air gap"). Such segmentation makes intrusion significantly more difficult.

Cybersecurity is already a critical part of maintaining the grid and will only become more important as it continues to evolve.

Electric cooperatives are working on a range of defenses, from cybertools to continuously improving cyberhygiene.

NRECA has created Essence, a tool that helps co-ops detect anomalies on their network traffic in real time. Developers are testing GridState, a project funded by the Department of Defense that extends Essence capabilities, allowing co-ops to run a mirror-version of systems to test various scenarios without affecting their real SCADA or IT systems.

Also, with the aid of a Department of Energy grant, NRECA has developed RC3 (the Rural Cooperative Cybersecurity Capabilities Program) to offer resources and training to help co-ops improve their cybersecurity.

Cynthia Hsu, NRECA's cybersecurity program manager, notes electric co-ops are working to stay a step ahead.

"They're definitely experiencing cybercrime," she says. "It takes a few different formats: Ransomware, compromised email, fake invoices."

Hsu emphasizes the importance of the human factor in cybersecurity. Education and awareness, she says, will be key to defending against future cyber incursions.

As part of RC3, NRECA built a Cybersecurity Tabletop Exercises toolkit that helps co-ops with varying levels of in-house IT capability to test themselves against different cyberattacks.

"The purpose is for personnel to become aware of how a scenario would unfold, so you can have that perspective on a clear-sky day instead of when something really does happen," Hsu says.

**More Resources on Cybersecurity:**

- *Assessing your cooperative's cybersecurity capabilities*

## Data Analytics

Data analytics and artificial intelligence are central to the evolving grid, enabling the automated system management that increasingly will become part of both distribution and G&T systems.

Electric co-ops have been using analytical tools for years, but those tools are growing in capability and are spreading, notes David Pinney, NRECA analytics program manager.

“We’re seeing increased interest in the past few years as more (smart) metering, bandwidth, and computational power become available cheaply,” he says.

Data analytics can help utilities manage DER, forecast and curb peak load, improve power flow planning, and reduce line loss, among other functions. It’s also been used to better understand member needs and make financial decisions.

“It’s already changing the ways cooperatives operate,” says Craig Miller, NRECA’s chief scientist.

In 2018, Platte-Clay Electric Cooperative, based in Kearney, Missouri, began using a fault detection and location system that uses powerful data analytics and visualization tools to identify and locate outages more quickly.

Based on AMI data from the co-op’s 20,000 meters, the system uses algorithms to determine how often and when meters on the co-op’s lines should be pinged, which can be as frequently as every 5 seconds in certain circumstances. It can detect an outage in about three minutes and then immediately begin determining the parameters of the disruption.

Cobb EMC, based in Marietta, Georgia, uses analytics as a powerful member engagement tool. The 180,000-member co-op analyzed information from its databases, along with more data it acquired by working with a survey firm, to develop a detailed profile of its members that goes beyond standard demographics.

Nurdan Cornelius, Cobb EMC director for consumer marketing, says the insights gained into the different types of members at the co-op have improved communications and marketing across the co-op’s diverse membership.

Brunswick EMC, headquartered in Shallotte, North Carolina, is using software that analyzes and learns from weather data to more efficiently position equipment and crews before severe weather hits.

Utility analytics increasingly depends on machine learning and artificial intelligence to refine analysis as co-ops continuously take in more data and compare predicted results against real outcomes. Yet Pinney believes the revolution in analytics is only beginning.

“Machine learning techniques have had huge success in other industries,” he notes.

For example, Google and Facebook have widely deployed speech and image recognition software that continually learn as they go in products like smart speakers.

Cooperatives are beginning to use machine learning for drone image analysis and predictive controls for DER management, Pinney and Miller say, along with peak load forecasting and reduction strategies.

“In the utility industry, we’re in early days of deploying machine learning techniques,” Pinney says. “But we’re beginning to see exciting applications.”

**More Resources on Data Analytics:**

- *Data and Analytics Resources*
- *Next Generation IT Architecture Guide*

## Drones

Middle Tennessee Electric Membership Corp. has begun getting a whole new look at the condition of its lines and poles.

The co-op is one of several using unmanned aircraft systems (UAS) or drones for system inspections.

Adam Seaborn, an electrical engineer and head of Middle Tennessee's UAS program, says unmanned aircraft will "be the start of a whole new level of inspection for co-ops. You move from a more reactive mode where you have an issue to where you see something before you have a problem and you can address it."

Middle Tennessee's drone can carry two cameras—one regular; one infrared—to check for hotspots and get different perspectives on the system. On-board sensors help it avoid collisions with poles, towers, and other aerial impediments.

The co-op has used it to check system components for wear and tear as well as in storm response work. When they flew the drone over the co-op's community solar array, it quickly identified several non-functioning panels, illustrating the value of these devices in the operation and management of remotely located energy resources.

"We were able to see some issues that we would never be able to see from the ground," Seaborn says.

UAS technology is moving rapidly, with significant recent gains in range and payload capacity. Accessories like high-definition cameras, LiDAR, and thermal imaging paired with functions like autonomous flight, integration with geographic information systems (GIS), data analytics, and artificial intelligence will be transformative for co-op operations, says Stan McHann, a senior research engineer at NRECA.

"AI will take a look at the images and find problems, where today it pretty much takes a subject matter expert to look at it and say, 'That's the problem,'" he says.

Commercial drone use has been hampered by certain federal restrictions, including licensing requirements, mandates for line-of-site and daytime-only use, and speed and height limits. But the industry is working through those impediments, McHann says.

When drones are fully integrated into co-op operations, he says, the grid inspection and analysis they will enable will result in greater resilience and reliability.

**More Resources on Drones:**

- *Opportunities for Unmanned Aircraft Systems (UAS) Use by Electric Utilities*

## Sensors

A new generation of sensors is transforming the ability of electric cooperatives to detect what is happening on their systems.

Intelligent line sensors that can pinpoint faults and provide information on circuit performance can present a more granular view of the distribution grid. Combined with substation sensors and AMI systems, these ubiquitous devices are adding to the data revolution that's transforming utility operations.

"You have a lot of sensors at the substation, which look at voltage and current and other input. Those are fairly standard ones," says Venkat Banunarayanan, NRECA senior director for the integrated grid. "The change that's happening is a lot of sensors are being developed that you can place on feeders or the end of the line.

"You can just clamp them on a line using a hot stick, and those are usually wireless-capable. They transmit the data to a central hub of some sort, and you can get access to data from different points on the grid at varying time schedules. You can get one-second data if you want, more granular or less."

Doug Lambert, NRECA senior principal for grid solutions, points out that AMI systems can also effectively provide a distribution system with thousands of sensors.

"With smart meters, every meter becomes a downline device that's reporting power quality," he says.

Analysts say advanced sensing is becoming even more essential as the use of distributed energy resources increases. Line sensors can work in tandem with smarter meters and advanced power inverters on solar arrays to monitor the impact of residential generation on a distribution network.

Advanced sensing capability is also possible at a centralized location.

Wake Electric Membership Corporation, based in Wake Forest, North Carolina, is participating in a pilot study of GridState, a cybersecurity tool that can detect anomalies in system operations. GridState allows a co-op to operate an offline version of SCADA systems that can be checked and tested.

"We're able to watch every piece of data that's coming in from the field and collect it in a mirrored database that we can work on and analyze without working directly on our system," explains Don Bowman, Wake Electric's vice president of engineering and operations.

The focus of GridState is cybersecurity, but Bowman notes that it has the capability to provide added value on a distribution network.

"There's a lot of future possibilities as we learn how this data can be used," he says.

More sophisticated line sensors also lie ahead. NRECA is working with SenSanna, a wireless sensor company, on "technology that can hang on a wire and give you very, very precise measurement of what's going on in voltage, current, phase, and angle," says Craig Miller, NRECA's chief scientist. "And we can do it with millisecond precision with no external power source."

Overall, Miller notes, "Technology is getting smaller and cheaper with greater reliability and precision."

## Power Electronics

Power electronics—solid-state devices that provide efficient control and conversion of electrical power—promise to play an ever-growing role in maintaining power quality on the grid.

Maintaining quality has been complicated by the growth of distributed energy resources, particularly intermittent renewable energy sources such as solar and wind. Voltage, frequency, and power factor are impacted as more solar or other distributed generation comes on a system. Harmonic power distortions that can lead to a variety of problems are also possible.

Power electronics, which can include silicon-chip microprocessors with advanced control capabilities, are already improving the reliability and stability of transmission and distribution systems.

"I like to say that silicon is the new copper," says Craig Miller, NRECA's chief scientist. "It's becoming that important. There's a lot of silicon out there making decisions on the grid."

Even more is ahead, according to government studies. The U.S. Department of Energy (DOE) has estimated that 80 percent of electricity could flow through power electronics by 2030. And the agency predicts the technology will be particularly important in managing the expected increase in residential and utility-scale photovoltaic generation and its integration with battery storage.

A DOE study also concluded power electronics can play a pivotal role in improving grid reliability and security by providing:

- Improved system stability.
- Increased grid reliability.
- Improved power flow control.
- Greater flexibility in generation siting.
- More efficient use of transmission corridors.

## ‘LIKE A SWISS ARMY KNIFE’

The GridBridge Grid Energy Router (GER) is one power electronics device that’s getting a lot of attention, says Brian Sloboda, NRECA director for consumer solutions. These smart tools can stabilize voltage, correct power factor issues, and mitigate harmonics in real time.

“It’s like a Swiss Army knife,” Sloboda says. “If you want it to help you with DER penetration or conservation voltage reduction, it can do that. If you want to do voltage optimization, it can do that too.”

An installation by Sandhills Utility Services, formed by four North Carolina co-ops to provide power to military bases, at Fort Bragg, North Carolina, illustrates one use of the device.

A restaurant on a feeder line on the base had been dealing with voltage fluctuation and power factor issues.

Deploying a GER immediately solved the issues when it was installed on the transformer, according to David Keith, Sandhill’s engineering manager.

The GridBridge GER is one of three such devices evaluated by NRECA in partnership with a vendor. Sloboda notes that all three helped integrate DG into distribution systems, but they differed in capabilities and characteristics.

The wide-ranging capabilities of such devices means “it takes a lot of thoughtful planning,” he says.

Nonetheless, he adds, the advantages mean more co-ops are likely to be turning to them in the future.

### Interactive Homes

**Visitors explore NRECA’s mock-up of a utility-connected home at the TechAdvantage Expo at NRECA’s Annual Meeting in Orlando, Florida. (Photo By: Luis Gomez Photos)**

The “connected” or “smart” home has received a lot of attention in recent years, but only now are smart appliances and home hubs at a point where they could transform residential energy management.

That future is on display at Dakota State University in Madison, South Dakota. East River Electric Power Cooperative, a G&T based in Madison, has partnered with the university and NRECA on the “Connected Home Research Project” at Dakota State’s Madison Cyber Labs.

A space in the lab has been transformed into a model kitchen with an array of connected appliances, including a refrigerator, dishwasher, and washer and dryer. The project also includes smart speakers, smart lighting, connected thermostat, and a home energy monitor, which installs in a home electrical panel to provide information on how electricity is being used.

Several of the interconnected devices can be remotely controlled or programmed to operate on a schedule to reduce energy costs.

The goal of the project is to increase the system’s intelligence, says Brian Sloboda, NRECA director for consumer solutions.

“What we’re doing with East River is trying to create a system that uses machine learning and artificial intelligence to allow the consumer to select preferences that fit their life and then communicate that to the utility in an automated fashion,” Sloboda says. “The appliances in the home could respond to either price signals or the availability of renewable energy on the grid and perform certain actions based on those signals.”

That capability will provide obvious benefits to both consumer-members and co-ops, notes Sloboda. Consumers can improve their energy conservation by tailoring usage in a manner that’s convenient; the co-op will better manage electricity demand, particularly peak load.

Sloboda says a key technology is the emergence of voice-activated virtual assistants like the Amazon Echo or Google Home, which are already in millions of homes and can allow voice control of other devices.

“What you’re seeing is an organic thing happening,” he says. “More and more appliances in the store are smart. They have Wi-Fi, and they can talk to the virtual assistant.”

Chris Studer, East River Electric’s chief member and public relations officer, says the G&T became involved in part because much of the technology for the interactive home is already available, but utilities have yet to significantly tap into it.

“There’s a gap between our demand response capabilities now and what this technology can do,” Studer says. “We’re trying to fill that gap and say how can we, as a utility, take advantage of this technology in a way that…brings value in more ways than one to consumers, but also helps the utility save money as well.”

Studer believes the interactive home’s arrival is near.

“We’re not going to see it overnight, but I think you’ll see much more of these products getting through people’s doors,” he says. “And if we can position ourselves as the trusted advisor in this area, it’s going to be a big advantage.”

**More Resources on Interactive Homes:**

- ***Consumer Expectations of the Connected Home***

## Interoperability

Interoperability is foundational to the evolving grid.

The diversity of DER—from solar arrays and gas-fired peaking plants to aggregated water heaters and home battery banks—means an increasing number of resources need to be integrated with utility operations, which cannot happen without seamless communication.

“Having diverse generation sources is a desirable thing, but without the ability to communicate and manage those resources, their value to the grid will be minimal,” says Venkat Banunarayanan, NRECA’s senior director for the integrated grid. “Interoperability is the key that unlocks all the potential of these DER technologies.”

For distribution utilities, data about an energy resource, which could be located beyond the meter in a home, and its operation must be readable and actionable by a SCADA system. For behind-the-meter resources, interoperability details will be specified by the utility in an interconnection agreement.

For many co-ops, MultiSpeak®, an interoperability tool created by NRECA, member co-ops, and vendors, has been a cost-effective solution for integrating disparate applications and reducing the need for costly software customization.

This widely used standard began as a fairly limited specification for electric cooperatives and vendors to allow automated metering platforms to “talk” to billing systems. Over nearly two decades of development, expansion, and refinement, MultiSpeak has been integrated into dozens of enterprise software systems, making it a cornerstone for distribution optimization. It’s now used by more than 800 utilities in 21 countries.

“As the electric industry becomes more complex, the value of having an interoperability standard has never been more crucial,” says Tony Thomas, NRECA’s senior director of distribution optimization.

The MultiSpeak 5.0 update enables important cybersecurity protections for distributed generation integration, microgrids, and demand response.

Troy, Missouri-based Cuivre River Electric Cooperative has been using MultiSpeak products since 2005.

“When it comes to integrating use of different software packages, this is one of the best things we’ve had available,” says Rick Didion, the co-op’s manager of engineering and operations. “It touches every piece of software that we own.”

**More Resources on Interoperability:**

- ***MultiSpeak***

## Interconnection Standards

Revised standards that the power industry is adopting to deal with the growth of distributed energy resources on the grid will have an impact on cooperatives and other electric utilities in the coming years.

The Institute of Electrical and Electronics Engineers (IEEE) is the organization that manages the standards governing DER interconnection. After four years of work, the IEEE in 2018 published a sweeping revision of those rules, Standard 1547-2018.

The new standard marks a change in outlook and approach to integrating DER into the nation’s grid, says Robert Harris, NRECA’s principal engineer for transmission & distribution and a member of the IEEE working group that tackled the changes.

“The primary goal was to enable more DER to be connected to the system,” Harris says. “A close secondary goal was to make sure the (bulk electrical) system could handle it.”

The changes will impact the interconnection of solar, wind, and other distributed generation. Some of the most significant changes come in the “minimum trip” settings for DER, which have been loosened to allow a much greater variance in voltage and frequency.

“The goal of the original standard was to cause the DER to trip if there was any kind of disturbance on the system,” Harris says. It was written, he explains, when the industry didn’t think DER would become a significant contributor of generation, and the objective was to minimize its impact.

“Nobody at that time envisioned it was going to become the entity that it is today, that it would ever be a significant contributor to the bulk electrical system.”

But with its growing role, Harris notes, “the emphasis has changed to keeping it on line for anything but the most egregious local electrical disturbances.”

A report by the National Renewable Energy Lab concludes the new standards enable penetration of DER at levels approaching, or exceeding, 100% peak load. The lab also said the standards should reduce interconnection approval time and the interconnection costs for advanced DER projects.

“The new standard is more densely written on top of that,” he adds. “So it’s at least an eight-fold increase in complexity.”

A closely related standard, IEEE 1547.1, covers testing of all interconnection components and will likely be published early in 2020. It will enable manufacturers to perform tests to certify their equipment as 1547-2018 compliant.

Dakota Electric Association, a distribution cooperative based in Farmington, Minnesota, has seen growing interest in both residential and larger-scale solar.

Craig Turner, the co-op's senior principal and regulatory engineer, says it is updating their interconnection technical standards.

But he notes that co-ops and other utilities face a hurdle in meeting the standards.

"We have these new requirements, but we can't really apply them because the equipment that will meet the standards doesn't exist," he says.

When IEEE 1547-compliant equipment becomes available, Turner says, electric co-ops will have to move quickly because "there'll be a learning curve and implementation curve that goes along with it."

A more detailed look at the revised standard is available in the "Guide to the IEEE 1547-2018 Standard and Its Impact on Cooperatives," published by NRECA in March.

More Resources on Interconnection Standards:

- *NRECA Guide to IEEE 1547-2018 Standard for DER Interconnections*