

Advanced Energy

2020 Annual Report



40
YEARS
1980 - 2020

Letter From the President

We look forward to the future with enthusiasm, knowing that we have the tools and expertise to keep providing important services and guidance.

As I think back over this year, I feel incredibly proud to be part of this organization. 2020 brought many challenges, yet Advanced Energy strategically navigated the uncertain times and made it a success. We were able to transition smoothly to working from home, creatively adapt to serve our clients and continue to collaborate with partners to ensure that energy is clean, affordable, reliable, efficient and safe for all people.

This year also marked an exciting milestone — our 40th anniversary. Since 1980, we have worked to provide benefits to North Carolina’s electric consumers and to make a positive impact in the residential, commercial and industrial, motors and drives, renewables and electric transportation sectors. The energy industry has rapidly changed throughout the decades, but we have remained a valuable and trusted resource for our clients. 2020 was no exception, and this annual report shares some of our most significant accomplishments. We look forward to the future with enthusiasm, knowing that we have the tools and expertise to keep providing important services and guidance.



Advanced Energy President and Executive Director

Advanced Energy's 40th Anniversary

On April 11, 2020, we celebrated our 40th anniversary! Over the past four decades, we have been able to help our partners navigate the ever-changing energy landscape by providing research, training, testing, consulting and program services. Since being created in 1980 by the North Carolina Utilities Commission, we have expanded our operations, added major research and testing laboratories and won numerous grants to study energy-related issues, but we've never strayed from our purpose. We are truly thankful for all the opportunities we have had over the past 40 years to assist our clients and utility members (Duke Energy, Dominion Energy North Carolina and the North Carolina Electric Membership Corporation) and support the energy industry.

1980

Advanced Energy was established as the NC Alternative Energy Corporation by the NC Utilities Commission in partnership with electric utilities to investigate and implement technologies for distributed generation, load management and energy efficiency.

1981

AE partnered with the NC Electric Membership Corporation to examine the benefits of implementing a load control program focused on managing water heaters and air conditioners.

1982

AE examined the feasibility of cogeneration systems in NC industries. Manufacturing plants saw annual savings from \$25,000 to \$50,000.



1983

AE established the Energy Conservation Fund. It was the first statewide energy assistance project to meet the needs for energy management among YMCAs, churches, museums, daycares and nonprofits.

1984

AE trained staff in more than 95% of NC school districts on how to develop and implement electric load management programs.

1985

AE collaborated with Carolina Power and Light to test a photovoltaic system to assess its impact on utility system voltage harmonics, line-crew safety, power line communications and distribution line protection.

1986

AE launched the Heat Pump Skills Center in Troy, NC, to teach technicians how to maximize HVAC efficiency.

1988

AE developed a series of energy management workshops for public housing authorities.

1989

AE tested an electric van to assess its potential application in commercial fleets.



1990

AE established the Industrial Electrotechnology Laboratory to evaluate infrared drying, powder coat curing, radio frequency drying and more.

1991

AE worked with the manufactured housing industry to develop guidelines for energy efficient manufactured homes.

1992

AE won an EPA National Award for educating NC poultry farmers about the benefit of switching from incandescent to compact fluorescent lightbulbs.

1994

AE worked with NC Power to award grants to 44 teachers to support energy activities in the classroom. AE was awarded the Public Relations Society of America award for community service for this project.



1997

AE achieved National Voluntary Laboratory Accreditation Program compliance and was the first motor lab in the world to be accredited by the National Institute of Standards and Technology for motor efficiency testing (Lab Code: 200081-0).

1998

AE began its motor repair quality assurance program known as Proven Efficiency Verification.

2001

AE launched SystemVision to provide low-income families with affordable housing that has comfort and energy guarantees.

2002

AE began research on plug-in hybrid electric school buses and worked with school districts to assess operating costs, emissions and other benefits.

2003

NC GreenPower became an operational subsidiary of AE after approval from the NC Utilities Commission.



2005

AE received a DOE grant to help develop motor controllers for electric vehicles.

2007

AE added a DC generator for zero to 500v DC, 510 Amp continuous power for DC motor testing.

2009

AE tested motors for the DOE and stakeholders to establish new minimum efficiency standards for small electric motors.

2011

AE and key stakeholders launched Plug-in NC, a statewide program that promotes electric vehicles through education and outreach.

**2012**

AE worked with stakeholders to create electric vehicle roadmaps for NC and conducted a 40-vehicle usage study to assess driving and charging patterns.

2013

AE increased electric vehicle outreach and facilitated dozens of workshops across NC.

2014

AE collaborated with NCDEQ, SC Energy Office and EPIC on the Carolinas Energy Planning for the Future Project that brought together stakeholders to discuss energy issues and prepare for future opportunities.

2015

AE commissioned a modeling study to analyze the impact of electric vehicles on NC's economy.

2016

With a grant from the DOE and assistance from NCDEQ's Utility Savings Initiative, AE completed a multiyear project assisting K-12 schools, community colleges and local governments with energy performance contracting.

2017

AE was selected to lead Duke Energy's PV Interconnection Commissioning and played a key role in facilitating the process for the review and update of the NC interconnection standards.

2018

AE launched Advanced Energy at Home, an online resource that provides information on residential areas such as crawl spaces, moisture, indoor air quality and energy efficiency.

2019

AE was recognized by the American National Standards Institute as a Certification Body to certify electric motors for efficiency as designated by the DOE.

2020

AE celebrates its 40th anniversary!



Collaborating to Promote Electric Transportation

While COVID-19 interfered with our usual approach to electric transportation education, Plug-in NC, our statewide electric vehicle (EV) outreach program, was able to find new ways to connect with audiences and make an impact. With support from our steering committee, we engaged stakeholders, the state government, businesses, municipalities, electric utilities and individuals throughout North Carolina.

Working with North Carolina's Clean Cities Coalitions, we organized and hosted a three-part webinar series on medium- and heavy-duty vehicle electrification. The series was well received and offered perspectives from a variety of utility, local government and other industry professionals.

In addition, we are authoring a first-of-its-kind "State of the State" report. Using the knowledge and expertise of our steering committee and reflections from other key participants, the document will provide a snapshot of the electric transportation sector in North Carolina, including updates on vehicles and charging infrastructure, strengths and opportunities.

In a separate effort, we worked with a major employer in the Research Triangle to evaluate its workplace charging and help it plan for future EV growth among employees. The assessment included projections on EV adoption within the company, charging station siting considerations and an overview of charging station providers and their functionality and benefits.

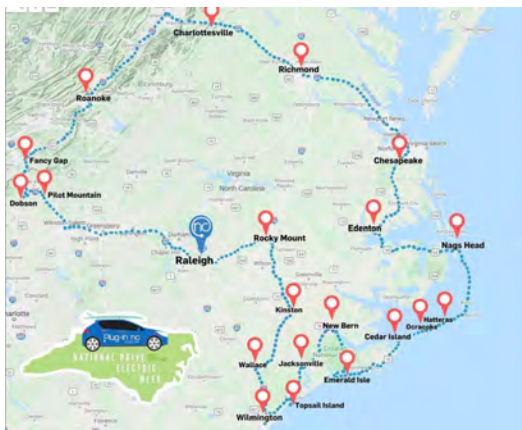


We have also joined with stakeholders to support E4 Carolinas in a U.S. Department of Energy project to create an alternative fuels resiliency plan for the Carolinas. The initiative involves understanding the utility and alternative fuel considerations should major disruptions, such as floods, fires or other natural disasters, occur. In the first of three years, we helped identify fleets across the state and gauge whether they were using EVs or would be interested in learning more about them for potential future adoption.

Electric Road-Tripping Through North Carolina and Virginia

Our typical National Drive Electric Week celebrations — coordinating in-person EV shows and ride-and-drives — were hampered by the pandemic, so we pivoted and embarked on a weeklong, 1,245-mile journey through North Carolina and Virginia. Along with our Chevrolet Bolt EV, which we named Wattson, we used the trip to travel to places with less charging infrastructure and to share our experiences — both thrilling and challenging — with the Plug-in NC community while debunking common EV myths.

Relying heavily on social media, we were able to spread the word about EVs with both new audiences and long-time supporters in an engaging and interactive format. The adventure also provided a great opportunity to collaborate with our member utilities and broadcast the critical ways they are supporting EVs and leading the deployment of charging infrastructure.



Regional Cooperative Education Series on Electric Vehicles

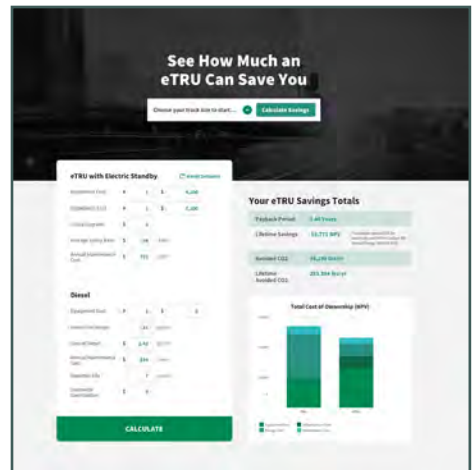
In 2020, we kicked off a project that is bringing together hundreds of electric cooperative staff members — across four generation and transmission cooperative territories — to share the benefits of EVs, charging stations and more. The effort represents a way to deepen the knowledge of member service representatives, energy services advisors, management and board members, allowing them to have more informed conversations with their member owners around EVs. In addition to six webinars, the project will feature a roundtable discussion to allow attendees throughout the Southeast and Mid-Atlantic to share their questions, perspectives and program offerings with each other.

Promoting Beneficial Electrification Through Education

We recognize the role that electrification will play in the future and the benefits it offers our clients and their end users. As interest increases, there are numerous opportunities for electric cooperatives to support electric technology implementation in commercial, industrial and agricultural applications.

In 2020, we helped North Carolina's Electric Cooperatives and the National Rural Electric Cooperative Association become trusted energy advisors in this area for their end users and members. We developed electric technology handouts, designed savings calculators and performed audits.

One technology we focused on was transport refrigeration units (TRUs), which are mobile refrigeration systems that supply precise temperature control for perishable goods during transport and storage. This equipment has traditionally been powered by a diesel internal combustion engine, but many industries are making the switch to hybrid diesel/electric versions (eTRUs) that use electricity to power the unit while not in motion.



Navigating Commercial and Industrial Work During COVID-19

Our commercial and industrial assessments slowed in the first half of 2020 due to COVID-19, but we adapted, still had a productive year and even welcomed a new team member. As stay-at-home orders and other guidelines were put in place, we paused our site visits and explored a virtual platform, using it to deliver an energy assessment to an industrial customer that produces biofuels. We later returned to in-person audits while implementing robust protocols to ensure the health and safety of our engineers and clients.



We also had a unique opportunity to assist the Asheville Art Museum as it reopened after shutting down. As part of this effort, we developed a white paper on considerations for safe reopening and turned this white paper into a webinar that we delivered to Electricities public power members and their commercial and industrial customers.

ISO 50001 and 50001 Ready Engagement

Over the last few years, we have become recognized subject matter experts in strategic energy management (SEM) and ISO 50001. In 2020, we saw continued interest and growth in these areas as more end users, utilities and support agencies requested education and consulting. Our member Duke Energy supported one of its large industrial customers, Daimler Trucks North America (DTNA), enabling us to start a multisite project across 10 DTNA facilities (five in North Carolina). The DTNA Mount Holly site achieved ISO 50001 certification in November, and work with other sites is ongoing.

The bulk of our effort featured webinar-based sessions for cohorts, or groups of facilities with like-minded operations and goals. In 2019, we developed remote training and consulting

services for the U.S. Department of Energy's (DOE's) 50001 Ready™ program, and they were very timely for application in 2020.

Throughout the year, we expanded our work with DOE's 50001 Ready Navigator™ tool. We led and delivered two federal agency cohorts, one for 16 NASA sites and one for five U.S. Department of Justice sites, and a single-site implementation at a large military base in North Carolina. All of these were sponsored by the Federal Energy Management Program. We also delivered eight 50001 Ready training modules to our first North Carolina 50001 Ready cohort. A total of 20 facilities from 18 organizations participated. One will seek ISO 50001 certification early next year, and several others are working toward 50001 Ready recognition from DOE.

In November, we were selected as one of four U.S. Technical Assistance organizations for 50001 Ready by the Advanced Manufacturing Office, a program operated by DOE. This new opportunity allows us to recruit and deliver more cohorts while also assisting in the research being conducted on the use and efficacy of 50001 Ready tools. The tools for the program, including Navigator, were developed and are managed by Lawrence Berkeley National Laboratory.

We are excited to maintain our credentials and continue to expand our business related to SEM and 50001 consulting. In 2020, we invested in new 50001 certifications for two engineering team members, and our most experienced ISO 50001

engineer joined the delegation from the U.S. on the standards committee. Looking ahead, we see many opportunities for our SEM and ISO 50001 services in North Carolina and beyond.



Earning Department of Energy Classification as a Nationally Recognized Certification Program

In July 2020, the U.S. DOE issued its final determination classifying our motor services as a nationally recognized certification program for electric and small electric motor efficiency.

Of the now three DOE-recognized certification programs, we operate the only National Voluntary Laboratory Accreditation Program (NVLAP) motor test lab (Lab Code: 200081-0). NVLAP is specifically designed for motor efficiency testing utilizing ISO 17025 and is administered by the National Institute of Standards and Technology (NIST). NIST has been auditing our lab annually since 1997. Also in 2020, we completed our second ISO 17065 audit with the American National Standards Institute, retaining our Certification Body status.

Electric Motors and Drives Program Update

Before the pandemic, our motors and drives team traveled to conferences, had client witness tests in our lab and visited with clients in their own facilities. As COVID-19 arrived and guidelines and policies changed, we transitioned to regional individual travel by road and adapted with video witness testing and video conferencing with our clients.

Overall, we were able to react quickly and maintain a safe environment to continue our work uninterrupted. We consulted with and tested for utilities, motor and drive manufacturers, original equipment manufacturers (OEMs), the motor repair industry, motor and drive developers, and others. We helped motor manufacturers obtain and keep their certifications for meeting efficiency requirements in the United States and Mexico. We also remain the only lab in the world able to carry out certification testing for the Air-Conditioning, Heating, and Refrigeration Institute certified drive program.

In the OEM market, we assessed the performance of motors used for conveyance. Online shopping is growing, and package delivery is creating new demand for large warehouses with complex conveyor systems. The OEM purchases motors and integrates them with

controls into conveyor systems. This taxing application requires specific performance that our lab was able to characterize.

We also helped the largest motor importer in the U.S. market stay on top of its quality with regular testing and evaluation of suppliers. Using our status as a Certification Body, we delivered our first product certification for motor efficiency to a motor



manufacturer in Japan. We were additionally recognized by the US Patent and Trademark Office for our Certification Body activities. Furthermore, we had 90-year-old transportation tunnel fan motors in our lab as part of one neat project as New York City was replacing outdated and no-longer-available equipment.

Through our Proven Efficiency Verification (PEV) program and the Electrical Apparatus Service Association's EASA Accreditation program, we helped 39 motor service centers achieve and maintain quality procedures that restore motor efficiency during the repair process.

Partnering with Plant Engineering magazine and others, our motor systems engineers delivered online trainings to over a thousand individuals. We further educated audiences by developing website articles on a variety of motor topics, including solutions to power quality issues and efficient motor management.

Finally, we expanded our multiyear research with Duke Energy to assess how the proliferation of grid-connected distributed generation in North Carolina is affecting the utility's power network. As part of this project, we finished a three-part video series on motor starting, and we sourced equipment typically used in agricultural applications to test in our lab.

Supporting Grid Management to Benefit Utilities and Their Customers

Continued advancements in home equipment and appliances and increasing adoption of new technologies are changing the way utilities think about grid management. These developments are altering when and how people use energy and, in some cases, may increase power demands at critical times of the day and year. They also unlock opportunities for utilities to partner with their customers/members in novel ways. With this in mind, our residential team pursued a number of projects in 2020 to help utilities manage their demand and operations while benefiting their energy consumers.



Early in the year, we provided technical research on grid-integrated water heaters for Dominion Energy, which was responding to an order from the North Carolina Utilities Commission to address a discussion and analysis of the technology. Grid-integrated water heating, also known as grid-enabled or grid-interactive water heating, uses bidirectional controls that allow the equipment to be turned on or off or ramped up and down as a flexible load on the grid by a utility or third party. Our research included a review of the technology, a comparison of grid-integrated water heaters and battery storage, a summary of grid-integrated water heater utility programs and a literature review of grid-integrated water heater findings from independent sources.

Another technology that has the potential to benefit both utilities and homeowners is the Wi-Fi-enabled/smart thermostat. In one effort, we evaluated the default settings of the ecobee3 product line commonly used in electric co-op HVAC programs. We then developed step-by-step guides with recommended settings for heat pump and dual-fuel HVAC systems, particularly ones that will optimize energy savings, comfort and peak demand reductions for Southeast co-op members.

We also worked with Mississippi's Cooperative Energy, three of its Member Co-ops and Tierra Resource Consultants to assess the feasibility of offering a smart thermostat program to residential members. The pilot project installed Nest thermostats in 77 homes and explored potential energy and demand savings, bill savings, cost-effectiveness, satisfaction and logistical outcomes. Participating members were found to have saved energy and reduced their winter and summer peak demand, and they reported high levels of satisfaction with the technology.

In addition to these completed projects, we kicked off several more in 2020 that will carry forward into next year and beyond. In one, we are examining the benefits and capabilities of residential variable-capacity HVAC systems in a more heating-dominated part of the state. Two in-field proof-of-concept projects in Asheville, North Carolina, are studying the extent to which these systems produce mutual customer and utility benefits. The primary focus is on energy and peak demand performance during more dramatic winter and summer weather, and a secondary goal is to understand the latent-load (moisture) control performance for optimal comfort in the milder shoulder seasons.

In a similar vein, we initiated a multiyear project with Duke Energy to explore whether battery storage technology provides benefits for customers and utilities through demand management services as well as peak power and seasonal energy consumption reduction. We are currently recruiting homes in the Research Triangle to participate, and we will be monitoring them through the next year.

Putting some of these ideas together, we are investigating how to create a home that has predictable peak energy demand on the grid. The first steps of this effort involve better understanding energy and power demands of different technologies on a home's overall power usage and which of these loads can be controlled in low-cost ways while supporting customer comfort. With this information, we will create a comparison of each component, its controllability and its estimated cost to implement in North Carolina homes.

Keeping Housing Affordable During a Pandemic

In mid-March as the reality of COVID-19 set in and our offices began to implement remote working conditions, our residential team, in solidarity with management and the North Carolina Housing Finance Agency, developed a strategy to continue SystemVision's mission of providing safe, durable and affordable homes to those in need. Though our inspection process would be fully remote — and use only the technology available to us and to our builder representatives — we quickly transitioned and blazed the trail for what would eventually become adopted as a nationwide alternative rating process.

Our goal was to continue to certify the homes that our affiliates built while standing behind our same energy and comfort guarantees for homeowners. This was a bold move by management since, at the time, we were unaware of how long this shift would last or how many houses we would be guaranteeing. It demonstrated that placing people into affordable homes, with a guarantee, took precedence over the risk involved. In early September, we introduced a hybrid process with remote insulation inspections and in-person final inspections. To date in 2020, we have certified 166 houses, most using a combination of these temporary procedures.

While working under our remote inspection process, we put technology to the test and pivoted to a more intimate method of inspecting homes. We used a one-on-one approach that opened the door for us to train builder representatives in real time. We also conducted interviews with a sampling of our builder types to get feedback on how our in-person inspection process could improve and which aspects of the remote process we could carry forward.

The number of SystemVision affiliates grew with both new and returning builders, and we were able to add



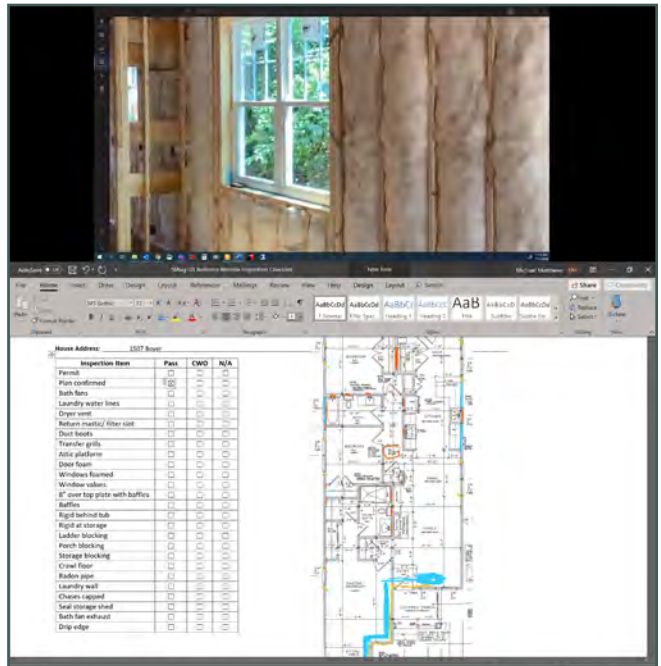
additional SystemVision Supportive Housing projects as well. At the end of the year, we began research on one of our previous projects, which will allow us to monitor and gather energy data from a women's shelter and provide us with an opportunity to better understand the impact of our work.

One remarkable takeaway from the SystemVision standards is how they are ahead of the curve regarding ventilation and a controlled method of diluting air. With growing evidence that the coronavirus is transmitted through the air, both the Centers for Disease Control and Prevention and the American Society of Heating, Refrigerating and Air-Conditioning Engineers have acknowledged the importance of air dilution in limiting its spread.

An additional blossoming partnership came out of our 2019 standards update, based on our passive radon mitigation requirement. We were invited by the NC Department of Health and Human Services to present our standards and explain why this requirement was adopted.

The City of Raleigh also remains on our radar as a collaborator in improving affordable housing. We are monitoring its Community-wide Climate Action Plan process and watching for opportunities where we can be of service.

Overall, our team was able to grow and adapt in our remote setting and even welcomed a new SystemVision employee. We continue to work with our latest modeling software and streamline our standards updates while navigating the pandemic.



Battery Storage Commissioning

As North Carolina moves to a more sustainable, cleaner grid, battery storage will play a critical role in helping to reliably integrate other emerging technologies. To assist with its deployment, we commissioned our first battery storage system in 2020, the Asheville Rock Hill Battery Energy Storage System. The project is North Carolina's largest battery installation to date, consisting of a nearly 9-megawatt lithium-ion battery system. It will be operated by Duke Energy as part of the utility's Western Carolinas Modernization Project.

We also conducted an inspection and provided consulting on Heron's Nest, a neighborhood microgrid located in Shallotte, North Carolina. We are currently working with North Carolina's Electric Cooperatives to commission several solar-plus-storage facilities under development throughout cooperative territories.

Increasing Safety Through Solar PV Interconnection Commissioning

The primary goal of interconnection commissioning is to assist in the development of utility-scale solar with a focus on safety, reliability and power quality, and personnel well-being is a top priority and motivation for us. We have found that internal quality assurance

is critical to making sure that facilities are built safely. With the knowledge we have gained over 160 facility inspections, our engineers have been able to inform developers of potential hazards before a site is energized and personnel are at risk. Our extensive experience on construction quality issues has also allowed us to educate the industry and improve the safety and reliability of utility-scale solar installations across North and South Carolina.



Supporting Our Schools and Environment with Renewable Energy and STEM Education

In 2020 our subsidiary, NC GreenPower, continued to improve North Carolina's environment by supporting renewable energy, carbon offsets and school grants.

Since its inception in 2003, NC GreenPower has used voluntary contributions to help fund the generation of 1.05 billion kilowatt-hours of green power from local solar, wind and landfill projects. Carbon offset donations, which were first accepted in 2008, have supported the mitigation of 95,000 tonnes of greenhouse gases through methane capture projects.

For the first time, and in its first year as a full-scale program, NC GreenPower's Solar+ Schools initiative awarded grants for the installation of educational solar arrays at 10 North Carolina K-12 schools in 2020. The program plans to expand further in the future, granting up to 15 schools in 2021 and up to 20 schools in 2022. In all, Solar+ Schools has provided solar installations to 42 schools in 33 counties, bringing STEM and energy education to more than 32,000 students across our state.



Smart Grid Webinar Series Breaks Attendance Records

Our Exploring North Carolina Smart Grid program saw record-breaking attendance during this year's Smart Grid Webinar Series. We have hosted the series since 2017 to provide government and business stakeholders with a convenient way to learn how the smart grid is changing our state's future. This year's topics included megatrends in the energy industry and implications for North Carolina, medium- and heavy-duty vehicle electrification in North Carolina and electric rate modernization in North Carolina. You can visit www.ncsmartgrid.org to view webinar recordings and supporting resources.

Advanced Energy Online

As many people transitioned to working from home, we saw increased interest in virtual education. Most years, we host dozens of in-person events, so to sustain these efforts in 2020, we participated in and organized over 65 virtual trainings and webinars. We also continued to provide educational information through our website and social media channels. We received our highest number of website visitors this year, at over 50,000, and reached more than 107,000 people on social media.



50K 
WEBSITE
VISITORS

220K 
SOCIAL MEDIA
IMPRESSIONS

MOST READ BLOG POSTS FROM 2020:

1. *What to Know Before Installing Solar at Home*
2. *Advanced Energy Classified as Nationally Recognized Certification Program*
3. *Home Rehabilitation Is Key to Supporting Energy Efficiency in Low-Income Housing*
4. *Beneficial Buses: Electric Buses Bring Benefits to Businesses, Communities and Utilities*
5. *Practical Solutions to Industrial Power Quality Issues*

Staying Connected

Our staff did a wonderful job adapting to the changes and challenges of 2020. To stay connected and keep up morale, we created a “Virtual Water Cooler” to talk with each other about life happenings. We also continued our all-staff meetings, and our social committee hosted multiple events to bring employees together for some virtual fun. In addition, we were excited to host our annual United Way fundraiser online and give back to our community. This year has further shown the dedication and camaraderie of our staff, and we are thankful for the optimism that we have felt across our organization. We look forward to 2021 knowing that we have an exceptional team that can work together to navigate trying times.



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