EPRI | ELECTRIC POWER RESEARCH INSTITUTE

EFFICIENT ELECTRIFICATION AT EPRI

JULY 2018 NEWSLETTER

Electrification leads us in many diverse and interesting directions. In this issue of *Efficient Electrification*, we examine a few of these paths–some of which might surprise you.

- Did you know there's an energy-focused network that has supported more than 500 companies, which have raised a combined $1.6 billion in funding? Read about the EPRI-operated Incubatenergy Network and other events at the upcoming Electrification 2018 conference that showcase many of these innovators.
- For-profit indoor agriculture companies are springing up around the country, but did you know this growing industry presents many opportunities and benefits to the local utilities that serve them?
- Efficient electrification in the United Kingdom is the subject of a series of recent reports produced by a U.K. electric power trade association. Learn more about the view from the other side of the pond.
- Did you know that 2018 is a critical juncture for the policy and regulatory framework surrounding electrification? Learn more in our article about the Policy and Regulatory Track of EPRI's upcoming Electrification 2018 Conference.
- EPRI's U.S. National Electrification Assessment led to specific recommended actions for various stakeholders. Read a summary of these.

Remember to check out our list of recent news, events, and EPRI resources at the end of Efficient Electrification–it's a thought-provoking compilation of electrification-related news assembled in one place for our readers.

More than 1,100 people have already registered for the Electrification 2018 International Conference & Exposition, August 20–23, 2018 in Long Beach … have you? A full agenda, information about plenary sessions, the exposition, special events, and registration, and an overview of pre-conference workshops (on August 20) are available at www.electrification2018.com. We hope to see you there.

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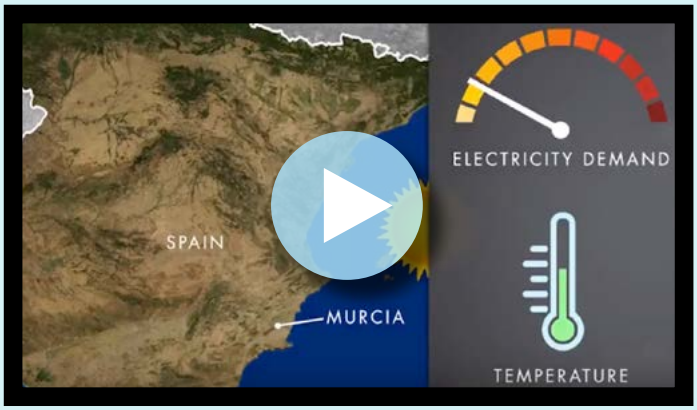

Featured Video of the Month

Time and Locational Value of Photovoltaics (PV) on Distribution Feeders in Spain.

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Indoor Agriculture: Opportunities for Utilities

Indoor agriculture is focused on providing short shelf life, high-value crops to society. It acts as an augmenter to traditional field agriculture and may help address food availability issues arising from increasing populations and limited farm land availability.

Today, a long list of market participants are interested in indoor agriculture (also referred to as controlled environment agriculture [CEA]). These include utilities, municipalities, technology manufacturers, economic development groups, food distribution companies, and urban planners. Sustainability researchers, water/energy nexus researchers, plant biology researchers, water use researchers, and water quality researchers are also deeply interested in this concept. Factors that are likely to further encourage participation and interest in CEA include:

- Interest in locally grown/farm-to-table produce
- Growing urban populations
- Opportunities to reuse existing buildings
- Desire to create local jobs
- Limited additional land availability for soil-based agriculture
- Issues related to food safety and security
- Concerns over produce spoilage and waste due to long-distance crop transport
- Interest in sustainable industries
- Water management issues (including water use and discharge)

Utility Collaboration with Indoor Agriculture Customers

CEA provides a range of opportunities for utilities, including assisting with the expansion, development, and siting of CEA facilities within their service territory. Utility engagement is important in this process due to the energy intensive nature of indoor crop production, which requires a range of electric technologies to maintain proper thermal, water, and lighting conditions.

Utilities and existing/future CEA facilities are likely to benefit from collaboration. When utilities establish relationships with CEA customers, they can help maintain the viability of CEA facilities by helping to improve operational processes. This, in turn, can lower production costs and increase the likelihood of CEA success. Utilities can collaborate in several ways, including:

- Familiarizing CEA customers with more efficient technologies
- Introducing CEA facilities to other local businesses such as those involved in logistics, food distribution, and food preparation, which deepens the facility's local roots
- Making CEA operators aware of load shifting and demand response programs in which they can participate

CEA may also offer the potential for participating in integrated and large-scale demand-side management programs. This will become increasingly important as generation shifts toward renewable energy. Alliances between CEA operators and utilities also inform the process of facility vetting and siting.

Open communication between utilities and CEA facilities can help utilities understand the load profile and energy consumption of each facility, which can benefit utilities by:

- Aiding utility program rate design and incentive program planning
- Improving understanding of the facility's impact on distribution networks, substations, and ratepayers located near the facilities
- Providing opportunities for gradual infrastructure build-outs and cost sharing plans

Apart from direct utility benefits, a range of community and societal benefits are possible. Most CEA facilities claim a 70-90% reduction in water use over field agriculture and significant reduction in the amount of water used per plant. Much of this water savings results from the capture and reuse of water within the facility. CEA operators typically monitor water use, wastewater content, water discharge, and other water-related issues in their facilities. In addition to water savings, CEA industries also benefit communities by:

- Creating jobs
- Potentially reusing empty structures
- Delivering crops reliably and sustainability
- Addressing food safety and food security issues

Considering CEA Strategically

It's feasible that as more CEAs deploy, they could establish their own load trends, and utilities could consider this strategically. For example:

- CEA can play a role in decarbonization measures.
- Utilities could form market partnerships to leverage the sustainability aspects of CEA and may be able to work with CEA facilities to establish community ties and link indoor agriculture to corporate social responsibility efforts.
- A variety of economic, social, and environmental impacts may result from increased CEA. Utilities need to consider new policy and regulatory constructs relating to safety, health, and the environment that may emerge in the future.

This combination of issues related to utility impact, grid stability, energy use, water impact, sustainability, and community ties means that CEA is likely to remain an evolving opportunity for utilities. For more information, contact EPRI Senior Technical Leader Frank Sharp, 865.218.8055.

The U.S. National Electrification Assessment: Key Recommended Actions

The U.S. National Electrification Assessment (USNEA) highlights many actions that appear necessary to realize the full benefits of electrification. All require research, development, and demonstration to develop and test technologies and to inform policy, regulation, and market choices. The recommended actions examine how alternatives may affect the grid and the energy system. Following is a list of these actions, summarized from the recently-released EPRI USNEA report.

Accelerate Technology Research, Development, and Demonstration

- Cleaner electricity production. Future reduction in the environmental footprint of power generation depends on:
  - Continued improvement of renewable energy, natural gas, coal, and nuclear technologies
  - Increased dispatch flexibility and improvements in storage capability
  - Expansion of sustainable biofuels
  - Development and demonstration of carbon capture and sequestration
- Grid modernization. Grid investment needs to enable the dynamic matching of variable generation with demand, while supporting new models for customer choice and control. Grid capacity planning and operation will need to address the integration of electric transportation networks with the grid through smart charging, fast charging, and storage utilization.
- Continued, rapid advances in electric end uses. Decreasing battery costs, digitalization, advances in materials, and increasing production scale can improve the efficiency and performance of a range of electric technologies. Transformative shifts on the horizon include mobility-as-service models and autonomous vehicles, indoor agriculture, additive manufacturing, and electro-synthesis of chemicals.

Develop New Analytical Tools

- More in-depth efficient electrification assessments. Building on the USNEA starting point, detailed regional studies are needed to gain a realistic understanding of the costs, benefits, and barriers that will drive customer choices.
- New cost-benefit frameworks. New methods for assessing individual electrification projects are needed to support informed regulation and help implement programs that address barriers to customer adoption of technologies.

Expand Focus on Reliability and Resiliency

- New metrics for reliability. Historical concepts of reliability may need to be re-examined as the electric system increases its reliance on variable renewables and just-in-time delivery of natural gas.
- Greater focus on electric system resiliency. The expanding role for electricity in the energy system heightens requirements for resiliency with respect to natural forces such as extreme weather as well as physical or cyber attacks.

Inform Policy, Regulatory, and Electricity Market Designs

- Coordinated, economy-wide policies. The dramatic sectoral shifts projected in the USNEA underscore the value of adopting a broad view of energy policy, rather than addressing issues piecemeal. Broadly considered policies may enable more effective, less disruptive shifts to the energy sector and society.
- Updated energy efficiency codes. A review of energy efficiency measurement and cost tests for appliances, heating, and transportation is needed to remove fuel bias and frame regulations that enable efficient electrification and encourage traditional energy efficiency.
- Facilitated market transformation. Targeted programs–similar to efforts with energy efficiency–may be needed to address barriers to efficient electrification where it makes sense economically and addresses public priorities.
- Electricity market designs to send consistent signals to both the supply-side and demand-side. With new electric supply and demand technologies emerging, it becomes increasingly important to value energy, capacity, flexibility, locational value, storage, and other attributes.

To learn more, download the publicly-available USNEA report. For more information, contact Chris Mahoney, EPRI Communications Manager, 704.595.2653.

Electrification 2018 Conference and Exhibition: The Policy and Regulatory Track

Electrification has the potential to transform the energy economy toward a more efficient, cost-effective, and environmentally responsible future. Informed policy and regulation will be integral to realizing the full potential benefits of electrification. The Policy and Regulatory track at the upcoming Electrification 2018 International Conference and Exhibition will facilitate a conversation about the impact of policy and regulation on efficient electrification.

The Electrification 2018 conference takes place August 20-23 in Long Beach, California and is the first electrification-specific conference in the United States. Participation by government and regulatory stakeholders from federal, state, and local levels will be critical to mapping out the next chapter for electrification.

"As an independent, not-for-profit, collaborative research organization, EPRI is uniquely positioned to convene and facilitate this dialogue among policy decision makers and their stakeholders," explains track lead Deana Dennis, EPRI senior manager of Government & External Relations. "For instance, there are existing policies that could limit evaluation of the full value of efficient electrification. EPRI's job is to perform the necessary research, development, and technology demonstration to help inform those decisions."

As an example, EPRI is advancing an analytical approach to help stakeholders comprehensively evaluate the benefits and costs of potential electrification investments. "EPRI is refining a benefit-cost methodology deeply rooted in decades of energy efficiency practice and adapting it for contemporary electrification applications," explains Omar Siddiqui, senior technical executive in EPRI's Energy Utilization group. "The vision is a rigorous methodology with the flexibility to assess any electrification application under any set of conditions."

Technology continues to advance rapidly through economy-wide applications such as electric vehicles, electric industrial equipment, and battery storage. The year 2018 is a critical juncture for the policy and regulatory framework surrounding electrification. Uncertainties include:

- How can efficient electrification benefit all consumers?
- How can electrification complement energy efficiency?
- What policies and incentives are needed to promote flexible demand?
- How can infrastructure be optimized?

A Sneak Peek at the Policy and Regulatory Conference Track

EPRI's Policy and Regulatory track at Electrification 2018 features five expert panel sessions:

- The Big Picture: Key Policy Considerations for Efficient Electrification–Learn about policy and regulatory challenges and opportunities associated with delivering value to consumers and society through the efficient electrification of end-use applications.
- Charging Ahead: Preparing for Mass Adoption of Electric Transportation–Gain a better understanding of the emerging policy issues surrounding transportation electrification.
- Promoting Flexibility in an Increasingly Electrified System–Understand the policies, markets, and incentives that could promote a seamless integration of efficient electric end uses and cleaner electricity resources.
- Evaluating Electric End Uses in the Context of an Evolving Energy System–Explore how the electrification of end-use applications can be evaluated amid an evolving and dynamic energy system.
- Electrification: The Key to Unlocking Smart Communities? –Examine the role of electrification in increasing the value of smart communities.

These sessions will feature energy government leaders from California, Illinois, Minnesota, and Ohio, representatives from a regional transmission organization and a transportation alliance, and public utility executives. The sessions will facilitate networking opportunities with industry, government, and academic leaders who are eager to collaborate and inform the future of electrification. EPRI encourages you to be a part of defining the future of electrification policy and regulation.

To Learn More

Contact track chair Deana Dennis, EPRI Senior Manager of Government & External Relations, 202.293.7517.

- For information on exhibiting or sponsoring, contact info@electrification2018.com
- Register, view the agenda, see a list of sponsors, view a sponsorship brochure, and more.

The EPRI Incubatenergy Network: Accelerating Clean Energy Innovation and Deployment

The EPRI Incubatenergy Network is a national consortium of 20 leading energy-focused incubators and accelerators that supports entrepreneurs. To date, the network has collectively supported more than 500 companies. These innovative technology start-ups have raised more than $1.6 billion in funding, generated more than $440 million in revenue, and supported more than 3,300 jobs.

Under EPRI leadership, the network is continuing to grow within the United States and is expanding collaborations internationally. The network represents a global source of scouting for EPRI's research programs, helps identify pilot project opportunities, and more. Over the last three years, more than a dozen companies have presented at each of the network's meetings, which were coordinated with the EPRI Summer Seminar. The network supports solutions such as advanced EV charging systems, data analytics and artificial intelligence (AI) applications, advanced indoor agriculture, smart buildings and smart cities, and many others.

Background

The Incubatenergy Network was originally launched in late 2014 with support from the National Incubator Initiative for Clean Energy (NIICE). A U.S. Department of Energy (DOE) grant created this national support network to serve the clean energy small businesses and entrepreneur communities. The goal was to provide critical assistance and training services to bring cleantech businesses and entrepreneurs closer to market readiness.

Through NIICE, DOE has funded two key components: the national organization (Incubatenergy Network) and three distinct regional projects in Austin, Los Angeles, and a partnership between the groups in Chicago and Detroit. In addition to these regional efforts, the NIICE program funded EPRI and the National Renewable Energy Laboratory to operate the Incubatenergy Network.

Engaging with EPRI Members

Several Incubatenergy Network companies have engaged with EPRI members through pilot projects, funding, and other projects. Examples include:

- Atom Power, a solid-state power distribution company supported by incubator CLT Joules, has raised funding from Siemens and has begun work with Duke Energy.
- AutoGrid, an energy internet applications company supported by innovation hub Prospect Silicon Valley, works with several EPRI utility members. It has raised $20 million from Energy Impact Partners and has announced a partnership with German battery company Sonnen.
- ConnectDER, supported by Elemental Excelerator, is operating pilot programs for its plug-and-play photovoltaics interconnection technology with Arizona Public Service, Austin Energy, Con Edison, Hawaiian Electric, National Grid, Salt River Project, and other utilities.
- SparkCognition, an AI and predictive analytics company supported by CLT Joules, recently raised over $55 million from Invenergy and others. They are now one of the leading AI companies in the energy sector.
- Switched Source, supported by Ameren Accelerator, is currently working to deploy a pilot project with Southern Company and other utilities.

Figure 1. The EPRI Incubatenergy Network has international reach. Shown above, the group participates in the November 2017 Accelerate Energy Summit in Shanghai.

The Innovation Track at the EPRI Electrification 2018 Conference

At the upcoming EPRI Electrification 2018 Conference, the Incubatenergy Network is a key element of the Innovation Track, which will showcase exciting emerging technologies. "We're looking at cutting-edge breakthrough solutions for utilities, their customers, and society," explains EPRI technical leader and track chair Beth Hartman. "And we plan to do it with some flair and style."

In addition to a full plate of panel sessions, this conference track will feature 16 companies in a "startup showcase" in the exposition hall, a "Shark Tank" style pitch panel (and reception) of startups with a distinguished panel of judges, and more. There's even a tour available to all conference attendees of the local LA Cleantech Incubator, which includes 60,000 square feet of wet labs, prototyping space, 3D printing, co-working, and more. "We're pretty excited about the range of creative and potentially beneficial technologies we'll be displaying and discussing," says Hartman.

To Learn More

Contact track chairperson Beth Hartman, EPRI Technical Leader, Incubatenergy Network, 720.618.1542.

- For information on exhibiting or sponsoring, contact info@electrification2018.com
- Register, view the agenda, see a list of sponsors, view a sponsorship brochure, and more.

Leading U.K. Electric Power Trade Association Provides Interesting Overseas Insights on Electrification

A leading electric power trade association in the United Kingdom has recently produced an insightful series of reports on "Electrification by Design." The British Electrotechnical and Allied Manufacturers Association (BEAMA) first published its overview report on this series in January 2018 and then produced more detailed reports in May and June on "Energy Storage by Design," "Electrifying Road Transport," and "Heat Electrification by Design."

The overview report points out that the U.K.'s "electric future will mean replacing fossil fuels with electricity on a wide scale, including for transport … and heat in buildings." The report series also emphasizes the key role of various forms of electric thermal storage.

Possibly the Most Significant Challenge: Low Carbon Heat Generation

According to BEAMA, approximately 44% of all U.K. energy demand was allocated to heating in 2011. Natural gas fueled approximately 81% of U.K. residential heating. BEAMA points out that "the future of heating points to widespread electrification."

The number of electric heat pumps installed in the U.K. is estimated to increase from the low tens of thousands in 2010 to 200,000 by 2020. Yet, BEAMA observes that "having a balanced offering of low to zero carbon fuel sources and methods of heat generation is possibly the most significant challenge we face in the drive to decarbonisation and clean growth." The heat generation report describes the technologies necessary to address this challenge. They include electric heat pumps, gas-electric hybrid heat pump systems (in which BEAMA is witnessing substantial growth), smart electric thermal storage (SETS), thermal stores and heat batteries, and electric hot water storage. For each of these, the report lays out likely installation scenarios, benefits, key market barriers, and field case studies.

Smart Electric Thermal Storage

The report emphasizes the importance of storage in U.K. planning and the role that smart electric thermal storage can play. BEAMA describes SETS as a new generation of electric storage heating that is less expensive and boasts 20% efficiency gains compared to traditional heat storage options. SETS systems typically consist of electric radiators for space heating, an insulated thermal mass, and a hot water tank. The system provides electric space heating, hot water heating, and thermal storage in an integrated system. SETS systems enable residential load control using decentralized storage. This can enable storing energy from renewable electricity during peak supply and low demand periods and subsequent use of the stored energy during high demand periods.

According to the overview report, the U.K. is now installing more than 50,000 SETS systems per year. The heat generation report projects that potentially up to 90,000-120,000 homes per year could be retrofitted with SETS systems. Market barriers include lack of consumer awareness and availability of smart tariffs and service packages. In general, the overview report explains that "energy storage technologies will play a key role in the transition to a flexible, optimized system."

Electric Transportation in the U.K.

According to the transport report, the U.K. government aims for almost all cars and vans to be ultra-low emission vehicles (ULEVs) by 2050. In 2017, approximately 117,000 EVs were on the road in the U.K., and ULEV registrations have been increasing rapidly since 2014. To support this transition, the U.K. has installed more than 12,000 public charging ports, including 900 rapid charging ports–which is the largest charging network in Europe. However, the report points out that continued rollout of charging infrastructure "will be a task greater even in scope, importance, and complexity than smart metering, with an even greater impact on the way we use and manage energy." The overview report predicts that reducing charging time to 5-10 minutes (comparable to the time required to refuel a petroleum-fueled vehicle) and achieving parity on range with petroleum-fueled cars are likely to be "tipping points for consumer interest."

This summary article only scratches the surface of the broad range of information and perspectives conveyed in this four-part report series. In addition to discussion of electrification technologies and the technology supply chain, the reports describe the policy and regulatory environment, market development and challenges, motivations and roles of the wide range of stakeholders, potential impacts on emissions, and recommendations for next steps.

ELECTRIFICATION IN THE NEWS

Leading Articles

- The July/August 2018 issue of *IEEE Power & Energy Magazine* contains seven feature articles on various aspects of electrification, including an article on the National Renewable Energy Laboratory's Electrification Futures Study.
- Bloomberg New Energy Finance reports that oil companies are entering the electric vehicle market by purchasing utilities and EV charging companies and are also planning to install chargers at their retail stations.
- The World Economic Forum released a report that describes "How 'electrifying' the energy sector can decarbonize the world."

Other News

- In its "Future of Cities" series, the *Wall Street Journal* describes the potential future pros and cons of autonomous vehicles in cities. The World Economic Forum published its report on "Electric Vehicles for Smarter Cities: The Future of Energy and Mobility."
- GreenTech Media reports that the Sacramento Municipal Utility District is offering large rebates to existing and new homes to install heat pumps, electric appliances, and other electrification technologies.
- A *New York Times* article describes the trend of large businesses and government agencies across the U.S. that are purchasing electric buses, vans, garbage trucks, and more.
- The World Economic Forum published a report predicting that electrified autonomous vehicles will reduce urban travel costs by up to 40%.
- The Toledo (Ohio) Area Regional Transit Authority (TARTA) announced plans to test autonomous buses in the city, using a $1.8 million grant from the Federal Highway Administration.

UPCOMING EVENTS

- Register for Electrification 2018, August 20-23, 2018, in Long Beach, CA.
- July 26: EPRI Integration of Distributed Energy Resources Webcast: Tools to Expedite Interconnection Processes, contact Amy Feser to register.
- Aug. 28–29: GridEd Short Course: Energy Storage Technologies, Applications and Integration, contact Amy Feser to register.

Get Involved

How can efficient electrification benefit you? To learn more or get involved in one of EPRI's programs, contact Jimmy Herren (West), Brian Fortenbery (East), or Kevin East (International).

EPRI RESOURCES

- Report: *Developing a Framework for Integrated Energy Network Planning (IEN-P): Executive Summary* (July 2018)
- Report: *Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge* (July 2018)
- Technology Innovation: *Electricity Reinventing Agriculture: Insights from EPRI's Ongoing Research Into Indoor Agriculture* (July 2018)
- EPRI Journal: The July edition is now available.
- Technology Innovation: *Quick Insights: Bitcoin Mining, Blockchain, and Electricity Consumption* (April 2018)
- Report: *U.S. National Electrification Assessment* report, a recorded webcast of the report release event, and presentations from the report release event (April 2018)
- For access to all of EPRI's efficient electrification-related R&D materials and other information, visit our website.

EPRI IN THE NEWS

- EPRI's Electric Transportation Program Manager Dan Bowermaster was featured in a Q&A interview about transportation electrification in Energy Fuse.
- EPRI's Energy and Environment Senior Program Manager Francisco de la Chesnaye outlined EPRI's recently released U.S. National Electrification Assessment that was presented to the Clean Energy States Alliance. "The main driver of electrification is the transportation sector," he said. "Driven by customer choice, that electrification trend can continue out for a couple of decades," according to Clean Energy Finance Forum.
- EPRI Technical Executive Ram Narayanamurthy was quoted in a Fresno Bee article about a new housing development in Clovis, California that will be the state's largest energy-saving home community. "We want to be able to better understand how zero energy works in a home," he said. EPRI will collect will data for two years on how much power the homes use and when it's used.
- EPRI's Energy Storage Program Manager Ben Kaun comments to an Illinois Commerce Commission briefing were cited in a Forbes article about manufacturers of lithium-ion batteries removing valuable elements that make them worthwhile to recycle. Kaun said that the lack of recycling adds an end-of-life cost to lithium-ion batteries. EPRI assesses the end-of-life cost of batteries in a report published at the end of last year.

About EPRI's Efficient Electrification Initiative

"Electrification" describes the adoption of electric end-use technologies. EPRI's Efficient Electrification Initiative explores electrification in the context of the global energy system, analyzing the customer value – lower cost, lower energy use, reduced emissions, improved indoor environment, and increased productivity – provided by advanced, end-use technologies that efficiently amplify the benefits of cleaner power generation portfolios. Coupling EPRI's modeling capabilities with extensive research on end-use technologies and grid operations, the initiative also will assess interdependencies among increased adoption of efficient electric technologies, their potential to provide enhanced control and flexibility, and their impact on grid operations and planning.

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