RESEARCH | Commercial Lighting's Role in Automated Demand Response Programs

By Cori Jackson

After nearly two decades of support and research focused on automated demand response (ADR), lighting remains underutilized as a demand response resource. Beginning in 2007 with the publication of the first open standard dedicated to ADR connectivity and communication (*www.openadr.org*), research and development efforts have resulted in a myriad of products and strategies designed to promote and advance ADR; however, recent studies demonstrate that commercially available, lighting-specific ADR products remain sparse. How can we increase these options and tap more lighting systems for actual ADR program participation? This article provides insights and recommendations for increasing the demand for automated demand responsive lighting systems.

First, let's discuss the reasons why lighting is underutilized in today's automated demand response programs. ADR programs are, at their core, utility initiatives designed to encourage reduced electricity use during periods of peak electricity demand or reduced availability. Most major utility programs that incentivize customers to participate in automated demand response programs do not promote small loads as a potential ADR resource, and few meaningful incentives exist to encourage customers with small loads to participate in ADR. A review of California data shows that the average size commercial building, regardless of occupancy type, requires 50 kilowatts or less for lighting (**Figure 1**).

According to ASWB Engineering, a major utility ADR program provider, ADR projects are primarily driven by ADR equipment vendors and contractors, who are focused on large commercial and industrial loads. Based on their experience from more than 4,000 ADR projects completed across California, roughly 2 percent utilized lighting exclusively to meet ADR program requirements and almost all of that 2 percent came from one large chain retailer who implemented bi-level fixture switching to meet reduction goals. The remaining projects utilized HVAC or large industrial process loads. Vendor products are targeted at these loads, because utility incentives are based on demand savings. Large loads lead to large incentives, which can buy down the cost of ADR equipment. Similarly, contractors and energy service companies are interested in projects with the highest electricity and demand savings because they are paid from those same utility incentives. For these reasons, states ASWB, lighting takes a back seat, and few, if any, lighting projects end up as part of a customer's ADR program.

REGS CAN DRIVE ADR

ADR is not just a utility company construct. In California, regulatory and policy guidelines clearly call for increasing ADR as a means to achieve energy and environmental savings goals. For example, in 2015, the California legislature passed Senate Bill 350, the Clean Energy and Pollution Reduction Act, which establishes a goal of doubling cost-effective energy efficiency savings in electricity and natural-gas end uses by 2030 in order to help meet greenhouse gas reduction goals. It also requires the California Public Utilities Commission and the California Energy Commission to increase grid reliability by, among other actions, increasing the use of "demand response, including, but not limited to, automated demand response." However, many believe that California's current Building Energy Efficiency Standards, which are a practical implementation mechanism for these goals, are insufficient in their requirements pertaining to ADR. Current standards require automated demand response controls for only certain lighting systems and thermostats in commercial new construction and some alterations, and they stop short of calling for compliance with any specific industry standard for ADR communication and connectivity.

According to Craig Ochoa, the lighting and controls manager at Morrow-Meadows Corporation, a large electrical and datacom contracting and engineering firm, the fact that regulators have yet to specify the single, uniform, standards-based "Demand Responsive Signal" alluded to but left

undefined in the building standards is directly inhibiting adoption of lighting ADR. "Most major networked lighting controls manufacturers whose products and systems we specify, engineer and install have a solution for implementing ADR on the output side (reducing networked load), whether through integration with the building automation system or a simple contact-closure type interface," he says. "Absent clarity on the input side and without a standard sequence of operations, building owners and operators, as well as those in the design, engineering and contracting realm, are left without clear direction. As such, installed systems are rarely optimized for ADR, which exacerbates the skepticism around specifying them in the first place, further diminishing adoption."

Manufacturers echo these same concerns, which have limited their investment in ADR lighting solutions. Due to the lack of both meaningful incentives and regulatory drivers, lighting system manufacturers simply do not provide automated demand response solutions for use with their lighting control systems. "[Code] compliance can be achieved inexpensively with a limited demonstration of the viability of ADR, which is far removed from functional deployment of ADR for lighting throughout the building," state Philip Hall and Carol Jones of Enlighted, a digital lighting controls company. "Knowing this, most lighting manufacturers are not sufficiently incentivized to develop ADR features."

ROI QUESTIONS

From the manufacturer's perspective, ADR is an advanced feature that requires a networked or connected lighting system. Historically, lighting controls did not have large market penetration, so the R&D investments needed from manufacturers to add features like ADR were not well justified with a meaningful return on investment, according to Hall and Jones. On its own, they say, ADR still doesn't have sufficient promise of ROI for most manufacturers due to market barriers such as limited regional utility program coverage and utility program complexity.

Given these challenges, where do we go from here and how do we get there?

First, stakeholders must continue to drive advances in technology, policy and education that will enable cost-effective, widespread deployment of automated demand response. Erin Malcolm-Brandt with the Center for Sustainable Energy explains the education gap well. "ADR is a critical tool for achieving grid stability and meeting California's energy efficiency targets … ADR equipment and communications standards have evolved significantly over the past 13 years. Despite these advances, there continues to be a dearth of training programs to prepare a workforce capable of installing and maintaining ADR equipment, resulting in poor installations and faulty

Building Type	Average Size (ft^2)	Average Lighting Load(kW)
Food/Liquor	6172	6.4
Health/Medical - Clinic	4812	5.6
Office	9930	9.9
Retail	6877	8.0
Restaurant	2646	2.9
School	47712	50
Warehouse	28817	11
Other	6001	5.5

Figure 1. Source: California Commercial Saturation Survey Report, 2012.

commissioning of systems."

In addition, according to Malcolm-Brandt, the deployment of ADR in small and medium businesses (SMB) is critical if California is to meet the full potential of this technology. Participation of SMBs in ADR programs is hindered by both (1) a lack of understanding amongst contractors and utility customers of the ADR programs offered by the utilities and (2) inadequate technical support resources for project implementers targeting SMBs.

To help expand both the pool of qualified ADR technicians and the number of SMB participating in ADR, CSE is leading a four-year training program funded by the California Energy Commission to support the adoption and proper installation of ADR technology. Electrical apprentices from disadvantaged communities will have access to both classroom and on-the-job ADR training at eight Joint Apprenticeship Training Centers throughout California.

The program will also accelerate the installation of ADR communications equipment by recruiting and enrolling owners of 200 small and medium buildings and public facilities in disadvantaged communities into utility ADR programs. Electrical contractors and building owners participating in the program will receive technical assistance to support the ADR equipment installation and incentive program enrollment.

Second, building regulations must better align with real-world ADR implementation requirements. In California, ADR solutions must follow the OpenADR standard for connectivity and communication with utilities. Under the standard, there are Virtual Top Nodes (VTNs) and Virtual End Nodes (VENs), two types of points that must link to enable demand reductions during ADR events. The VEN resides with the customer, while the VTN resides with the utility or ADR program provider. In California, utilities utilize a VTN called a Demand Response Automation Server (DRAS) for communicating demand response events to customers. Customers must install an OpenADR-compliant VEN to link with the utility DRAS in order to participate in ADR programs. Under the current regulatory framework, lighting systems and thermostats can comply with Energy Standards requirements for demand response controls, while containing no OpenADR-compliant hardware or software to enable its practical implementation.

Few meaningful incentives exist to encourage customers with small loads to participate in ADR

THE PRODUCT PIECE

Currently, there are 128 products listed as OpenADR-compliant according to the OpenADR Alliance, which supports the OpenADR protocol and associated initiatives. Of these 128 products, only six are offered as part of a lighting control system or marketed toward lighting control systems. Of the six offered, only one includes an OpenADR-certified VEN as a native, default feature of the lighting control system. One other offers the VEN as an optional feature upon request and with no additional charge. Three additional lighting system manufacturers offer non-native or stand-alone components for use with their lighting control systems to enable ADR, which must be purchased separately. The remaining ADR-compliant solutions are integrated in larger building or energy management systems, or marketed for use with non-lighting loads such as HVAC, industrial processes or electric vehicle charging stations (**Figure 2**).

Stakeholders recognize the disconnect between requirements for demand responsive lighting controls contained in California's Building Energy Efficiency Standards and the real-world requirements set by utilities for participation in their ADR programs. Groups, including the newly formed California Energy Alliance (CEA), are working on proposed updates to these requirements, which have been submitted to the California Energy Commission for consideration in the 2019 Building Energy Efficiency Standards. CEA recommendations include explicit requirements for compliance with the national OpenADR 2.0 standard to better ensure installed control systems are ADR-ready upon installation.

Last, utility programs must improve their efforts to tap the 60 to

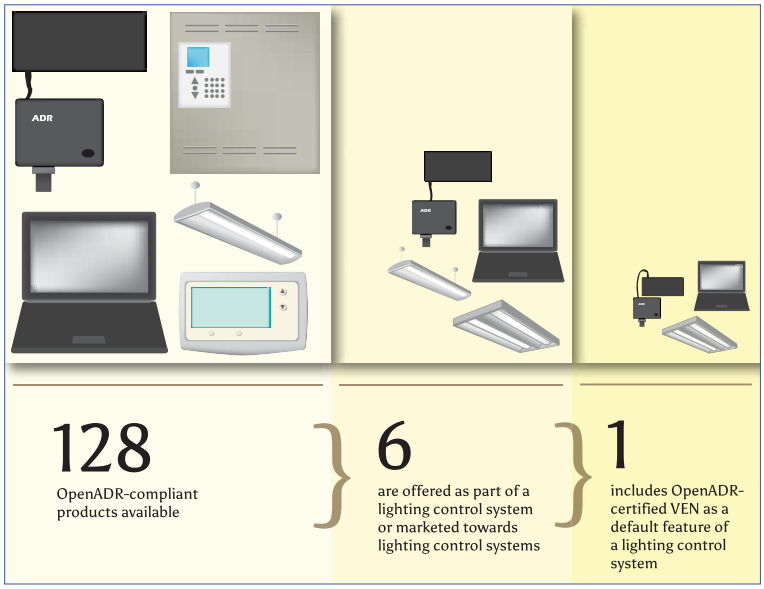

Figure 2. OpenADR-compliant solutions.

90 gigawatts of estimate lighting demand available nationally for use with ADR. Targeted incentives and programs for lighting ADR that are based on realistic lighting demand savings targets coupled with sufficient financial incentives will increase customer participation in ADR programs and increase manufacturer investment in ADR solutions, bringing down costs and increasing deployment.

Some utilities are beginning to recognize this need, but standard incentive mechanisms are still insufficient to encourage owners to participate in lighting ADR. According to Energy Solutions, an engineering services firm that supports utility ADR programs, one utility doubled its standard ADR incentive in a targeted effort it believed would overcome the additional first cost associated with ADR lighting controls. Two lighting manufacturers became approved for the higher rate but did not end up completing ADR projects. States Energy Solutions, "The higher incentive rate was still not enough for vendors to complicate their sale with a discussion on demand response."

Multiple market-based research efforts are underway to quantify the real costs and benefits of lighting ADR to support utility efforts to set an effective incentive. The California Lighting Technology Center, in partnership with Southern California Edison, is working on quantification of market potential, costs and technology demonstrations of viable ADR solutions for its small commercial customers.

Lawrence Berkeley National Laboratory and Energy Solutions are also working together on a CEC EPIC-funded project to quantify the value proposition of implementing code-compliant, DR-enabling lighting controls for various non-residential building retrofits including the energy and non-energy benefits.

In addition to supporting research, there are things that utilities can do today to improve ADR program enrollment. ASWB Engineering recommends that all utilities transition to use of the OpenADR 2.0b standard. The 2.0b standard enables better reporting of actual load shed, resulting in financial benefits for the customer facility, and allows customers to substantiate their ADR investment. Targeted outreach and on-bill financing of ADR equipment and installation could also improve ADR adoption.

Lighting is a fast and reliable ADR resource when systems are properly equipped and commissioned. Researchers, manufacturers, specifiers, utilities, contractors and regulators all must align to close the gap between the concept of lighting ADR and the practice of ADR. By taking a few simple steps such as explicit specification of an ADR industry standard in the building code, or targeted utility lighting programs with aggressive program incentives, lighting has the potential to become a widespread demand response resource.

THE AUTHOR

Cori Jackson is the program director at CLTC.