WESTCOAST LIGHTING INSIDER

DC Lighting: Empowering Our Digital Future

by Lois I. Hutchinson | Aug 21, 2018 | WCLI Feature Article | 3 comments

LEDs are innately DC, so DC power for LED lighting is natural fit. But with a wide variety of

system configurations and lack of standards – or is it too many standards? – DC lighting faces formidable challenges from 100 years of AC infrastructure. Even where system intelligence benefits energy managers and the grid, it will likely take another decade for the advantages of DC-powered lighting and appliances to capture the construction industry.

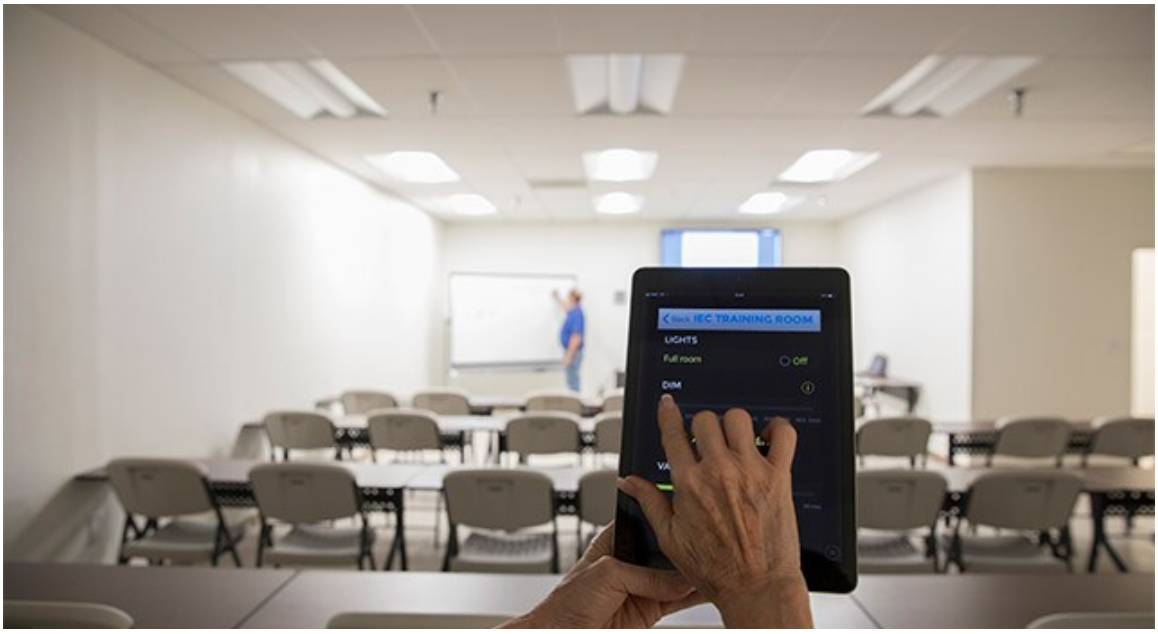
Innovation and lower cost are driving the DC lighting market; whether they're easy-to-install, low-voltage "dumb" distributions of luminaires or IoT-enabled systems comprising luminaires, sensors and more on a connected load-balancing microgrid. Removing the AC driver from the luminaire and directly powering LED fixtures with DC reduces the drivers' 10-15% in energy losses and eliminates a common point of failure. Stephen M. Frank, a senior systems engineer in Building Energy Sciences at the National Renewable Energy Laboratory (NREL) cited DOE's picture of our digital future: due to increased use of variable-speed motors, personal electronics, computers, electric vehicles and energy storage, electricity flowing through power electronics is expected to increase rapidly. By 2030, an estimated 80% of all US electricity is projected to flow through power electronics. DC lighting also overcomes problems with poor power factor in drivers, which can waste significant power (though the user does not see this in their electric bill) and limits the capacity of lighting circuits.

Grid-tied DC lighting systems offer the advantage of a single AC-to-DC transformer per system – small or large. Even with low-voltage DC power distribution systems, LED lighting boards still require a current regulator at the LED board. But DC-to-DC transformations generally incur about half the losses of AC-to-DC, according to Frank. He warned that actual savings compared to AC varies widely with system design and the installation. A topic he is exploring at NREL.

Salk Middle School in Spokane, WA, uses a drop-down linear fixture powered on a DC lighting system from JLC Tech. Lines of light integrate well in unconventional ceiling grids; design by NAC Architecture.

Several systems that integrate DC lighting into grid ceilings are seeing early success. USAI Lighting and Mark Lighting, among others, have partnered with Armstrong to run fixtures off a DC-powered rail that is part of the ceiling grid. JLC Tech replaces selected cross tees in ceiling suspension systems with ½ or 1 inch lines of light in orthogonal patterns or staggered designs. “Unlike most linear fixtures where you need to modify the ceiling in some way, we’re more of a lit building element,” said Jeff Corvese, product development manager. A few different fixture types (including lensed, RGB and a drop-down, indirect fixture) are compatible with several 24V DC distribution systems; they also market their own dimmable DC distribution system.

Low-voltage wiring to the luminaires does not require a licensed electrician, which can save on the initial installation and in reconfiguring lighting. Mike Lunn, director of product marketing for Eaton’s Lighting Division described increased interest this year in their DLVP (Distributed Low-Voltage Power System) lighting products. Eaton promotes the system as Title 24-compliant and easy-to-install: a 20% savings in materials and 40% in labor. An electrician is needed to connect the DC distribution module, but after that, technicians or facilities personnel run low-voltage wire and install the luminaires and other system components. “It’s plug-and-play from the standpoint of, as you connect those loads and connect the switches, occupancy sensors and plug loads, the system actually knows how to operate,” he explained. The low-voltage wiring powers loads and carries control signals comparable to a conventional, addressable wired or wireless lighting control system. The huge DLVP retrofit at H5 Data Centers in Denver (pictured at top) used Metalux pendants to upgrade from an AC fluorescent system – installed in 1 day.



Audacy has partnered with Armstrong to layer their advanced wireless controls system (DLC-listed) on top of the DC distribution system. Audacy also acts as integrator, installing small systems currently, but with the capacity to scale up with multiple gateways on their proprietary cloud-based controls platform. Their primary pitch is flexibility to not just quickly rezone lighting and controllers, but to quickly and easily change out and reposition fixtures as occupant preferences and space use change, according to Nolan Bello, business unit manager for advanced wireless solutions. Audacy's YouTube channel shows a good (albeit promotional) overview of one system installed in Boston. In Phoenix, two classrooms at the Independent Electrical Contractors Association of Arizona use an Audacy set-up to train technicians in both DC lighting and advanced controls. Low-voltage DC power is inherently safer in terms of burns and shocks. But according to Bello, falls from ladders can also be reduced: contractors often report falls after being startled by a spark from line voltage.

Eaton provided these wiring schematics of a conventional AC lighting system layered with a low-voltage lighting controls system; versus power-and-control DC wiring.

DC lighting: wired for connectivity

Low-voltage DC lighting also opens the door wide to data gathering to better leverage lighting controls, energy management and building use. "The bigger picture there is, as you get into more sophistication with the control you get more automation," explained Frank. Automation can maximize energy savings and serve end-users – and it requires power

electronic circuitry.

The Power over Ethernet (PoE) platform provides a strong US standard for DC lighting and scalable, adaptable connected lighting. “Power over Ethernet is the only standardized method to have intelligent lighting brought into a new building, from a wired solution standpoint. And the key piece is the E, the Ethernet,” explained Randy Jones, engineering manager – new product development and connected lighting solutions for H.E. Willliams. The Ethernet data communication protocol has been in use since 1980, evolving faster transmission speeds over the decades. Since accommodating power transmission in 2003, the protocol has increased to 90W DC, maintaining Ethernet’s reliable, plug-and-play automatic handshake and interoperability.

Because lighting is generally powered and distributed throughout a building, PoE lighting permits multiple – previously siloed – building systems to be wired on the same network: HAVAC, lighting, life safety, security, AV, telephony, etc. “It makes for great efficiency from a project standpoint: project costs both in the materials and installation,” said Jones. “Because one low-voltage contractor can now get above the ceiling and layer in this low-voltage distribution, which is Ethernet cables, versus say eight or ten different contractors.” Wiring standard practices are well established, and building systems are customarily isolated from valuable business data networks.

These project cost savings begin many conversations with owners about data collection, energy management and out-of-the-box value propositions. “When we talk about big data, there is no generic answer. You’ve got to look at it case by case, customer by customer, and type of business by type of business to say how much data you need to gather and what you can do with it,” Jones added. He emphasized the importance of occupant feedback over AI in evaluating the effectiveness of connected lighting systems. He describes the capabilities of PoE as comparable to wireless connectivity with AC-powered lighting, but called out PoE for higher reliability. “If I can wire it, I’ll wire it every time versus wireless. And that’s not coming from me, that’s coming from 80 to 85% of the specifying engineers that we’ve been working with over the past 3 years.”

Microgrids: for resilience

Solar power and improvements in battery storage are driving experiments with microgrids. Microgrids are characterized by their ability to operate completely independent from the grid, or to isolate and continue operation during a grid failure. Currently, the vast majority of US solar power installations do not have batteries and will not power loads during an outage. Even a with an LED light just a few feet away, solar power must convert to AC to feed into the grid and then incoming grid power must convert back to DC to power the

light. Complex, intelligent DC microgrids balance loads, generation and battery storage within a building, factory, campus or neighborhood. Microgrids curtail loads and dim lighting on a DC bus (often imperceptibly); draining and charging batteries according to the variable supply from solar panels. Such systems can also support grid stability second-by-second, according to demand response signals from the utility.

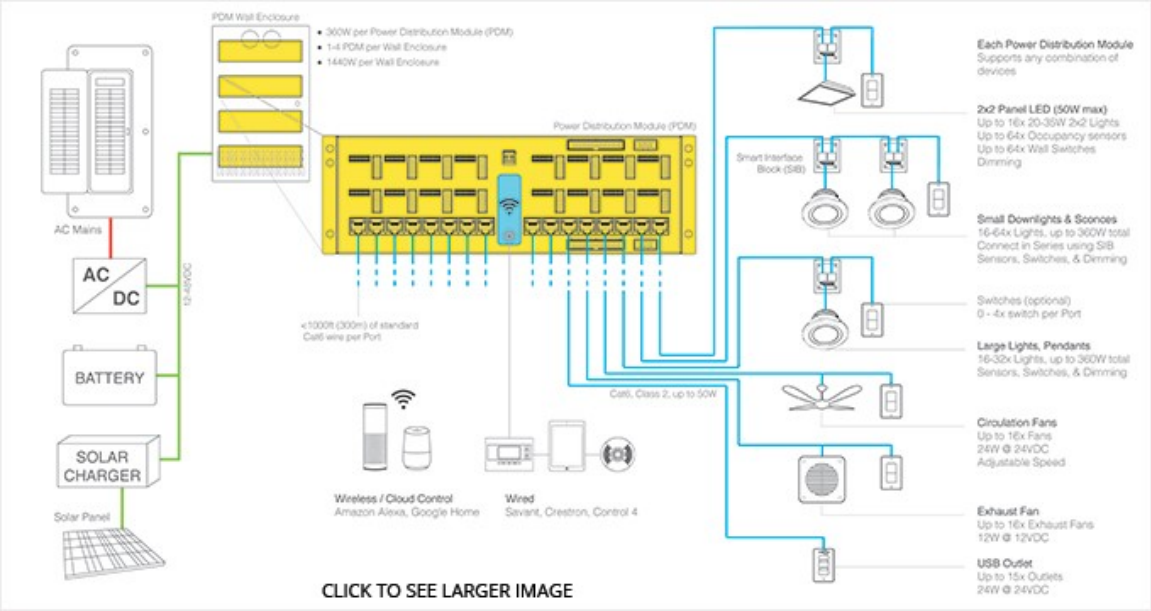
Resiliency in the face of natural and manmade disasters is a prime benefit: the ability to power computers, lighting, communications, and critical operations loads eliminates downtime in a grid outage. (Outages are less of an issue in the mainland US than in developing regions; off-the-grid DC solutions are ideal in unelectrified regions.) Given sufficient battery storage, backup generators and their maintenance are eliminated: backup and standard operating systems are one and the same.

Honda recently deployed a microgrid at their campus in Torrance, CA. A large solar array there and 546 kWh battery feed a 380V DC microgrid by Bosch. This connected system (powerline communications) operates 300kW in lighting, ventilation fans, forklift charging stations and other loads in the facility. Back East, the American Geophysical Union is renovating their net-zero headquarters (ironically, in Washington, DC), where a DC ceiling grid will power lighting and DC desk loads, including monitors and laptops and USB task lighting.

The nonprofit Alliance Center in Downtown Denver employs a small DC microgrid powering some lighting and desktop loads. This demonstration project provides real-world data for researchers, according to Jason Page, director of operations. “The technology is just not mature yet. Hopefully, demonstration projects will reduce the barriers to entry and increase the options on the market. Fortunately, we’re seeing a lot of interest, which indicates demand. But in terms of supply of product, that’s what needs to come.” It is a big lift to move an entire industry and thousands of lighting manufacturers away from the AC standard. (Note that the Alliance Center recently deployed DC fast charging for electric vehicles [EVs] – a natural application for solar power. However, their solar plant is too small to support EV DC fast charging.)

“Most people will say the problem with adoption of DC lighting is the lack of standards,” says Derek Cowburn, founder and CEO of LumenCache. “The opposite is the problem. There’s lots of standards. There’s too many standards already, and they’re evolving. So builders don’t know which one to pick. So they just put in old AC.”

The LumenCache platform supports smaller “nanogrids” for residential and small commercial applications. These systems offer low-voltage installation savings and resilience, balancing renewable energy and powering lighting and many types of DC-native plug loads, e.g., appliances, WiFi repeaters, etc. Distribution modules can be networked with wired or wireless home controllers, including a demand response feature. The LumenCache gateway is designed for upgrades in communications protocols and accommodates different ISPs and global standards.



“We think there will be technologies allowing us to increase power over Cat 5. And we know that because the same thing happened with data and data compression,” Cowburn postulated. “You can take a reasonably good bet to say that power can do the same kind of thing. That’s exactly what we’re doing. The DC world is digitizing power.”

About the Author | Latest Articles

About Lois I. Hutchinson

Lois I. Hutchinson is a freelance writer specializing in lighting and energy issues. She is also the content marketing mastermind behind Inverse Square LLC, a Los Angeles–based consultancy. Contact her via lightinginsider@exponation.net with your comments and any article ideas that concern the lighting community here in the Southwest.

Comments are subject to approval.

3 Comments

Pam Stuckey on January 7, 2019 at 3:17 pm

Reply

We have a public art sculpture, with solar power in the design, installed in Las Vegas. We will have the unveiling in February.
Can we add anything to the box in the pedestal (solar panels on top, wiring runs through the sculpture, connected to the battery, a small electrical board in the box in the pedestal)?
The LED lights in the pedestal will be powered by the solar energy stored in the battery.
Without a network or AC power can we connect with a router to some app to tell us how many kWh produced and used?

Jeff Harris on August 28, 2019 at 12:12 pm

Reply

Hi Pam, I may have a solution for you. See link below

https://illumadrive.com/cense/

Jeff Harris on August 28, 2019 at 11:36 am

Reply

Great article Lois. The shift from electrical to digital systems, and the emerging low voltage power options to supply them,

may be the biggest change the electrical industry has seen in the last 100 years! At iLLUMA-DRIVE, we develop Digital DC Electric technologies that provide real “behind the meter” consumption strategies and many new opportunities for the electrical industry today and for tomorrow.

CENSE is the first product in our roadmap. CENSE is a Low Voltage, modular DC power distribution system. It can directly power with Low Voltage, any LED light or fixture using our LM1 module, eliminating the need for in-ceiling or internal drivers. CENSE can provide intelligent control, IoT connectivity, dimming and advanced functions using wired switches or wireless switching through our integrated wireless capabilities using switches and sensors.

The iLLUMA-Drive platform isn’t limited to specific applications. Save on lighting and installation costs, or go off-grid in your manufacturing plant, healthcare facility, recreational vehicle or in your home. Our solutions are the key to real off-grid consumption and our renewable future.

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