

EMERGING TECHNOLOGIES SHOWCASE WEBINAR: COMMERCIAL LIGHTING: THE 10 YEAR OUTLOOK

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Question and Answer Session

Q: What do you feel will be the wattage impact of the added features and functions of these connected products

A: In order for a lighting system to be alert and aware and talking to everybody all the time, it needs electricity. One guideline I heard is that the Energy Star limit for each device in the off state is one Watt, and it might go down to ½ Watt. How much less than one Watt depends on the communications protocol – a WiFi device uses a lot more power than a protocol designed for low power, such as EnOcean or Bluetooth Low Energy. One Watt or less continuous per device is pretty small, but might be noticeable in a high performance building.

On the other hand, if smart streetlights pave the way for a future where there's a metered EV (electric vehicle) charging port on every downtown light pole, that's a huge new load that will dwarf any prior baseline from lighting. That won't happen overnight, because most light poles aren't wired for that large a load, yet. But the basic idea is: who knows what new functions might be added?

A: Are the standards being developed in conjunction with lighting manufacturers?

Q: Yes. The development process that I'm most familiar with is the NEMA/ANSI committee which is a committee of manufacturers. Gabe Arnold from Design Lights Consortium (DLC) and Michael Poplawski from Pacific Northwest National Laboratory (PNNL) are leading the committee but the members are mostly manufacturers. That particular standard, which has a goal of describing performance metering, actually needs more input from utilities. In terms of other standards, the answer is yes, I think it varies by standard. TALQ is a way to get streetlights to work together. If a city puts in a streetlight control system and five years later they want to add some new streetlights, they'll have a choice of different products they can add. That is driven by the manufacturers. As far as I know, most of the standards are driven by manufacturers. The question is how the utilities are going to get in on the game.

A: Are there currently any manufacturers working on an "open" standard that could be used by other manufacturers? Or does the market currently consist of as many proprietary standards as manufacturers?

Q: Orama has an LED driver standard that's being developed. Their first goal is to have a few partners but then expand more broadly after that into an open standard. A lot of manufacturers use ZigBee in a proprietary sense. I believe there's a new LG driver that implements the complete ZigBee series so it can be more of a multi-vendor product. Daintree is close to being multi-vendor. Many of the parts of the Daintree system are open to multiple vendors. That's a great question for Gabe.

Gabe Arnold: I'm with Design Lights Consortium leading up this CALC project which has many different components, one of which is to attempt to address this very important issue that Levin has raised for the need for open industry standards. We've got a challenging situation. Right now there are a number of competing or overlapping standards and activities. At least now, you can't pick which will be the winning standard at the end of the day, which one will be enabled at a large enough scale in the future. Levin talked about a couple standards out there for communication, ZigBee being one of them. There are a number of others that are also in that space and even additional ones that are being developed. At the end of the day, for this to be successful, the effort needs to be led by manufacturers. All we can do as utilities is to try to push manufacturers in that direction. Try to support the efforts that are underway, to try to get industry on the same page. It's a challenging undertaking. One of the things that we're going to try to do through the CALC project is to collect info on all the control systems out there. We'll be collecting info as to what standards they comply with, what standards are open standards, whether there is a certification and compliance process for the standards. We hope to provide marketing and education and potentially incentives for standards that comply with the open standards. That's one tangible thing that the programs do, so it will take some time.

I also want to add a little bit of information around the NEMA/ANSI c137 standard. ANSI is what's called a standard development organization. The c137 committee is the lighting systems committee, a newly formed committee to develop standards specifically for lighting systems. The committee recognizes that the industry is changing from components to systems. They've organized themselves into different subcommittees to explore and potentially pursue different standards. I and Michael Poplaski with PNNL are co-chairing an effort to develop a standard specifically for energy reporting. This standard would be for the accuracy, precision, frequency, format of data, and potentially the communication of data from the energy meters that are going to be incorporated into the luminaires and devices. We're already seeing some of that and Levin talked at length about the reasons that should be very important to us with energy efficiency programs. We have received initial approval for the full c137 committee to continue to move forward and develop a draft version of that. We're potentially facing a lot of challenges getting manufacturers to support and adopt. Nonetheless this is a very key and important component of the future that Levin described. We're going to be doing all we can to try to make it happen.

Q: Is IES (Illumination Engineering Society) involved in the development of Open Standards along with NEMA and DLC?

A: Gabe: not with this particular topic. It's got to be something that's led by industry. The efforts that we've seen that are underway are being done by industry consortiums.

Q: In the absence of an existing open standard, how might you suggest utilities incentivize performance metering?

A: Gabe: We are working on an answer to that. There are a few early programs at SMUD, Efficiency Vermont, ConEd, MassSave, and others. The CALC program is developing a program guideline for a national pilot program next year. A few general guidelines are for programs that are easy to administer and that tend to pay a certain amount of money upfront per kW per square foot. Most construction projects do things in square feet. If you can pay a certain amount per sq ft to say that this building will have a lighting control system in it, then that's easy for construction folks to deal with. The performance metering comes next. You pay a certain amount of money upfront just to have the lighting control system, and then it will start generating reports about energy use. In the absence of a clear standard, you can still ask for, say, a quarterly report or an annual report of energy use. When advanced lighting control systems are installed, some of them come with a warranty where they run quarterly energy reports over the first year to see what they're doing. The utility can ask for these quarterly reports to see how the system actually performed. And then an additional incentive could be paid, based on the kW hours saved. The details of how to calculate that kW hours saved gets complicated, and that's something that CALC is working on. I think the main answer to that question is: stay tuned in with DLC CALC as they roll out components of their new program that utilities can adopt.

Q: How accurate does the performance metering need to be? How easy would that be at the individual luminaire level?

A: The c137 committee will debate that big question at length. On the one hand, are you trying to do better than you do now, which is to ask people how often the lights are on, and then take a rough guess at how much energy is saved? Or do you really need accurate energy reporting comparable to an electric meter, or is it okay to have a little bit more error, perhaps plus or minus 2 or 3% error, which is still a lot better than guessing. That's an open question.

Q: How would performance metering work? The fixture will not know the previous lighting technology. And when will we start to see fixtures/luminaires be available with the open standards & performance metering?

A: Gabe: I'll answer the second part first. There are already some systems available with performance metering built in. We'll see more and more of them over time. It's still going to be a few years before we reach the point where we've developed open standards that define how that metering should be done, the information to collect, the accuracy, the precision, and the format and products to comply with them. There is a lot of opportunity in the near term to experiment and it's important to get some experience with this. But it's still a few years out before we scale up.

The first question, I believe, was how it would work if the meter doesn't know what lighting was there before. This is a very good question. That's always going to be an issue. You may need to have other methodologies to determine the savings vs a prior existing lighting system on a retrofit project. I do think we will be able to use this method to determine savings vs a code baseline. I think that we can use the methodology to give us some assumptions to use in a simplified calculation. One of the key things it will be able to tell us is how much we are saving from the controls in particular. That's the area where there are a lot of unknowns and we're making a lot of wild calculations. It will also give us really good data on operating hours. That's the other big variable piece. The existing wattage and the proposed wattage are things that are pretty clear and we understand them well. We will potentially be able to use the metering results from these systems to check assumptions of what we're getting from controls and what the operating hours are and the kind of use, along with the known wattage change from the luminaires and estimate savings.

Q: What should we consider concerning Cyber Security? What about security of data from PM?

A: That's an important topic. The wireless protocols vary a lot in terms of the security level. For instance, there are some concerns with ZigBee vs Wi-Fi where Wi-Fi has more layers of security and is less likely to drop security protocols when network traffic is too heavy. This issue does not concern only lights but all kinds of things that become networked and start talking with each other, especially the wireless ones; but with wired devices, security is also an issue. It's about the whole internet of things.

Gabe: There is a c137 subcommittee that's been formed specifically to address the issue of security with lighting systems. The good news is that the industry has recognized this and started the work to develop standards in order to deal with it.

Q: Utility incentives for non-energy-saving benefits? Is this kind of like paying people to eat ice cream ... when the utility doesn't serve ice cream?

A: Thanks for asking that question so I could clarify. I did not mean to say that the utility would pay for non-energy benefits. What I meant to say is that people will buy new lighting systems for non-energy benefits. In addition to getting 10 different non-energy benefits, they are hopefully also saving some energy. The utility still has an interest in that purchase because the system saves energy. And the utility has a particular interest in encouraging people, when they're choosing among different products, to choose the one that saves energy over the 3 or 4 others that do not save energy. There may be so many non-energy benefits that people don't notice the energy savings anymore. Utilities care about this because right now lighting systems use a lot of energy. If we stop paying attention, lighting systems might keep using a lot of energy. If utilities help steer the market to help all these non-energy benefits happen, then that will transform the market as a whole and energy savings can occur in the process.

Q: What are other customer segments and example applications where smart lighting would demonstrate significant non-energy benefits?

A: One is in hospitals. There is a lot of research about circadian rhythms, for instance patients getting out of the hospital quicker when their room is on the east side of the hospital with a good window catching the morning sun. Learning how to tune the lighting system for the color and intensity and even placement such as the ceiling or the wall will be very valuable in setting up appropriate lighting in hospitals. Another is in schools, where people are starting to play with the color and brightness of the lights, to support high concentration at some times, and relaxation at other times. Those are two examples. I would say over the next 10 years, most lighting applications will start to see some aspect of this.

Q: What are some examples of non-energy costs or negative impacts of smart lighting?

A: The main difficulty is that smart lighting systems are confusing. The reason that the market has not taken off yet is that they are hard to specify, hard to install, hard to use, hard to figure out three years later after the person who knew how to run the system got a new job. They are just difficult. I think that will continue to be a huge barrier until new products become more plug-and-play and easy to use. As far as I know, we're not there yet. The Lighting Research Center has been looking into the newer systems and I think we're getting close but that's the biggest one that comes to mind, they're just hard to deal with at the moment.

Q: Regarding incentive sunsets, it seems like a regional strategy is preferable to one-off decisions. Are you aware of anyone monitoring this from a regional perspective?

A: I believe NEEA would be the place where that discussion would happen. Does anyone from NEEA want to comment? That's the question I know the least about.

BJ Mogadam at NEEA: NEEA is not currently involved in efforts to coordinate regional sunseting of incentives. Please direct questions about regional efforts related to open standards to Debbie Driscoll, ddriscoll@neea.org.

Q: Have utilities begun to explore how lighting reductions can be used to sell demand response (DR) to the utility when needed by the utility to help the utility avoid transmission and distribution infrastructure upgrades? Would a utility be willing to have a standard offer contract whereby the utility could send a customer signal to dim nominated lights upon the signal – and once the customer's lights dimmed, the customer would receive a bill credit?

A: There are demonstration projects that connect lighting systems with DR. I believe the programs are fairly advanced in other parts of the country. There are several DR demo projects that BPA is involved with, but I'm not sure if BPA is doing any specifically on lighting control systems. Nationally the answer is yes, that is definitely happening. I don't personally know of anything local at the moment but it's definitely possible.

Q: Is performance metering being considered for smart appliances? Is there anything we could learn from work in that area? Could we coordinate on a common approach?

A: That would be the holy grail. If you could get clothes dryers and washing machines and water heaters and dishwashers and thermostats and lights all talking one language. At the moment in the residential home energy space, a lot of things are proprietary. Once you buy an appliance from one manufacturer, that may mean that you're tied into buying your other appliances from the same manufacturer. Or you may need a universal hub so then you can talk to more things. It's really complicated at the moment. But yes, that would be ideal, if the idea of performance metering could extend beyond lighting and somehow be compatible with other appliances.

Gabe: Other industries are most definitely thinking about this at the same time. As we have just started our work with our c137 ANSI committee, we discovered that there is another ANSI committee that's not being organized by NEMA but by the Consumer Electronics Association. They have developed a standard for not exactly all the things we think we need for energy performance monitoring but they still have a lot of the same things. They intend to include appliances, though I'm not sure they did. It's for residential consumer devices that you would find within a home. They have expressed to us either a desire for us to expand their specifications or to at least make sure that it aligns with what they have developed thus far. I totally agree with Levin that this is a very important concept. This isn't just about lighting. It's going to be important that we approach this from the perspective of the whole building or the whole home, and all the energy uses in the building. Because lighting is ubiquitous, in every room and in all of our cities, lighting control systems could serve as great infrastructure to support the future smart building systems. Lighting manufacturers are looking to expand beyond lighting and are envisioning a future where it's not just the lights that incorporate this energy performance metering, but it's also the plug loads and other large loads that feed into the lighting control system, which isn't just a lighting control system anymore. That's something we need to strive for and we're working on.

Q: So this presentation is more about open standards for digital sensing, data collection/monitoring and communications, with lighting as an adjunct component?

A: Yes, but we started from the perspective of where commercial lighting is going. The answer agrees with that comment. Yes, the lights aren't just lights anymore, they're becoming part of a larger system.

Q: We are trying to make digital building systems more interactive with the human occupants - do you foresee a lighting technology that can take a cue (to dim or to change color) from the human in the room (not from the people at the controls)?

A: Yes. People are researching various different ways to track people in rooms, some with video cameras. If there isn't a photo of the person, there might be enough information about where they are, what position their body is in, if they're sitting in front of a computer or standing up at a white board. If you knew a little bit about where the people are in a room, you can change the lights appropriately. For instance, if someone is up talking at a white board, you want the lights to focus on them. In a teleconference room, you may notice that when someone talks, the video camera turns to focus on the person who's talking. You can imagine the lights doing something similar, tracking where people are, and where to focus the light. So yes, that's coming, it's being researched. I don't know that it's ready for prime time yet, but it's coming.

Q: Do manufacturers want to saturate a market with existing LED technology in order to have a wide open market for offering upgrades to this type of energy monitoring system? It's kind of like, why offer an iPhone 6 when not everyone has purchased an iPhone 5 yet?

A: This question highlights the point that the lighting market is undergoing fundamental change into the world of digital consumer electronics. Some manufacturers are beginning to develop new value streams from lighting as a service. When a lighting system is networked with upgradeable software, new functionality can be added without replacing the hardware. That can continue for a few years, until new functions require more advanced hardware to run. Other manufacturers who focus on hardware sales might take the strategy that you describe. Still, the LED lighting market is extremely decentralized and diverse at present, so the strategy of any single manufacturer may be disrupted by competitors' strategies.

Q: What changes are in the immediate future to utility programs incorporating these changes?

A: The big question is, what energy savings can a utility expect? That determines an appropriate incentive to pay. A utility can pay a widget-based incentive for each point of control, or a performance-based incentive for annual kWh savings. For the former, as widgets add more and more functions, it's becoming increasingly difficult to predict with any reliability the energy savings that will be generated by each widget. For the latter, as this market grows, utility programs will need to have an easily administered way to calculate annual kWh savings.

Q: Besides lighting, what other appliances/equipment will soon have performance metering capability?

A: Networked thermostats come to mind. Also the CEA 2045 standard applies to residential hot water heaters, and a similar standard in Japan applies to ductless heat pumps.

Q: Where current program evaluators typically provide a realization rate for retrofit lighting projects of 90% or higher, will the benefits of integrated performance metering equipment justify the additional costs?

A: Current program evaluation practices have a significant cost. The goal of integrated performance metering is to reduce the overall cost of M&V, not increase it. Economies of scale will drive down the hardware component cost for performance metering below \$10 per device, and perhaps eventually below \$1.

Q: It would be neat to be able to install updated control/function chips on existing LED fixtures. Perhaps this can be done repeatedly as capabilities continue to evolve.

A: We'll see. With consumer electronics, sometimes it's possible to upgrade the memory, such as a larger microSD card. But to add processing power or sensors to a phone, you usually buy a new phone. It's even getting difficult anymore to find a phone with a slot for upgradeable memory. Different manufacturers may take different paths, with some selling new hardware every few years, while others sell lighting as a service, with upgradeable hardware.

Q: Do you see building and energy codes and standards playing a significant role in directing the broader non-participating market toward the "high road"?

A: Well, "standards" are certainly significant, as I described in the presentation. Some building energy codes have a performance-based path, so performance metering can help there with verification. It remains to be seen how energy codes will support advanced lighting controls most effectively. I expect it will happen eventually, as easy-to-use products become more available. In California, the Title 24 requirements for lighting controls appear to be backfiring, with unintended negative consequences, so this is an area to navigate with caution.