SMART BUILDINGS

WINTER EDITION

CONSULTING - SPECIFYING engineer eBOOK

ABB

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How building automation, controls help HVAC systems

Learn how buildings can become smarter using building automation systems and building controls

The technological advances in the heating, ventilation and air conditioning industry over past two decades has helped building systems operate in a more energy-efficient manner. There is no shortage in the building industry of buzz words such as “smart buildings” or “green buildings.”

However, it is important to note that, regardless how energy-efficient a building is, if the building is not a net zero building, then the systems within that building will still use energy and, in many cases, significant amounts of energy. The latest draft version of the 2018 Commercial Buildings Energy Consumption Survey issued by the U.S. Energy Information Administration states that since 2012,

“The number of buildings has grown by 6% and floorspace by 11% and newer buildings are larger, on average, than older commercial buildings. The total energy consumption by the residential and commercial sectors includes end-use consumption and electrical system energy losses associated with retail electricity sales to the sectors. When electrical system energy losses are included, the residential and commercial sectors accounted for about 21% and 18%, respectively — 39% combined — of total U.S. energy consumption in 2021.”

Also, per EIA, “… in 2021, renewable energy sources accounted for about 12.2% of total U.S. energy consumption and about 20.1% of electricity generation.’”

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This imbalance between the amount of renewable energy being generated in the U.S. and the total energy being used by residential and commercial building will continue to have a significant negative impact on the environment. It is important to note that a net zero building is not a building that uses no energy; a net zero building is a building that, on an annual basis, uses an energy amount that is less than or equal to the amount of renewable energy that it produces onsite.

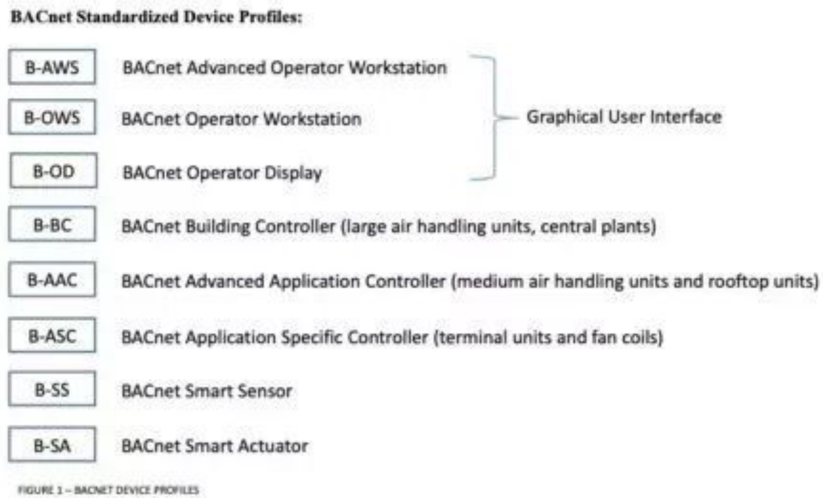

Figure 1: BACnet device profiles. Courtesy: SmithGroup

Although design engineers and building owners strive to design and install energy-efficient HVAC equipment (i.e., chillers, heat pumps, etc.) and lighting fixtures, just by having this efficient equipment in a building it is not an indication that the building will be an energy-efficient building. Providing a building with energy-efficient equipment could be considered as a first step toward having an energy-efficient building; the building automation system plays a crucial role in the overall energy consumption levels of a building.

Up until the late 1980s and, on rare occasions, through the early 90s, the HVAC controls system in a commercial building was mostly pneumatic based. This type of pneu-

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matic based control was, in its most simplistic form, an on/off type of a control system in which pumps and fans were left “riding their curves” based on the load. Variable frequency drives and implicitly, the concept of varying the speed of a pump moor or a fan motor based on the load was a relatively novel concept in the HVAC industry and one of the reasons behind this was the relatively high total cost of a VFD.

Similarly, the concept of having a building engineer receive alarms and notifications by the BAS was in its early stages. Looking back at these antiquated methods of controlling and operating building systems, one could assume that building systems could have performed better and use less energy.

The advent of direct digital control systems in the mid-80s and the publication of the BACnet Standard for building automation and control system networks, ANSI/ASHRAE 135-1995 provided the building industry with the potential and tools for reducing the amount of energy that is being used by building systems.

BACnet, known as a building automation and control network, is a BAS communication protocol developed by ASHRAE. The standard is continuously maintained by the ASHRAE SSPC-135 committee.

It is common for building DDC systems to talk with the cloud and with myriad apps, each marketed with various promises to support the sustainability of the building, provide better control over the environment in the building and, for building engineers and commissioning professionals, to provide more information (i.e., alarms, trends, diagnostics, energy performance, etc.) about the operation of the building systems.

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Smart buildings and building automation

Are smart buildings automatically energy-efficient buildings? What makes a building smart? A simple web search of this terminology shows as many definitions as there are web links in the results page.

For example, a provider of internet of things devices may define a smart building as "a building that uses IoT devices to monitor various building characteristics, analyze the data and generate insights around usage patterns and trends that can be used to optimize the building's environment and operations."

Similarly, a provider of information technology networks may define a smart building as a building that "converges various buildingwide systems — such as HVAC, lighting, alarms and security — into a single IT managed network infrastructure."

Adapting a widely used saying to the industry, we could infer that what makes a building smart is in the mind of the beholder. The same could be inferred when using the term energy-efficient building; to establish that a building is energy-efficient, we need to clarify what deficient baseline (i.e., reference) has been used to make the determination that a building is indeed energy-efficient.

Designing a smart building might be an effort that could start with a set of general requirements set by the building's owner, while recognizing that an energy-efficient or net zero building does not necessarily mean that the building needs to be a smart building. Similarly, designing a smart building does not mean that the building is an energy-efficient building.

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A couple of examples of a type of broad performance requirements set by the building's owner regarding what constitutes a smart building could be as follows:

BAS shall use the BACnet communication protocol and shall use smart sensors and actuators. The BAS sequences of operation shall be based on ASHRAE Guideline 36: High-Performance Sequences of Operation for HVAC Systems.

BAS shall use the BACnet communication protocol, use edge control devices and be connected to the cloud. The BAS sequences of operation shall be based on the ASHRAE Guideline 36. The data from the building automation system shall be used by cloud-based applications such as analytics, anomaly detection and artificial intelligence algorithms for the control of building systems

The BAS shall be integrated with the building lighting control system such that information related to occupancy levels, occupancy detection and lighting levels is shared between the two systems. The BAS shall then monitor and control the HVAC system based on the actual occupant load and lighting levels in the building with the overall intent of reducing the energy consumption of the HVAC systems by minimum 25% when compared with the energy consumption levels of the same HVAC systems when the referenced information is not shared between the BAS and the building lighting controls system.

The overall intent behind the use of the BACnet Standard as a performance requirement is to provide the potential controls contractor(s) with a clear and concise set of requirements that must be met by any manufacturer of controls devices. It will not matter to an owner who makes the controls device for a lighting controls system and for an

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HVAC control system, as long as controls devices carry a BACnet listing, said devices will speak the same language.

How to design a building automation system

The BACnet Standard defines eight profiles for controls devices, as shown in Figure 1; the first three devices are typically used to access the entire BAS via a graphical user interface. Out of the first three device profiles, the BACnet advanced operator workstation is the most robust; a B-AWS provides the user with a complete engineering tool for the monitoring and configuration of the BAS and any systems (e.g., HVAC, lighting, etc.) controlled by it; consider the B-AWS as a computer provided with a relatively easy to use GUI.

Further, the B-AWS and its tools allows for future system changes under proper password protection including dynamic creation, deletion and modification of all configuration parameters, programs, graphics, trend logs, alarms, schedules and every BACnet object used in the installed system.

For each device profile, the ANSI/ASHRAE 135 standard defines a minimum set of requirements that the device must meet to be formally listed as a BACnet device. It is important to note the difference between BACnet “listed” control devices and BACnet “compatible” control devices. The fact that various manufacturers may claim that their product is BACnet compatible, it does not mean that said control device is also a BACnet listed device. At best, the claim may mean that the control devices can communicate with other BACnet devices.

For a control device to be BACnet listed, it must carry the BACnet Testing Laboratories

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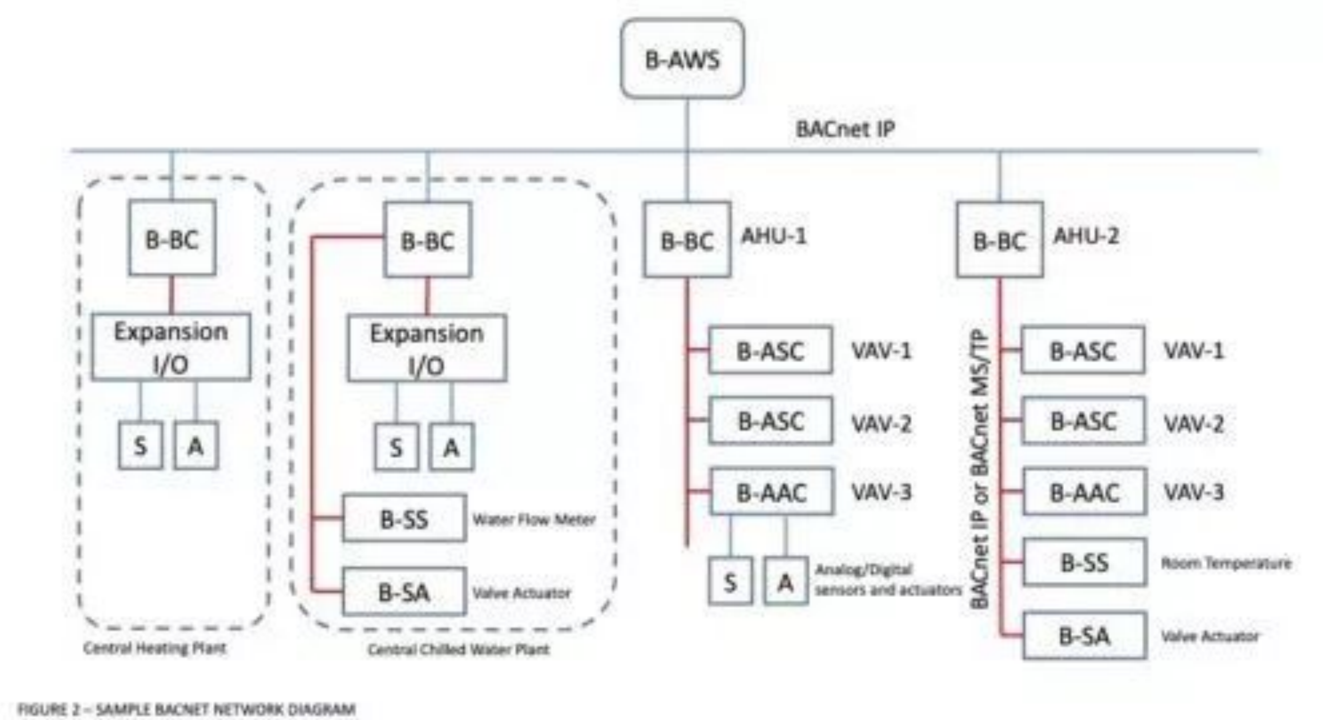

Figure 2: Sample BACnet network diagram. Courtesy: SmithGroup

stamp, which is an indication that the device has been tested by a BACnet certified laboratory and certified under the BTL Certification Program. The BTL website maintains a public list of all BACnet listed control devices.

Each BACnet listed device is required to be provided with protocol implementation conformance statement, which is a document that describes the options specified by BACnet that are implemented in the device.

A sample network architecture of a BAS based on the BACnet communication protocol is shown in Figure 2.

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The BACnet master slave/token passing (MS/TP) communication protocol is a peer-to-peer, multiple-master protocol that shares data by passing a token, or permission to “speak”’ across the network, between control devices (masters) that authorizes the holder device to initiate communication on the MS/TP network; master devices send requests and slave devices submit responses.

Further, master devices can only request services from slave devices if they have an available token; if master device does not have a token, it must wait for a token to be passed on to it. This is one of the main reasons for an MS/TP network to become slow, in particular when there is a high number of devices (more than 50) on the same bus. The control devices on an MS/TP network are connected in series via shielded twisted pair cable and the communication speed across the network is typically limited to 0.1 MB per second.

Unlike the devices on an MS/TP network, the devices on a BACnet internet protocol network are connected via Ethernet cable and the network speed is typically greater than 100 MB per second.

A standard analog sensor (e.g., air temperature, chilled water temperature, etc.) can send an analog signal (typically resistance or volts) only to a BACnet control device. The control device then uses the analog signal for control of the HVAC equipment or shares (via BACnet communication protocol) the associated values from the sensor with the other BACnet devices. The same principle applies to standard actuators; they are typically controlled by a BACnet control device via a 0- to 10-volt signal or 4 to 20 milliampere signal.

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Figure 3 shows a sample PICS for a BACnet smart sensor. The main difference between a BACnet smart actuator and B-SS and a standard analog or digital sensor or actuator is that the B-SAs and B-SSs are provided with a control board that allows them to be connected to a BACnet network and communicate with other BACnet devices on the network.

Lastly, but not less important, BACnet listed smart sensors and actuators are significantly more expensive than standard sensors and actuators, typically by an order of three or more.

PICS
B-SS

BACnet Protocol Revision: 1.12

Product Description:
Sensor device with BACnet MS/TP RS485 interface

BACnet Standard Device Profile: BACnet Smart sensor (B-SS)

BACnet Interoperability Building Blocks supported:
Data sharing - ReadProperty-B (DS-RP-B)
Data sharing - ReadPropertyMultiple-B (DS-RPM-B)
Data sharing - WriteProperty-B (DS-WP-B)
Data sharing - COV Unsubscribed-B (DS-COVU-B)
Device Management - DynamicDeviceBinding-B (DM-DDB-B)
Device Management - DynamicObjectBinding-B (DM-DOB-B)
Device Management - DeviceCommunicationControl-B (DM-DCC-B)

BACnet Standard Application Services Supported:
ReadProperty
ReadPropertyMultiple
WriteProperty
DeviceCommunicationControl
WhoHas
WhoIs

Segmentation Capability: No

Data Link Layer Options: MS/TP Master
Baud rates 9600, 19200, 38400, 76800
Max. 32 nodes (without repeater)

Device Address Binding: No static device binding supported

Networking Options: None

Character Sets Supported: UTF-8

FIGURE 3 – SAMPLE PICS FOR B-SS

Figure 3: Sample for protocol implementation conformance statement for a BACnet smart sensor. Courtesy: SmithGroup

Figure 4 shows two controls diagram for the same variable air volume box. In the diagram on the left of the figure, the control and monitoring of the VAV box and associated zone is done via standard analog and digital sensors and actuators while in the diagram on the right side of the figure, the control and monitoring of the VAV box and associated zone is done using a combination of standard analog and digital sensors and actuators and B-SS and B-SA.

ASHRAE Guideline 36

ASHRAE Guideline 36 is a repository of sequences of operation applicable to HVAC systems that are typically installed in most buildings, except residential buildings.

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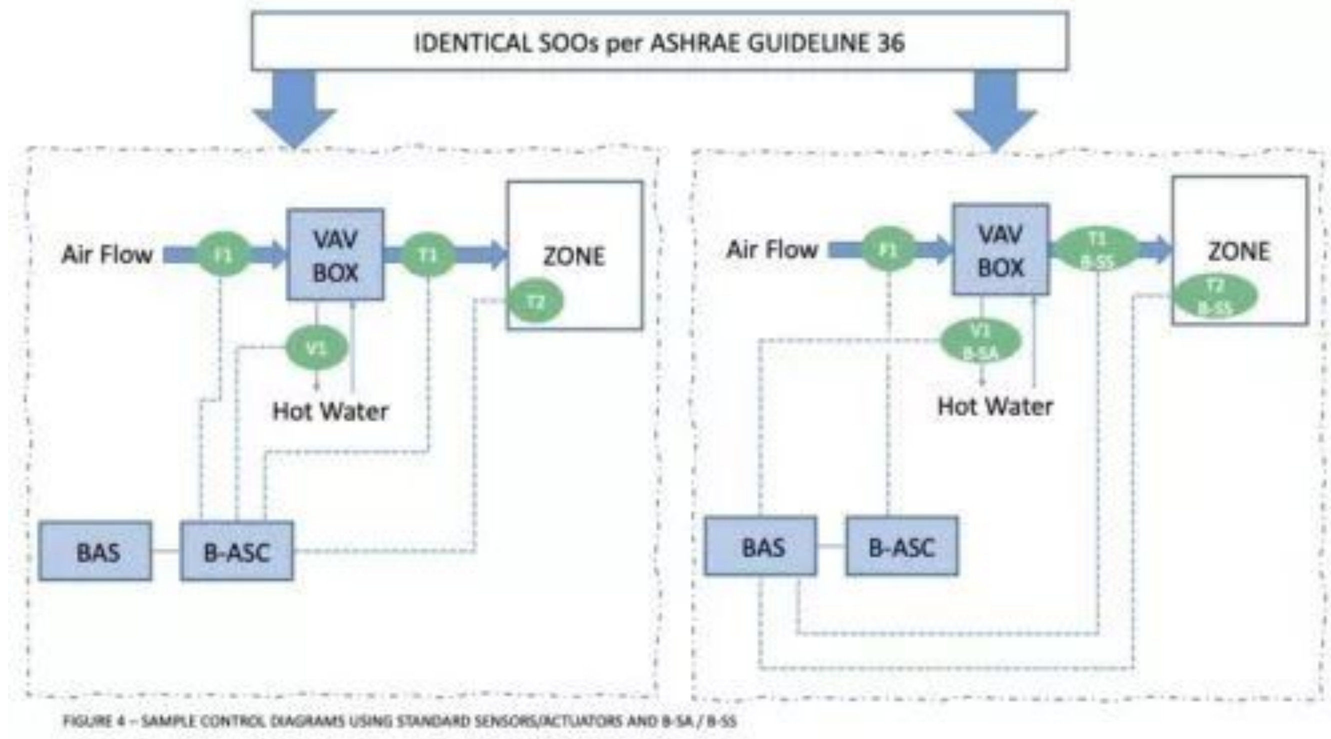

Figure 4: Sample control diagrams using standard sensors/actuators and BACnet smart actuator/ BACnet smart sensor. Courtesy: SmithGroup

The intent of this guideline is to encourage engineers, contractors and building owners to use standardized sequences of operation that have been proven over time to be reliable and to operate systems in an energy-efficient manner. These proposed control sequences are sensor and actuator agnostic. In the context of this example, being sensor and actuator agnostic means that it does not matter if a building automation system is provided with standard sensors and actuators or with B-SAs and B-SSs; the outcome (i.e., the energy consumption of the building systems) will most likely be the same.

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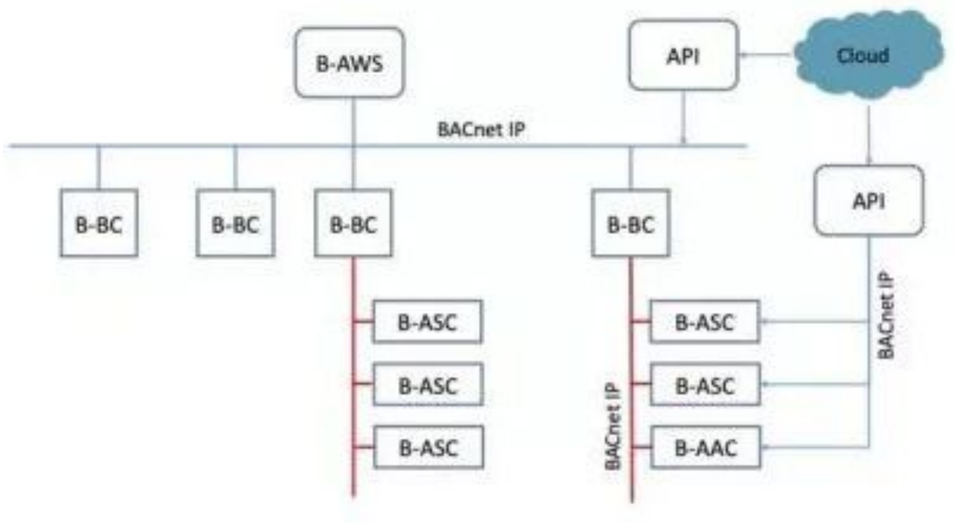

Figure 5: Sample BACnet network diagram with edge control devices. Courtesy: SmithGroup

Referring back to the first example of broad requirements set by the building's owner regarding what constitutes a smart building and assuming that the building HVAC systems are programmed to operate based on the sequences of operation defined in ASHRAE Guideline 36, what value will the owner get if the energy efficiency of the building will be the same, regardless of what type of sensors are being used? It may be that an owner may find the marketing aspect of using smart sensors as extremely valuable, in addition to the value of having an energy-efficient building. One could reasonably infer that the building by itself did not become smarter due to the use of BACnet listed B-SSs and B-SAs. Engineers and design professionals should inform the owners about any potential risks and benefits before recommending the use of B-SSs and B-SAs.

Figure 5 shows a sample BAS network architecture connected to the cloud. In this scenario, the local controllers, typically the BACnet application specific controllers are connected to the BAS network and also to the cloud. What makes these controllers edge controllers is the fact that they are located at the edge (periphery) of the BACnet

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network. These types of controllers are provided with significantly more capabilities (i.e., memory, processing speed, storage capacity, etc.) than typical B-ASC controllers; this is because they must be able to execute the standard proportional-integral-derivative loops required to control the associated HVAC equipment and, in the same time, must be able to respond to the requests (i.e., sending data) from the cloud-based applications.

An application programming interface is typically needed to facilitate the communication between the cloud-based applications and the edge controllers. An API can be viewed as a collection of software applications required to collect and prepare the data before sending it to the cloud-based applications. Although building automation systems are provided with the capability to store, trend data and provide alarms with the operator, anomaly detection applications are typically cloud-based. This is because they typically require more computational power (to execute various algorithms) that cannot be supported by typical BACnet building controllers.

Defining fault detection

Fault detection and diagnosis is the process of identifying or detecting deviations from normal or expected operation (faults) and resolving (diagnosing) the type of problem or its location.

Figure 6 shows an example of an anomaly in the operation of the VAV box shown in Figure 4. At a certain time during the day, the VAV box leaving air temperature has exceed an expected maximum value of 85°F. It is important note that the BAS also could issue an alarm once it detects this condition; however, in the case of a more complex scenario (as shown in Figure 7) the BAS may not be able to detect the anomaly.

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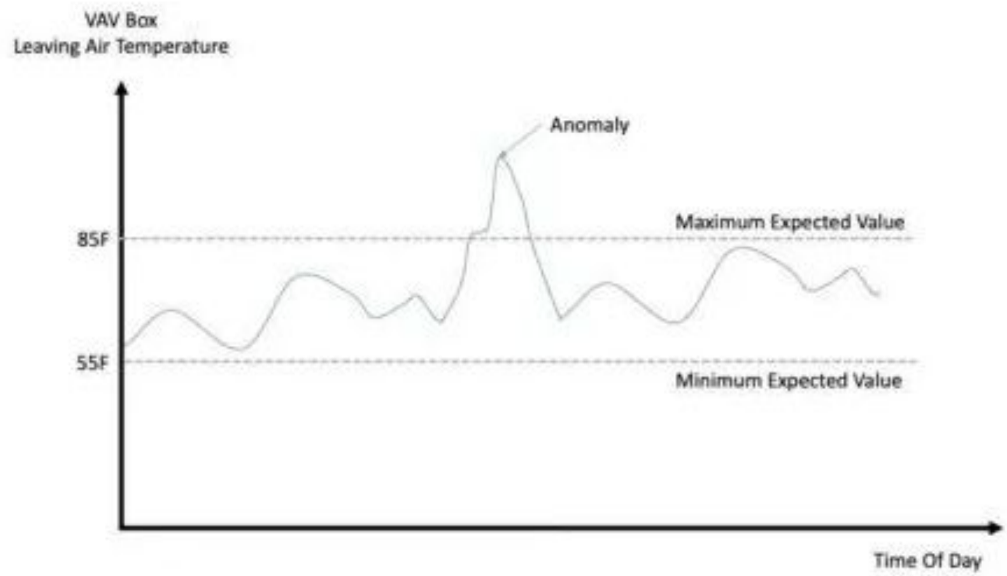

Figure 6: Example of a simple anomaly in building automation system trends. Courtesy: SmithGroup

In this scenario, even though the VAV box reheat control valve is almost fully open, the actual VAV box leaving air temperature is below an expected range. This may be an indication that either more airflow is going through the box than expected (even though damper is not as open) or the temperature of the water entering the coil is not as warm as expected, which, in turn, has caused a reduction in the heating capacity of the VAV box. The output from an anomaly detection software application may be a series of actions for the user to implement; the intent of said actions is to help the user determine the actual cause of the anomaly.

Anomaly detection applications can play a significant role in the operation of building HVAC systems; anomalies that go undetected can result in systems using more energy than expected. For example, an owner may use the output from a predictive energy model as a reference to predict future operating costs; anomalies (e.g., chiller plant uses 20% more energy than predicted) may negatively impact an owner's cash flow

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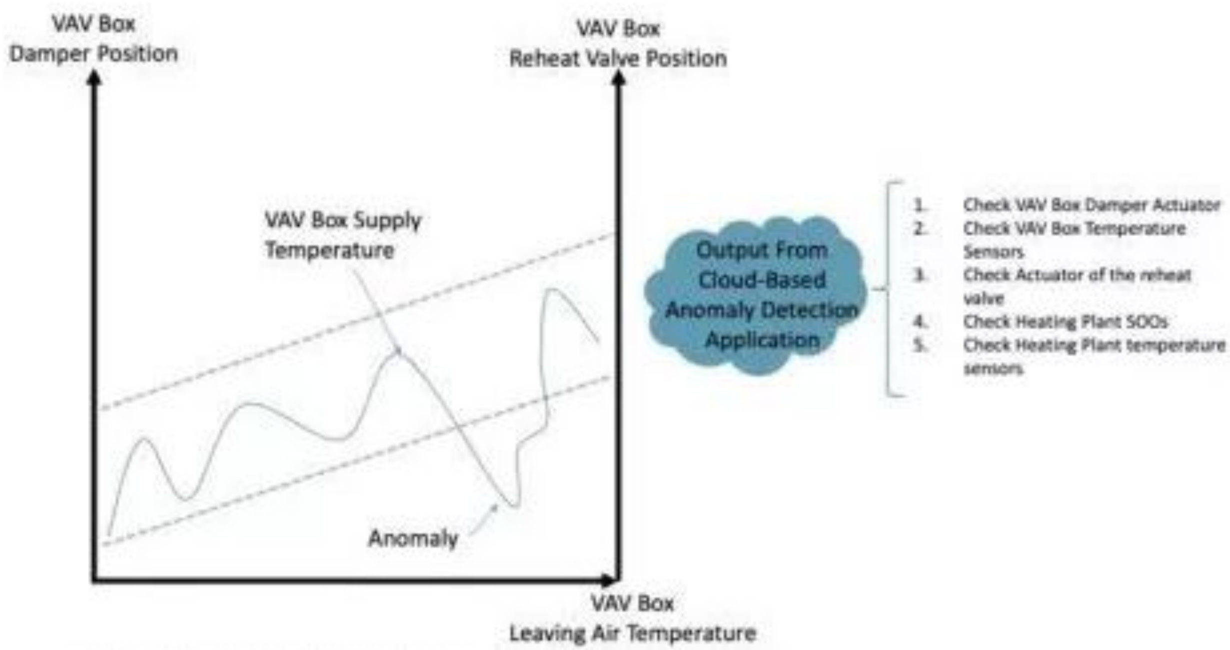

Figure 7: Example of a more complex anomaly in the operation of a variable air volume box. Courtesy: SmithGroup

models. Undetected anomalies can also affect the preventive maintenance efforts of the facilities team by reducing the useful life of equipment; this, in turn, may also negatively impact an owner's cash flow models associated with the operation of the building.

An overview of the application of AI-based algorithms for the control of building systems is available in the article "Using artificial intelligence to control building systems." Referring back to the second example of broad requirements set by the building's owner regarding what constitutes a smart building, are analytics, anomaly detection and AI based applications enough to classify a building as being a smart building or a green building?

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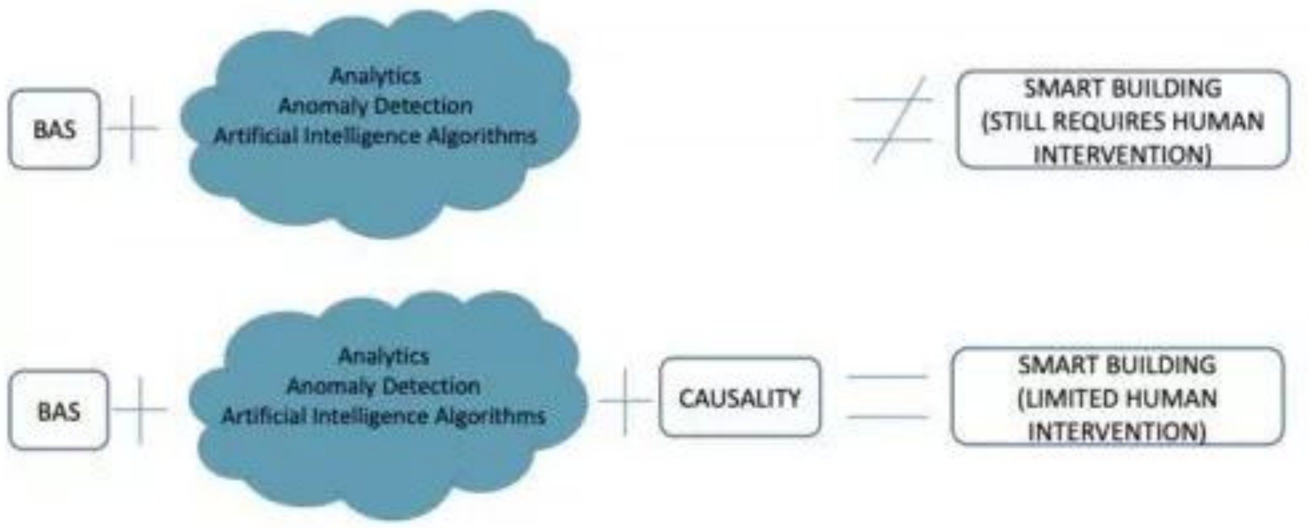

Figure 8: Limitations of standard applications. Courtesy: SmithGroup

For this example, neither the BAS nor the other three types of applications (analytics, anomaly detection and AI-based algorithms) can help in identifying what caused an anomaly. Giving a building automation system user a series of actions to execute to find the cause of the anomaly is helpful, however implementing the actions takes time and, when the facilities teams is short-staffed, finding the cause of the anomaly and then fixing the issue may not prevent the building as a whole from running in an energy-inefficient manner for prolonged periods of time.

Identifying the cause behind an anomaly will most likely require the implementation of causal algorithms in addition to the three types of applications previously mentioned. AI Algorithms by themselves are not enough to make a building smart. Causal algorithms are not AI algorithms. AI algorithms take data input at face value; said algorithms assume that the input is correct (I.e., garbage in, garbage out). AI

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algorithms cannot determine if a portion of the training data is incorrect or if it includes anomalies. Causal algorithms are used to find the cause behind an anomaly, with minimal to no human intervention. Causal algorithms are extremely difficult to program at scale and the industry is just not there; my overall message with this article is that AI algorithms to control building systems are simply not enough to make a building smart and to minimize the impact on the environment. The industry needs to keep pushing for more advanced algorithms, i.e., causal algorithms.

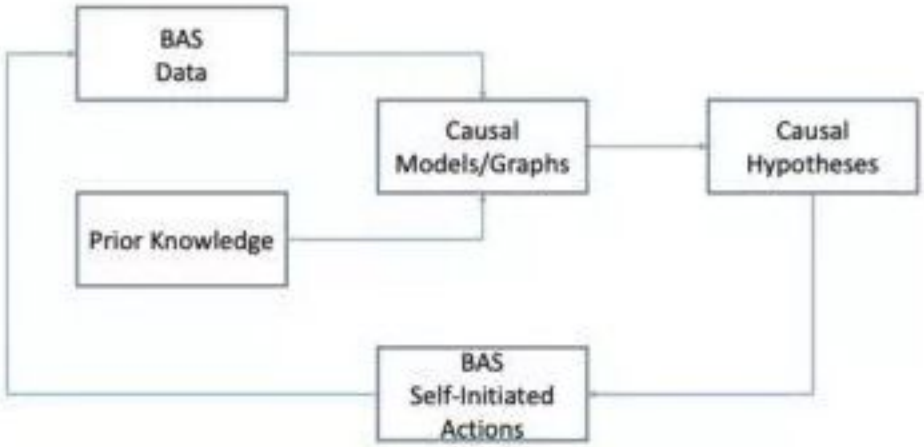

Figure 9: Causal discovery workflow. Courtesy: SmithGroup

Example building automation success

Causal algorithms are typically used in biomedical research to discover causal relationships from biomedical data. Causal models can be build using prior data or, in the case of building systems, data stored by the BAS. A sample process for causal inference is shown in Figure 9.

A causal model is typically build using a direct acyclic graph, aka DAG, which is a graph between a set of variables connected by arrows. A path in a directed graph is a

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nonrepeating sequence of arrows that have endpoints in common; in a DAG a variable cannot have a path toward itself.

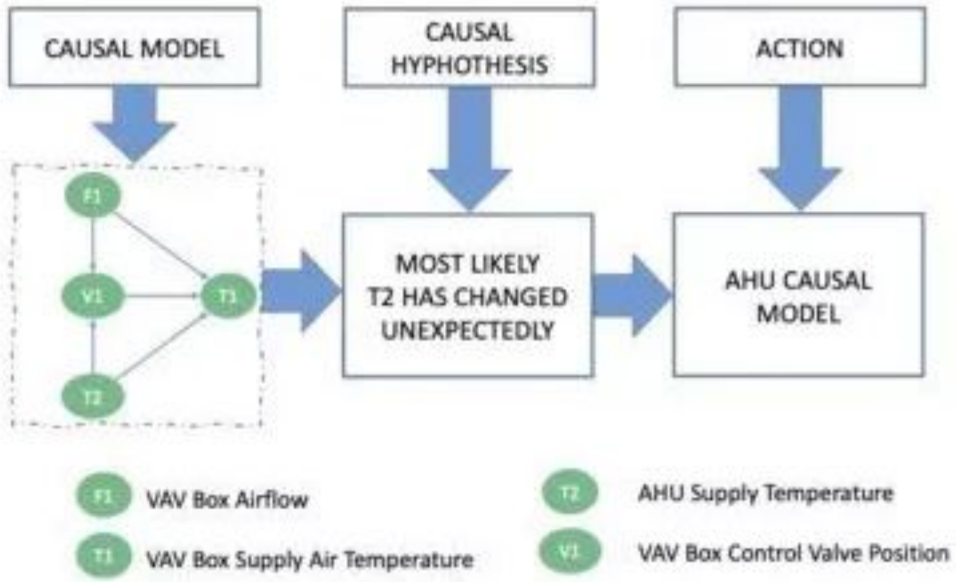

Figure 10: Variable air volume box causal model. Courtesy: SmithGroup

Figure 10 shows a sample causal model for the VAV box shown in Figure 4; each variable in the DAG represents all historical values available at the BAS and filtered by a desired timeframe (i.e., the time interval starting with one hour before the anomaly as occurred and up to two hours, for a total of three hours). The purpose of the graph is to identify what may have caused the VAV box supply temperature to go outside of its expected range (the cause behind the anomaly). An arrow from one variable to another variable — from F1 to T1 — represents that F1 is a direct cause for T1.

For example, if the reheat valve doesn't continue to open, an increase in airflow of the VAV box has a direct effect on the VAV box supply air temperature. The causal model also includes the air handling unit supply air temperature (variable T2), which has a direct effect on T1 and an indirect effect on T1 (via variable V1). The outcome

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from this causal model may be that the AHU supply temperature has changed unexpectedly. The causal algorithm will then create a new causal model of the AHU as whole to identify what may have caused the AHU supply air temperature to drop.

Causal models used with high-performing building automation systems (including analytics, anomaly detection and AI algorithms) have the potential to help facility operators better maintain the building systems and operate them in the most energy-efficient way possible and/or meet owner's requirements.

Ionel Petrus, PE, CEM, LEED AP BD+C, SmithGroup, Washington, D.C.

Ionel Petrus *is principal and mechanical discipline leader of the Washington, D.C., office of SmithGroup.*

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ABB Ability™ Building Ecosystem: The simplest way to a smart building

Achieving all the benefits of a smart building may seem a distant ambition, but ABB Ability™ Building Ecosystem makes the journey simple. This open and scalable digital platform fits with your building needs, enabling you to optimize energy efficiency and sustainability. The ABB Ability™ Building Ecosystem is built on an open platform that accommodates scalability and interoperability.

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How lighting control systems contribute to flexible, future-proof buildings

Lighting control systems play an important role in buildings that need to address future challenges, both predictable and unanticipated

The U.S. Green Building Council defines resilience as "the ability to prepare and plan for, absorb, recover from and more successfully adapt to adverse events." We see engineers and owners prioritizing resilient building systems in new construction and renovations, especially in response to the COVID-19 pandemic and the unprecedented accommodations that had to be made in many commercial spaces.

Lighting control systems play an important role equipping buildings to handle future challenges, both predictable and unanticipated. In addition to meeting the parameters of the USGBC definition smart, digital lighting control systems support resilience with solutions that are flexible and future-proof, simplify adjustments and quickly adapt to changing work schedules and new occupancy patterns over time.

Engineers are looking for ways to bolster building resilience, support their clients and incorporate best-practice design of smart lighting control systems. They need solutions that are technologically savvy enough to monitor and analyze system data, help reduce waste, promote comfort, enhance productivity and continue to add value over time.

Digital lighting controls promote building flexibility

Commercial spaces will look different moving forward. Smart, digital technology makes

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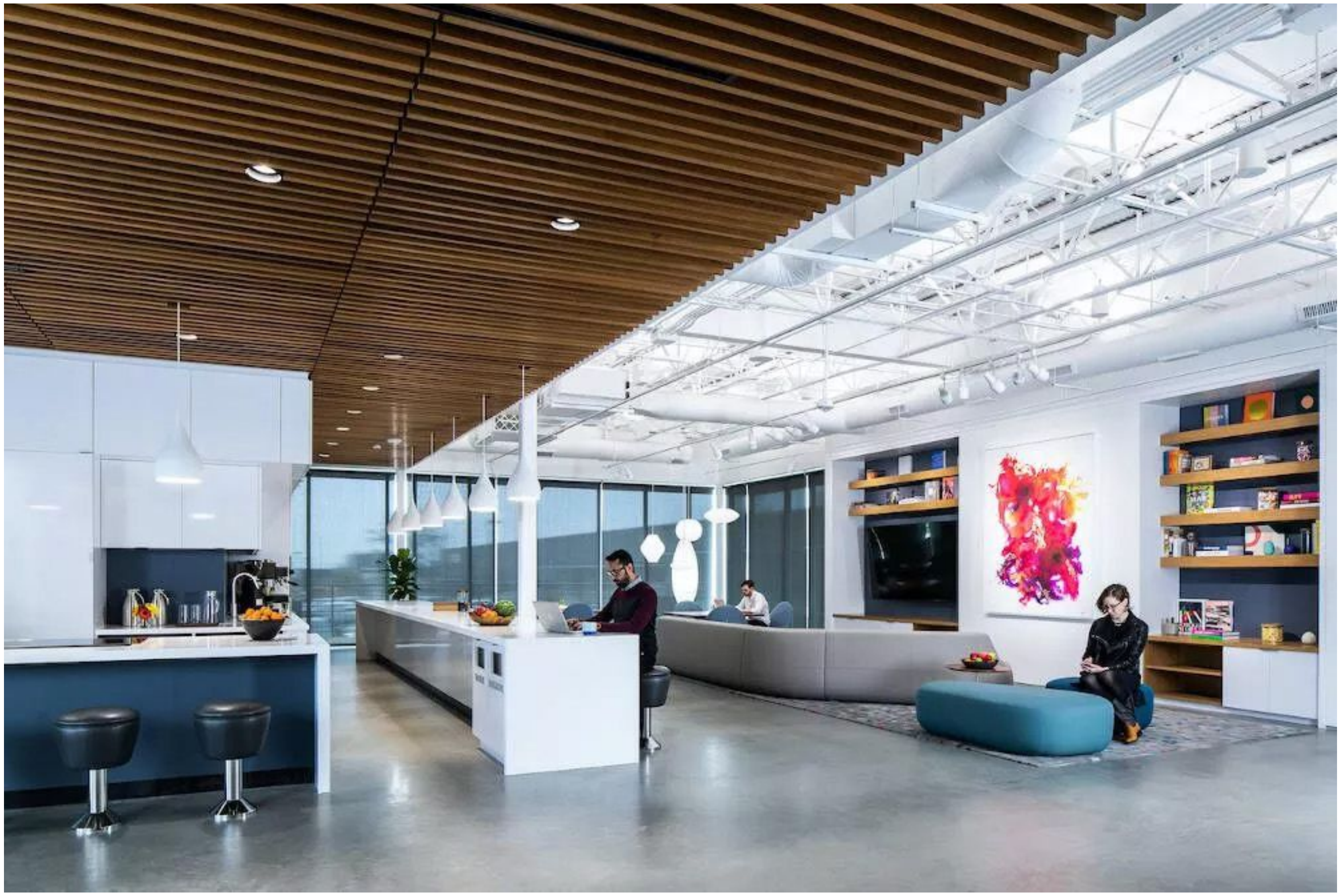

Flexible lighting systems support resiliency in the workplace by providing a comfortable, productive, engaging work environment that can change and adapt over time. Courtesy: Lutron Electronics

it easy to design lighting systems that support new conventions such as continued social distancing, the increased demand for touchless technology and spaces that can be quickly partitioned and redesigned as needed. Lighting also contributes to buildings that embrace a connection to the outdoors with integrated smart shading and daylighting strategies. Lighting control is the one building system connected to each of these performance goals.

Individually addressable LED fixtures, advanced LED technologies and centralized, adaptable controls enable code-compliant design and enhanced system flexibility. As requirements evolve, lighting and shading systems will play a pivotal role in spaces that foster well-being and promote productivity.

To design systems that best serve your clients' needs, it is often necessary to go beyond the traditional, stand-alone system. Review the solutions you typically choose for basic code compliance and make sure you are taking advantage of the available digital and software benefits to set your client up for success.

Robust software is critical. Moving forward, system software should be cloud-updatable, able to quickly adapt to new challenges, changing occupancy patterns and a variety of building uses. The software should also easily accommodate programming changes by the facilities team without the need for factory support.

Wireless solutions make flexibility future proof. They offer all the advantages of smart, digital lighting control and the power to make systems easier to design, more intuitive to program and personalize and more flexible than wired technology.

Wireless also offers seamless integration with heating, ventilation and air conditioning, building management and other third-party systems and enhances control options for better usability. They use all the same devices as wired systems — fixtures, load controllers, keypads, receptacles, sensors — but with no communication wires, fewer power wires and less conduit making them easier and more cost-effective to design, install and adjust over time.

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Wireless lighting control technology provides installation flexibly, allowing you to locate controls on typically challenging surfaces such as glass with no backbox or wiring. Courtesy: Lutron Electronics

Connected, wireless solutions make an already flexible system easily scalable whether the client expands over time or wants to consolidate space in response to trends such as hybrid work or remote learning. Add controls and sensors exactly where they are needed with no additional wiring or opening up walls. Centralize control and system management over multiple areas or buildings, making changes in minutes using a convenient app. The benefit is the opportunity to adjust quickly and seamlessly.

Advantages of wireless lighting controls

With wireless, digital control it can be easier to update traditional solutions and to integrate today's advanced LED technologies as well as the next smart-source innovation into a high-tech project. The technology also accommodates the integration of smart

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assistants, voice control and system automation. Wireless capability and performance have come a long way since their introduction more than 20 years ago and have proven themselves in the field by delivering reliable, scalable, future-focused control for more resilient buildings:

- **Design flexibility:** With wireless, you eliminate many decisions about wiring and power requirements. And, when the project specification changes, the lighting control system can accommodate without going back to the drawing board.

- **Control/installation flexibility:** Wireless controls and sensors can be wall-mounted, ceiling-mounted or free-standing and they can also be used in locations that are traditionally challenging when it comes to control including glass doors and dividers, door jambs and even on podiums and furniture — no backboxes or new wiring required. Additional points of control can be added in minutes and sensors are easily repositioned to ensure best performance.

- **Faster installation:** Wireless systems install up to 70% faster than wired. This is a big plus for commercial contractors who are struggling with skilled labor shortages, supply chain challenges and unprecedented scheduling demands.

- **Simple set-up:** Certain wireless systems offer simple button presses or app-based setup and enable changes in real time, right in the space. With just their smartphone or tablet, the building facilities team can easily reassign keypads and zones to adjust to new space layouts or employee requests.

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For future-proof design, consider performance over protocol

Once lighting designers commit to using a wireless system, they can focus on desired system goals — performance, reliability, scalability, security, integration, pricing, product availability and available service options. Then, work with a manufacturer who can help meet your needs and overcome objections rather than adhering to a specific protocol.

A building's smart lighting control system should provide the same code-compliant, reliable, easy-to-use experience your client expects from any lighting system and enhanced with all the data-driven building management power they have come to need in an efficient, comfortable building. Specifiers may lean toward open protocol systems for several reasons:

- They may feel that open-protocol design alleviates concerns about being permanently linked to a given manufacturer. Manufacturers can go out of business, obsolete a product line, change their service agreement or even be acquired. An open protocol can seem like a smart hedge against these concerns as a perceived back-up, of sorts, when it becomes necessary to replace a component or augment the system with another manufacturer's open-protocol product.

- To offset concerns about proprietary system pricing. Using an open protocol, the assumption is that if one manufacturer increases pricing it is possible to substitute with another manufacturer's equivalent product. This concern has been amplified in recent years as some companies have instituted significant and frequent price increases. Specifiers do not want to compromise their professional reputation or their client's budget and system performance.

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- Because open protocols are more regulated, they can be perceived as offering elevated system security and the best option for achieving seamless, secure integrations between different building systems.

But these assumptions can be problematic. When you are deciding on a system, be wary of these open-protocol assumptions — "open" is a matter of interpretation. Many manufacturers' systems start with a standard protocol, such as Zigbee, but then customize the code to meet their use case, potentially negating the openness the engineer intended to design into the lighting specification. The wireless communications may be based on an open protocol, but now you cannot swap out one manufacturer's device for another because the solution has been customized. You also do not get the advantages of a system optimized for your project and you may see degradation in performance, responsiveness, reliability and scale.

Proprietary, manufacturer-specific protocols, on the other hand, are designed to be optimized for a specific purpose and to take full advantage of digital network resources. These systems are engineered to meet well-defined performance criteria, ensure reliability for the life of the system and scale seamlessly to large installations without performance degradation or interference with other wireless devices such as Wi-Fi access points and Bluetooth headsets.

It is also important to think about how easy it will be to address maintenance and replacement issues down the road. If a driver or fixture fails, your clients need assurance that their system will respond as expected. Ultimately, you should be able to count on the system manufacturer to articulate the benefits and pitfalls of their designs and explain how it will support your application while meeting performance expectations.

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Resilient lighting control architecture

Fixture-based, luminaire-level lighting controls (LLLCs) are another trend in smart, flexible building system specifications. LLLCs can be simple to design and install, but when it comes to system flexibility and resilience, zone-based control may be the more practical option over time.

Wireless lighting control systems require less physical wire, making them easier to design and install while still supporting energy code requirements. Courtesy: Lutron Electronics

LLLCs are lighting control devices integrated into the lighting fixture itself. Because these devices are typically factory installed, they can simplify some design considerations and reduce installation time. However, since the control is physically embedded into the fixture, it is not simple to swap out one LLLC for another. If there is a failure in the embedded controller, for example, you are likely to need to replace the entire fixture — a process further complicated by ongoing supply chain challenges. Because

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the LLLC is installed in the fixture at the factory, it is not likely to be available from stock and probably requires a lighting rep to provide a quote, potentially adding time and cost when a client needs a quick, effective solution.

In contrast to the LLLC-based hardware approach are wireless, zone-based controls. These solutions typically have a wall- or junction-box mounted solution where one device controls a group of standard LED fixtures using an open protocol like 0-10V or phase control. They are not embedded in the fixture, which means you should be able to independently install or upgrade the controls and fixtures.

Using a zone-based solution, in the event a component fails you can easily install an in-stock,

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readily available, off-the-shelf replacement in just a few minutes. And, if one of the standard 0- to 10-volt fixtures or drivers fail, you can usually find those components at your local distributor instead of having to wait for a rep to quote and a manufacturer to custom-build the LLLC-based replacement fixture.

Zone-based systems typically require fewer components than fixture-based solutions, may be less expensive to install and often allow the client to upgrade or repair devices quickly and easily. A zone-based, digital, wireless lighting control system can easily accommodate facility expansion and the software is likely to be cloud-updatable.

Smart, wireless lighting control solutions add value, longevity to projects

Protect your clients and your projects by specifying a lighting control system that promotes building resilience. A smart, digital, wireless, zone-based solution, built on a carefully chosen protocol can help to future proof projects and increase flexibility, ultimately leading to a building that is better equipped to handle future changes.

Specifying the right system for each job starts with laying out all the design considerations — reliability, responsiveness, security and scalability — asking the right questions about integration, remote system access and system resilience and making sure the manufacturer you choose has a history of service and support that meets your client's needs now and into future.

Matt Ochs
Matt Ochs *is senior director of commercial business for Lutron Electronics.*

Canadian Shopping Centre Made More Efficient with AI for HVAC

Westcliff, a Canadian private real estate development and investment company, has a portfolio of more than 10 million square feet of leasable space in Canada and the United States. For this asset, Granby Galleries located in Quebec, the primary project objective was to achieve energy savings while also improving the efficiency of the building's individual HVAC equipment.

Building details
Shopping Centre

Location
Granby, Quebec, Canada

Controls system
Automated Logic

Total square footage
509,612

Total square footage controlled by BrainBox AI

315,000

HVAC equipment controlled

Heat pumps

Fresh air handling units (FAHU) at pumps

PROCESS

Transforming a Granby shopping mall into a self-adaptive building

Installed its leading-edge technology into a 509,612 sq. ft. shopping centre in Granby, Quebec, where approximately 60% of the building was controlled, to convert the existing HVAC system into an autonomous one using artificial intelligence, cloud computing, and a set of custom curated algorithms. After a few weeks of data mapping, building analysis and an AI learning period, we were able to establish a strategy unique to the building by enriching its existing data sets with external weather and tariff structure data, resulting in a significant reduction in asset and equipment runtimes as well as energy consumption from HVAC operations.

Having a small building management team, engineers and project managers also offered significant value by delivering ongoing client support and acting as an extension of the client's team.

IMPACT

Achieving significant electricity and gas savings

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Electricity savings on HVAC equipment

-21%

Electricity savings on HVAC equipment

205,214kWh

Average runtime reduction by equipment type

Supply fan runtime

-33.5%

Heating stage runtime

-62%

Cooling stage runtime

-5%

Reheat stages runtime

-30%

Global reheat utilisation

-78%

Overall fan runtime

-61%

Heating modulation runtime

-91%

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Heating state runtime
-81%

This resulted in electricity savings on HVAC equipment of 205,214 kWh (21%) after a year of operation with BrainBox AI. Total monetary savings for the year amounted to 19,249 CAD, significantly reducing the shopping centre's operating expenses and improving its net operating income.

Aligned with the clients' primary goals, the technology helped improve operational efficiency by optimising the usage of certain HVAC equipment autonomously, the result of which was an average reduction in equipment runtime of 55% (see table for breakdown per piece of equipment). We were able to achieve these savings and reduction in equipment runtime while avoiding any fluctuations in average zone temperature* (average temperature of 69 °F with AI, versus 68.9°F without AI.)

The success story of this shopping centre is a prime example that building efficiency can be easily and quickly achieved with smart HVAC technology. We are proud to have helped the client in realising these great results.

*Based on a 1-week assessment in April 2021.

Office building design has changed

COVID, employee well-being and indoor air quality issues have all changed the way office buildings are designed

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Daniel Donahoe, PE, Senior Mechanical Engineer, LEO A DALY, Omaha, NE – Tyler Jensen, PE, LEED AP, Studio Leader, ESD, Chicago, IL – Brad McNiff, PE, LEED AP, WELL AP, Principal, GHT Limited, Arlington, VA – Gerald Williams, PE, LEED AP, Senior Mechanical Engineer, CRB, St. Louis, MO.

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What's the biggest trend you see in office buildings?

DANIEL DONAHOE: Stay-at-home orders during COVID-19 have accelerated the adoption of remote working and hybrid scheduling. With that, buildings need to be able to seamlessly flex between full to partial occupancy. Meanwhile, employees are looking for ways to engage with counterparts in their homes and offices simultaneously. To enable this level of flexibility and connectivity, we're seeing increased demand for technology that can accommodate mobility and allow for staff to collaborate from anywhere.

Working from home has also reduced the occupied load in current office buildings. This is contributing to higher heating, ventilation and air conditioning systems efficiency, especially for chillers and boilers that operate at a higher part-load efficiency.

TYLER JENSEN: A focus on employee well-being. Buildings are investing in upgraded air filtration, enhanced ventilation, secondary air purification, air quality monitoring systems and other measures to help make employees feel safe and comfortable returning to the office. Further, buildings are improving amenities and adding perks that encourage employees to work from the office rather than from home.

GERALD WILLIAMS: The most significant trend I have seen in office buildings is that since the outbreak of the COVID-19 pandemic in March 2020, there has been a widespread reluctance for many, if not most, workers to return to the office environment. This may be due to new restrictions on public gatherings, mask mandates and social distancing and a general concern for personal safety from the risk of contracting the virus.

With Zoom, Teams and other video conferencing tools now available, many people are discovering that they can be as productive from home as they were in the office every day, without the wasted time and money of a daily commute. As a result, many people now work entirely from home or through a hybrid model where they only go into the office once or twice a week for in-person meetings and to take advantage of office resources like a color printer.

What trends do you anticipate in the next six to 12 months?

DANIEL DONAHOE: Spaces will shift from more individual or private spaces (offices and workstations) to more flexible shared spaces that support functions people cannot get at home — namely, collaboration, socialization and learning. Employees have become completely untethered and float between spaces supported by state-of-the-art audiovisual and lighting that enhances the interior environment. Smart buildings allow for all spaces in a floor plate to react to changing outdoor conditions immediately, with systems reacting in real time to provide optimal comfort for occupants.

Post-COVID, we're seeing an increased focus on the health impacts of the building, especially with indoor air quality. Owners are paying more attention to ASHRAE recommendations for HVAC systems. For example, pre-COVID, they would be happy with a MERV 8 rating for filter efficiency, but we're seeing office buildings with MERV 13 ratings.

TYLER JENSEN: Newer office buildings will continue to differentiate themselves with higher-performing ventilation systems and improved amenity and retail offerings. As tenants return more to those newer office buildings, older buildings will look for ways

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Carson Headquarters in Omaha, Nebraska, is an example of innovative, high-performance design achieved through visionary architecture and highly refined engineering. Courtesy: AJ Brown Imaging, LEO A DALY

to catch up. I anticipate more repositioning work in existing buildings such as lobby renovations, amenity upgrades and HVAC improvements.

GERALD WILLIAMS: The traditional open office environment, with rows and rows of cubicles stacked together with short partitions, may become a thing of the past. People working in close proximity is not ideal for preventing the spread of airborne

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diseases, but is also no longer practical with so much of our daily business performed through video conferencing media. Even with good headphones, having multiple people talking into microphones next to each other can be distracting and counterproductive. The traditional meeting method of gathering people in small conference rooms is still perceived as unsafe, so the prolific use of video conferencing may become a permanent fixture of daily office life.

We may see a trend toward more individual offices instead of an open cubicle format as a means of isolating individuals from one another to prevent the spread of airborne disease. Individual offices are also more suitable for participating in virtual environment meetings and activities. New hybrid work models give employees who want or need to return to the brick-and-mortar offices a higher level of personal protection and productivity as underused spaces get converted into private, walled rooms.

How are you working with building owners and facilities personnel to ensure workers can safely return to office buildings after COVID-19 shutdowns?

DANIEL DONAHOE: Owners are definitely looking for improved indoor air quality. We are recommending increasing filter efficiency as per the ASHRAE recommendation. Existing and older fan systems may not have adequate fan power to meet the increased filter efficiency, which would lead to frequent filter replacement.

Companies are also working to maintain cleanability and adequate social distancing, but that is just the tip of the iceberg. COVID-19 has fundamentally changed workplace strategy for many employers. Offices must now appeal to workers by offering some-

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thing people cannot recreate at home — authentic connection to colleagues in spaces that appeal to employees in new ways. Spaces must be comfortable, easy to use and visually appealing. Amenity spaces that provide natural light, connections to the outdoors, ways to unwind and socialize are becoming the norm.

TYLER JENSEN: We developed a rapid building wellness assessment to help building owners and facilities personnel evaluate their existing building systems and operations and identify areas for modification that could improve indoor air quality in line with industry guidelines. Many buildings increased ventilation rates and HVAC operating hours in line with ASHRAE guidelines and were able to achieve goals with minimal capital expenditure. Some building owners wanted to go further and differentiate their assets by providing best in class indoor air quality. Our team worked with one client, Riverside, to deploy a state-of-the-art indoor air quality program at three office towers (one existing, two under construction) consisting of MERV 15 hospital-grade filtration, increased ventilation rates, secondary air purification and a 24/7 year-round air quality and pollutant measurement and verification system.

GERALD WILLIAMS: Even with the apparent success of transitioning to the virtual meeting environment, there continues to be a need for people to meet in person on occasion. As facility design engineers, it is incumbent on us to develop meeting places that address the safety concerns of people with respect to the spread of airborne diseases. As a result, this may completely change the way typical office HVAC systems are designed and operated.

Before the pandemic, environmental air distribution systems were designed with air diffusers that provided high throw and turbulence for good mixing of the colder

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air with the warm room air as a cost-efficient way of cooling the space. Costly, fresh outside air was kept to a minimum, per ASHRAE 62.1 standards and used mainly as a means for diluting volatile organic compounds, volatile organic compounds, from building materials, carbon dioxide by people exhaling and other odors that may be generated in the indoor environment.

With the desire to help prevent the spread of airborne particles and pathogens, a new approach to office environment HVAC design may need to be considered.

For decades, engineers and architects at CRB have been designing environments that tightly control the spread of particles and pathogens in bio-pharmaceutical cleanrooms and indoor environments to support the sensitive nature of the drug manufacturing process. These designs use laminar airflow diffusers with terminal HEPA filtration and low wall returns to gently capture particles that are generated by people and products, sweeping them away from the breathing zone using laminar airflow patterns.

This is in sharp contrast to the standard office airflow design, which uses low-efficiency filtration and high-velocity diffusers to create turbulent airflow patterns in the office for good mixing. Offices could use cleanroom techniques by installing terminal HEPA filters and low wall returns to wash clean air over conference tables, break room areas and office desks to sweep particles generated by employees downward into low wall returns. The addition of low-velocity HEPA filtered air in the breathing zone of occupants, in combination with a higher percentage of outside air, could substantially increase the air quality and resulting health and safety of the indoor environment.

Heat wheels and other similar energy recovery systems can recover up to 80% of the

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sensible and latent energy of air being exhausted, so a 100% outside air HVAC system could be more economical to operate and provide an additional level of higher air quality for the indoor environment.

Tell us about a recent project you've worked on that's innovative, large-scale or otherwise noteworthy.

DANIEL DONAHOE: Carson Headquarters in Omaha, Nebraska, is an example of innovative, high-performance design achieved through visionary architecture and highly refined engineering. Clad in electrochromic glass, the high-tech building skin bathes the interior in healthy daylight, yet occupants experience very little glare or heat gain. With no need for window coverings, dramatic vistas are available in every season. Natural daylight renders truer colors, skin tones and textures, enhancing the circadian rhythms of occupants. All this while reducing energy consumption — 15% less for HVAC and 74% less for electric lighting. A post-occupancy evaluation confirmed performance using illuminance meters, spectrometers and other devices. On the hottest days of summer, the building was still 19% more efficient.

Based on intensive research of Carson's brand and values, LEO A DALY developed the design concept for Carson headquarters to embrace a thriving, work-live-play culture. The 194,000-square-foot office campus features two four-story glass towers joined by a two-story amenity zone. Inside the amenity zone, named Carson Commons, visitors and Carson employees can dine, socialize and nourish their health with café and fitness amenities.

LEO A DALY's design for Carson headquarters earned the moniker Ascend based on its upward-sweeping rooflines, which reference Carson's guided by growth — live life by

design, not by default value. The exterior features a transparent skin that invites ample interior daylighting to a mix of private and collaborative workspaces, while conveying outwardly Carson's value of transparency.

Integrated amenities such as courtyards, a rooftop terrace and the central amenity zone reinforce Carson's passion for its people and its obsession with the client experience. Carson's family philosophy toward its employees informs the interior design. Public areas are designated as living room, front porch and kitchen table and the materiality is light and open, with natural wood accents lending warmth, like an invitation, especially when made visually prominent by streams of daylight. Orientation of the campus opens southward, maximizing diurnal cycles in all of Nebraska's four seasons. From higher elevations, it also offers sweeping views of Heartwood Preserve, the adjacent 500-acre mixed-use development.

TYLER JENSEN: We are working on a 700,000-rentable-square-foot, 30-story office tower in Denver for Riverside Investment and Development with Goettsch Partners architects. The building is currently in design and will break ground in Q1 2022. We have previously worked with this same team on multiple office towers in Chicago, but we were presented with a unique challenge in Denver due to the stringent energy code requirement to be 24% better than International Energy Conservation Code 2018.

The market demand is for a highly glazed envelope with floor-to-ceiling views, which can be a challenge for energy performance. Extensive energy modeling was used to confirm that code could be met with a high-performance curtain wall coupled with highly efficient mechanical, electrical and plumbing systems. The primary HVAC system consists of a dedicated outdoor air system (with increased ventilation rates for indoor

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air quality benefit) and a water-source variable refrigerant flow system for space heating and cooling. The end result will be a best-in-class, highly efficient building that achieves the desired aesthetic and will be attractive to potential tenants.

BRAD McNIFF: Metropolitan Park, the first phase of Amazon's HQ2 development in Arlington, Virginia, is a 2.2 million square foot Class A office project spread across two 22-story towers, connected by an ~800,000-square-foot underground parking garage. GHT partnered with ZGF Architects and other design professionals to design the new project, which is being managed and developed by Seneca Group and JBG Smith, respectively.

Several sophisticated MEP systems were needed to meet the project's aggressive sustainability goals, including a premium efficiency central chilled water plant optimized around the campus load profile derived from energy modeling, dedicated outdoor air systems with sensible cooling fan-powered terminal units, water-to-water heat pumps to reclaim heat from building condenser water loops for domestic hot water heating, greywater and stormwater recycling systems and foundation dewatering heat exchange systems. The project is currently being built by Clark Construction and will be completed in 2023.

How are engineers designing office facilities to keep costs down while offering appealing features, complying with relevant codes and meeting client needs?

DANIEL DONAHOE: Supply chain issues are driving cost conversations, especially where the unavailability of a certain product can cause delays in the project. We've had

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to remain flexible to pivot to different building systems or materials, designing around access and lead times. We are specifying the products that are most available and have the best lead times and changing design accordingly to maintain schedule and cost.

For example, we recently switched from using a variable frequency drive motor instead of an electronically commutated motor on a fan because there was an 18-week lead time for the ECM, compared to four weeks for the VFD. Avoiding delays is critical to saving on cost.

TYLER JENSEN: The best way is to use solutions that can reduce first costs while also improving energy performance needed to comply with energy codes and certification programs like U.S. Green Building Council LEED. For office HVAC systems, we are using low-temperature air and water distribution systems with a high delta T to achieve that goal. Low-temperature air systems can provide the required cooling capacity with lower air volume. Smaller fans, shafts and ductwork reduces the first cost and also provides significant fan energy savings. Similarly, high delta T water distribution systems reduce installed pump and pipe sizes and also provides pumping energy savings.

Consulting-Specifying Engineer

Manufacturing and industrial building codes and standards trends

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Several new and retrofit manufacturing building projects show trends in codes and standards changing

Brian Arend, PE, LEED AP, Electrical Engineering Manager, SSOE Group, Toledo, Ohio – Shane R. Eckman, PE, LEED AP, Vice President, Industrial & Institutional Practice Leader, Stanley Consultants Inc., Minneapolis – Kevin LaPlante, PE, LEED AP, Mechanical Group Leader, CRB, Medford, Massachusetts – Sunondo Roy, PE, LEED AP, Director, Design Group, Romeoville, Illinois

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Which codes/standards should engineers be most aware of?

BRIAN AREND: On the electrical side, the NFPA 70: National Electrical Code, is by far the most used. We also routinely use NFPA 101: Life Safety Code, NFPA 70E, NESC, ASHRAE Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings and IEEE color books.

SHANE R. ECKMAN: IBC, IFC, IEBC, IECC, NFPA, Occupational Safety and Health Administration, ASHRAE, UL, state and local codes and the owners established requirements.

SUNONDO ROY: NFPA 70, National Electrical Code, is obviously one of the most crucial codes with regard to electrical design in all facilities. However, for industrial and manufacturing facilities, Articles 500 through 504 are especially critical for determining Hazardous (Classified) Locations, Classes I, II and III, Divisions 1 and 2. These articles cover the requirements for electrical and electronic equipment and wiring for all voltages in locations where fire or explosion hazards may exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts or ignitable fibers/flyings. Additionally, designers should be familiar with NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas and NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas.

What are some best practices to ensure that such buildings meet and exceed codes and standards?

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SHANE R. ECKMAN: The design team must understand which codes are applicable and have a thorough understanding of those codes, including the requirements and intent of each provision, as the codes sometimes need to be interpreted. The team must also understand how the space is being used (manufacturing, storage, shipping, laboratory, etc.), layout of equipment and utilities, material and traffic flow, chemicals being used or stored, occupancy and electrical classifications, fire requirements, etc. The code requirements need to be addressed at the beginning of the project and then confirmed at the end of the design process, to ensure compliance as the requirements may have changed during the design process. Equally important is to engage the local code official early, to keep them informed of the project, identify their concerns and confirm that their interpretations of the code requirements match the design team's.

BRIAN AREND: A couple come to mind, like peer reviews and quality checks. Engaging a senior engineer in a peer review in the 20% to 30% complete range cannot only validate the original design intent, but also allow for outside input and provides a mechanism for a different perspective. Quality checks before major postings is another useful tool. Having a senior engineer do a line-by-line check of the contract documents allows for a code, best practices and constructability review before the set is released for bids or permits. A side benefit of both is the lead on the project has an avenue for continuous learning.

SUNONDO ROY: It is critical to understand the actual extent of the hazardous environment to ensure the special design precautions in the National Electrical Code (NEC), Articles 500 – 504, are applied correctly to the areas of hazard and not applied to areas beyond the area of the specific hazard. It is important to establish hazard boundary(ies) and create a matrix of mitigation measures to ensure the installing contractor knows that not only equipment specifically noted on the drawings, but any additional equipment, devices and wiring that may be installed in the course of con-

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struction phase adjustments comply with the applicable sections of NEC Articles 500 – 504 and the NFPA 497 and 499. Typically, it is advisable to engage a specialty firm to perform a dust hazard analysis for all locations with processes where potentially combustible dust is generated or can settle and collect.

What new or updated code, standard, guideline organization or association do you feel will change the way such projects are designed, bid out or built?

SHANE R. ECKMAN: Sustainable design (U.S. Green Building Council/LEED) and WELL building design

What are some of the biggest challenges when considering code compliance and designing or working with existing buildings?

SHANE R. ECKMAN: The codes are written in a way that they can be ambiguous and may require some interpretation to identify the intent. As different people have varying backgrounds, expertise and perspectives, getting everyone to agree on the intent can sometimes be a challenge. The key to addressing this challenge is to approach the code discussions with an open mind, realizing that there may be more than one correct interpretation.

BRIAN AREND: The loading of existing equipment needs to be carefully reviewed. NEC Article 220 requires the designer to understand the existing load before adding new load. As design professionals, we need to either calculate what that starting load is or work with the client and get metered data.

Building codes set solar standards

The future of rooftop power plants

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Solar panel producers are gearing up production. Yes, they took notice when policymakers set targets for the production of clean energy. And they took thousands of orders when consumers were given incentives to install renewable energy systems.

Now, they are preparing to meet the demands that will come from California's revised building codes. The 2019 Building Energy Efficiency Standards, which will go into effect in January 2020, will require solar panels for new single-family homes and low-rise apartment buildings that are built in California.

"The groundbreaking decision to make these new homes net-zero electricity, coupled with major savings from more efficient lighting required by the updated code for commercial buildings, will save Californians more than $1.7 billion in net energy savings over the next 30 years and reduce carbon pollution statewide by 1.4 million metric tons," according to Pierre Delforge, a senior scientist with the Natural Resources Defense Council.

There will be a new look for new housing, though not every new homeowner will have to buy solar panels. The panels can be leased, or homeowners can get their energy from shared solar arrays.

The Sacramento Municipal Utility District, for example, says enrollment in its SolarShares program will be available to residential customers in 2020. "A community solar project is an agreement where an electric utility provides solar energy to a customer from arrays connected to the grid and in which the participant has all the rights to

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make the environmental and renewable claims from the power they use," according to the District. "This allows the customer to avoid developing and maintaining their own on-site solar facilities."

An article in the Los Angeles Times by Jack Flemming describes the costs for photovoltaic systems, affordability concerns, potential savings, and what developers are doing to prepare for the solar power requirement.

"The nation's largest home construction company, Lennar Corp., builds about 50,000 houses every year and has been preparing for this day as well. Five years ago, it created SunStreet Energy Group, which produces and maintains solar panel systems in homes for Lennar and a handful of other developers," Flemming wrote. "While many solar panel systems are retrofitted after the home is built, SunStreet builds them into the fabric of the house during the construction process."

California was not the only state to advance the clean energy cause in 2018. The Aurora Solar Blog tracks new policy developments in the industry, and published updates on about a dozen states.

"Actions by California, New Jersey, New York, and Washington state to commit to 100% renewable or carbon-free energy were especially noteworthy. Nevada also established an ambitious clean energy targets of 50%," wrote Gwen Brown in the blog. "Additionally, Hawaii's redesign of utility incentives provides a model for how utilities can benefit from solar growth. Virginia's major utility took the first steps toward significant solar procurement in accordance with a new state law. Illinois, New York, and Massachusetts updated their solar incentive programs and Maryland offered grant funding

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for solar-plus-storage projects to improve resilience."

IMS has covered hundreds of projects related to solar power, clean energy, and zero-net energy buildings. The 2018 policy changes and mandates will have an impact for housing developers, energy engineers, designers of solar farms, plan examiners, and utility engineers.

IMS will continue to cover a range of these public-sector projects for the A/E/C industry via in-depth research, daily project leads from RFPs and RFQs, and Advanced Notice information on upcoming opportunities. Some recent projects that IMS has covered for its clients include:

- The Georgia Environmental Finance Authority released an RFP in November 2018 for a consultant to provide training for code officials, engineers, architects, building inspectors, and builders on the energy requirements in the Georgia Energy Code that goes into effect January 1, 2020 (IMS 449498).

- The University of Oregon issued an RFP in September 2018 for a consultant to perform energy analyses for the Housing Building Replacement Project to determine whether it would meet the University's advanced energy threshold of 25% above the current state energy code (IMS 441715).

- The State of California, Energy Commission, released an RFQ in August 2018 for a consultant to provide technical support for compliance and performance tools for the California Energy Code (IMS 439226).

- In Colorado, the City of Boulder issued an RFP in June 2018 for a consultant to provide assistance with developing an increasingly stringent version of commercial and residential energy codes (IMS 429542).

- The New York State Energy Research and Development Authority released an RFQ in March 2018 for consultants to provide design and support services for innovative energy efficiency and clean energy market development programs, such as net-zero energy and carbon-based energy codes, and net-zero energy design and construction (IMS 420529).

- Peninsula Clean Energy, in San Mateo and Santa Clara Counties, Calif., released an RFP in November 2018 to develop model building reach codes for member municipalities to address electric vehicle infrastructure and building electrification needs (IMS 450465).

- IMS published an Advance Notice and the subsequent RFP in October 2018 for the City of Berkeley to develop a Pathways to Clean Energy Buildings Report focused on the existing building stock. The project included evaluating the Building Energy Savings Ordinance and identifying programs and policies to transition to 100% clean energy (IMS 440662-1).

It will be interesting to track the uptick in solar panel installations. And a team at Stanford University has created a machine learning program named DeepSolar that is capable of doing just that. The program recently analyzed satellite images to identify nearly every solar power asset in the 48 contiguous United States.

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"The analysis found 1.47 million installations, which is a much higher figure than either of the two widely recognized estimates," according to Stanford University. "The scientists also integrated U.S. Census and other data with their solar catalog to identify factors leading to solar power adoption."

According to the group Environment America, the country is "still not even close to reaching our solar potential."

"At this point, any new home or building constructed without solar power is a missed opportunity to capture clean energy from the sun and move California to a 100 percent clean energy future," said Michelle Kinman, Clean Energy and Transportation Program Director for the Environment California Research & Policy Center.

Dodge Construction Network

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