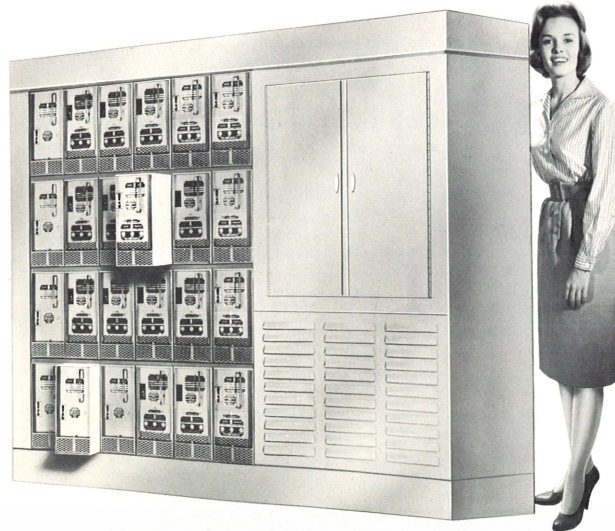


Is It Time to Sunset Control Panels?

A lighting-controls architecture white paper

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Prepared for engineering, design, commissioning, sustainability and owner-advisory teams



Executive Summary

Yes. It is time to sunset panel-first lighting control design. The recommendation is not to eliminate every lighting control panel; it is to move centralized panels from the default basis of design to an exception that must justify itself against distributed and luminaire-level networked alternatives. Panels remain legitimate for emergency and life-safety interfaces, normal/emergency segregation, industrial or high-current loads, specialty dimming, radio-prohibited facilities, legacy retrofit constraints and owner-specific Operations and Maintenance (O&M) standards. For ordinary commercial projects, however, the default should be least-material, software-defined control located as close as practical to the load and the occupancy/daylight signal.

This position is useful to engineering firms because it is both provocative and defensible. It does not claim that panel products fail. It claims that the architecture has to win a complete comparison. If the panel performs a unique engineering function, keep it. If it merely preserves a legacy wiring habit after the luminaires, sensors and software have moved elsewhere, the design team should remove it before the owner pays for unnecessary metal, space, labor, commissioning and future churn.

1. Why the question is legitimate now

Lighting control panels solved a historical problem: how to switch, dim, schedule and override lighting loads when luminaires were passive electrical loads and control intelligence was scarce. That problem has changed. LEDs made the load electronic. Sensors made the luminaire aware of people and daylight. Wireless and digital networks made zoning a software object rather than a fixed wiring condition. Owners now expect controls to support occupancy/vacancy response, daylighting, high-end trim, scheduling, demand response, diagnostics, HVAC integration, space-utilization data and credible sustainability reporting.

The code trajectory makes this an architecture question, not a product preference. ASHRAE 90.1-2022 tightened open-office control granularity with 600 ft² general-lighting control zones; California Title 24 pushes demand-responsive lighting controls and OpenADR capability; NYC's 2025 Energy Code materials call out primary and secondary daylight-responsive zones with separate control thresholds. Plug-load and lower-LPD (Lighting Power Density) trends further increase the value of occupancy data as a building signal. Each requirement can be simple in software and expensive in copper: in a panel-first design, every new zone tends to become another relay, switch leg, home run, conduit path, label and commissioning point. [1][2][3][4]

This is the core reframing: a control panel is not a neutral detail. It is a commitment to a wiring topology, material bill, electrical-room footprint, commissioning workflow and future-change pathway. In buildings expected to churn – offices, schools, healthcare administration, labs, retail, warehouses with changing racking and mixed-use campuses – panel-first design can hard-wire a temporary space plan into permanent infrastructure. A building that changes by software is less brittle than a building that changes by re-pulling control intent through conduit.

2. What panel-based systems still sell – and why it is no longer decisive

Panel vendors do not sell cabinets as cabinets. They sell risk reduction: central schedules, local override, emergency interfaces, BACnet connectivity, known risers, familiar contractor workflows, visible relays and manufacturer-backed sequences. Those are real strengths and should be conceded. The mistake is allowing those strengths to settle the architecture question for every interior zone. Reliability answers “Will it work?” It does not answer “Is this the least-material, most-adaptable way to deliver the sequence?”

The hard-to-counter angles are simple. First, codes require outcomes, not cabinets: occupancy control, daylight response, high-end trim, manual control, scheduling, demand response and integration can be specified as performance requirements. Second, centralized visibility does not require centralized power switching: owners need device maps, diagnostics, trends, schedules, data export and durable configuration records, not necessarily a relay in an electrical room. Third, total burden must be counted: cabinets, relays, dimming modules, power supplies, terminal blocks, spare capacity, branch-circuit home runs, conduit, control wiring, electrical-room wall space, field labels, coordination drawings, commissioning time, troubleshooting and future tenant-improvement work.

Incumbent manufacturers also weaken their own panel-first defense. The same companies that sell panelized systems also market wireless or distributed controls using claims such as no control wire, faster installation, app-based commissioning, fewer installed devices and easier expansion. Those claims do not prove every distributed project is superior, but they do validate the pain points: wiring, installation time, disruption and reconfiguration burden are real costs. The vendor can defend exceptions; it cannot credibly defend the panel as the default for every standard interior application. [14]

The specification implication is clear: do not ask “Can the panel meet the code?” Ask “What unique function does this panel perform that cannot be met with a lower-burden architecture?” This moves the discussion from product familiarity to owner value. It also prevents the common estimating distortion in which the panel price is compared with a distributed controls package while the panel's conduits, home runs, clearances, spare capacity, coordination time and future rewiring are buried in other line items.

3. The undercounted burden: material, carbon, space, commissioning and churn

Panelized lighting-control costs are routinely undercounted because equipment, branch wiring, controls wiring, labor, commissioning and future maintenance sit in separate budget lines. A complete comparison should include the enclosure, copper conductors, raceway, terminal blocks, DIN rail, relays, dimming modules, breakers or feed-through assemblies, low-voltage cable, junction boxes, supports, labels, packaging, freight and spare capacity. The cabinet may look inexpensive while the architecture is expensive.

The embodied-carbon issue is no longer peripheral. Carbon Leadership Forum work notes that MEP systems can represent 15-50 percent of embodied carbon over a building life, especially when replacements and tenant improvements are counted. Copper, steel and aluminum are carbon-intensive, and panel-first designs multiply

those materials through cabinets, conductors, conduit, feeders and unused future capacity. A single panel may not define a building's carbon story; a panel-first design pattern across floors can. [8][9][10]

Panels also occupy real estate and coordination bandwidth. They need wall area, clearance, access, sleeves, fire-stopping, electrical-room layout, riser coordination, field terminations and owner training. Pacific Northwest National Laboratories (PNNL)'s lighting-controls guidance identifies recurring project problems such as unclear objectives, incomplete documentation, terminology ambiguity and manufacturer-specific architectures. Panel-first designs add physical specificity: relay counts, branch-circuit grouping, switch legs, emergency/normal segregation, dimming zone schedules and field checkout. [7]

The maintenance penalty appears when the building changes. A tenant improvement can turn yesterday's relay zone into an awkward artifact. Splitting a conference room, changing a classroom cluster or moving warehouse racking may require rewiring, revised drawings, night work and recommissioning. Distributed and luminaire-level systems do not eliminate all field work, but they move more changes from wiring to software and make the zone follow the space instead of forcing the space to follow the circuit.

The circular-economy critique is not that panels are "bad products." It is that panel-first design often creates project-specific, mixed-material assemblies that are hard to reuse and likely to be scrapped. Responsible alternatives must also be scrutinized: more nodes can mean more electronics, radios, firmware and batteries. A credible specification should require modular/replaceable control modules where available, documented software support, battery strategy, Environmental Product Declarations (EPD)s where available, take-back or recycling plans and service procedures that do not force replacement of an entire luminaire for a small control fault. [11][15]

4. Why distributed and luminaire-level control is the stronger default

The argument for distributed control is not convenience alone. Its strongest claims map directly to engineering pain points: less permanent control infrastructure, faster fit-outs, lower disruption, software rezoning, granular savings, better diagnostics and better integration data. DLC/NEEA reported average networked lighting-control savings of 49 percent across the studied population, with a higher average for systems with luminaire-level capability than for systems without it. GSA guidance for federal buildings likewise treats networked LLC with HVAC integration as a high-savings pathway because occupancy data can support both lighting and HVAC occupied-setback strategies. [5][6]

Interoperability is becoming a stronger technical argument than it was when many proprietary wireless systems were introduced. Bluetooth SIG completed Bluetooth Networked Lighting Control (NLC) in 2023 as a full-stack wireless lighting-control standard, from radio through device layer, intended to support multi-vendor interoperability. For engineering firms, that reframes wireless luminaire-level control from "vendor gadget" to a specifiable standards path: require qualified devices, documented cybersecurity, exportable data and owner-accessible commissioning records. [12]

Fixture-level metering and addressability also change the savings conversation. A panel can switch a group; a fixture-level system can show where power is going, tune by task, shed selectively during a demand-response event and keep critical or occupied areas comfortable while reducing load elsewhere. As electricity-price pressure and grid constraints increase the value of curtailment, the ability to dim or shed individual luminaires is more useful than switching a coarse zone at a panel. [13]

Distributed architecture can also become a building-data platform. Occupancy, daylight, temperature, air quality, people counting, shade position, energy, load-shed and other signals can be exposed to BACnet/IP or APIs while still presenting analog or contact signals where required. Because control lives in software, updates and sequence refinements can occur through managed software workflows rather than a service visit to every controller. [12]

This does not mean "no panels ever" or "wireless always." It means the default burden of proof has changed. A design should place the control point near the load and the space condition unless a centralized panel performs a unique engineering function. It should also avoid merely replacing the electrical-room panel with another ceiling-centralized box that preserves the same hard zone boundaries. The goal is not a different box; it is a more adaptable building.

5. A policy proposal: make panels exceptions and require complete comparison

For ordinary interior general lighting in new construction and major renovations, use distributed or luminaire-level networked control with software-defined zoning as the basis of design. Permit centralized lighting control panels by documented exception only. This policy does not assume that every distributed solution is superior; it requires every panel-first solution to compete on the full engineering problem instead of on a narrow equipment-cost comparison.

- Default requirements: local occupancy/vacancy sensing, daylight response where applicable, high-end trim, manual control, scheduling, diagnostics, trend data, documented sequence of operation and BAS integration where indicated.
- Material discipline: minimize new cabinets, conduit and copper. Where a panel is proposed, quantify cabinet count, branch-circuit home runs, control wiring, conductor length, spare capacity, wall space and estimated future rezoning work.
- Owner control: require searchable device maps, role-based access, cybersecurity documentation, exportable configuration records, firmware/support terms and commissioning handover that the owner or service partner can maintain.
- Permitted exceptions: emergency transfer or bypass, normal/emergency segregation, exterior/site loads, parking structures, industrial or high-current loads, theatrical/specialty dimming, legacy constraints, radio-prohibited facilities and owner standards with a defined operational reason.

Panel-exception test

1. What unique function does the panel perform?	2. Why can that function not be met by distributed or luminaire-level control?
3. What added material, space and carbon burden does the panel architecture create?	4. How will future rezoning occur, and which changes require rewiring?
5. How will commissioning, daylight calibration, overrides and emergency behavior be verified?	6. What data, diagnostics, metering, trends and export methods are available to the owner?
7. What cybersecurity, firmware and software-support commitments apply?	8. What is the end-of-life, reuse, take-back or recycling plan?

Basis-of-design clause

Interior general lighting controls shall be designed using a distributed or luminaire-level networked architecture unless a centralized lighting control panel is approved by exception. The system shall support software-defined zoning, occupancy/vacancy control, daylight response where required, high-end trim, scheduling, manual override, diagnostics, trend reporting and BACnet/IP or API integration where indicated, with analog/contact interfaces where required. The design shall minimize cabinets, conduit and copper while meeting code, safety, cybersecurity, serviceability and owner O&M requirements.

Controls submittal comparison

Item	Panel-first design	Distributed / LLLC design
Material	Cabinets, relays, dimming modules, home runs, conduit, control cable and spare capacity.	Fixture nodes/controllers, sensors, gateways where needed, minimal control wiring, batteries only where justified.
Adaptability	Identify work required to split, merge or move zones after tenant changes.	Identify which changes are software-only and which require device relocation or added nodes.
Energy/data	Document whether sensing, metering and diagnostics are by circuit, room or area.	Document per-fixture or per-zone occupancy, dimming, diagnostics, energy estimates, trends and export methods.
Commissioning	Point-to-point checkout, relay schedules, sequence testing, daylight calibration, emergency verification and owner training.	App/network commissioning plan, device map, sequence testing, firmware record, calibration workflow and owner handover.
Carbon/circularity	Cabinet counts, conductor/conduit length, service life, spare capacity and end-of-life path.	Device counts, modularity, support term, battery policy, EPDs where available, take-back/recycling plan.

Decision rule for engineering firms

Use the panel only if it wins a complete comparison or performs a required exception function. Do not use a panel because circuits already organize the lighting schedule, because a legacy detail exists, because it appears cheaper before wiring is counted, or because the design team wants to defer software zoning decisions until commissioning. The engineering standard should reward the architecture that reduces permanent infrastructure, supports measured performance and protects the owner from tenant churn.

The owner-facing message is equally simple: the project is not buying fewer boxes; it is buying a more adaptable building. A distributed or luminaire-level approach can allow spaces to change without rewiring, produce better savings data, expose occupancy to HVAC, support demand-response strategies and reduce hidden infrastructure. Where a panel is still necessary, the owner will know why and can maintain it as a specialty device rather than inherited clutter.

RFP / Division 26 checklist

- Require an architecture bill of material: panels, gateways, controllers, sensors, luminaires, control cable, conduit, batteries and spare capacity.
- Require an acceptance-test narrative for occupancy, daylight, high-end trim, scheduling, override, emergency behavior, demand response and BAS/API points.
- Require a reconfiguration narrative that distinguishes software-only changes from work requiring new devices, wiring, licenses or factory service.
- Require owner handover: device map, sequence of operation, commissioning records, login/role model, firmware policy, cybersecurity documentation and support term.
- Require a circularity statement: EPDs where available, battery plan, replaceable modules, take-back/recycling plan and avoidance of unnecessary permanent infrastructure.

Conclusion: sunset the default

Lighting control panels earned their place when lighting was a circuit problem. In many current buildings, lighting control is a sensing, software, energy, carbon and adaptability problem. The defensible engineering position is not to over-claim that distributed or LLLC is always better; it is to require panel-first systems to prove they are better on

the complete architecture. Sunset the default. Preserve the exceptions. Make least-material, software-defined control the standard basis of design for spaces expected to change.

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