The Importance and Best Practices of Power Over Ethernet

December 8, 2022

ELECTRIC LEAGUE
OF THE PACIFIC NORTHWEST

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Today's Panel

Design Considerations

Seth Ely, Associate
Lighting Design
Stantec

Luminaire and Integration Considerations

Eden Van Ballegooijen, Principal
Director of Controls
Pacific Lighting Systems

Moderator

Shaun Darragh
Lighting and Controls Design and Education

Installation Considerations

Mark Klokkevold
General Foreman
Valley Electric

Utility Considerations

Rob Marks
Energy Efficiency Engineer
Snohomish County PUD

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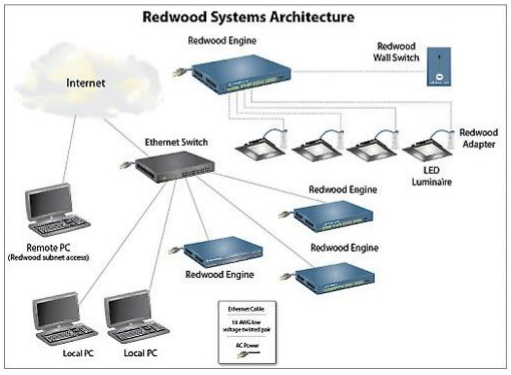
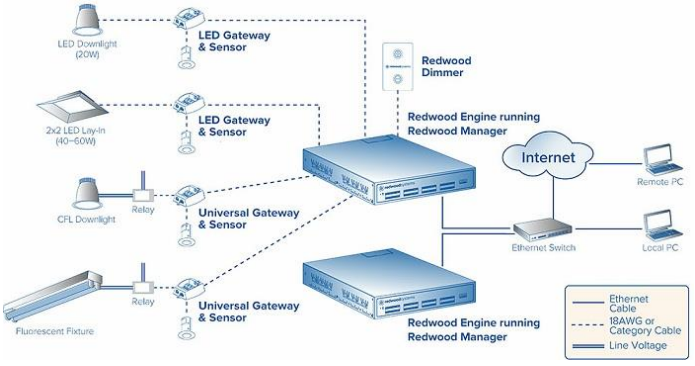
Redwood Systems Launches First Network-based LED Lighting Technology

Redwood Systems today publicly launches the first network-based technology for LED lighting and building performance systems. This new technology is based on the idea that LED lighting presents a new opportunity to create a unified network-based digital platform for smart buildings, helping building owners and designers reduce energy costs while providing control and automation in commercial lighting never before possible.





2008 Redwood Systems

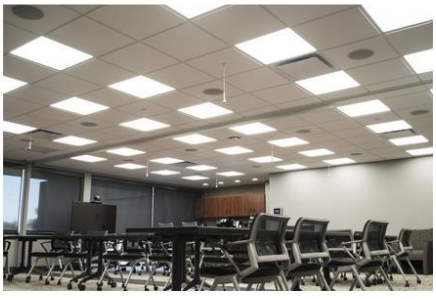
●3

Can Integrators Replace Electricians?

By Brian Rhodes, Published May 28, 2012, 08:00pm EDT

PoE is not just for cameras, and a new trend may turn the tables by making lights just another networked service.

While electricians often poach security business and hang cameras, this tech could flip things by allowing integrators to install light systems, with the end result looking just like conventional systems.

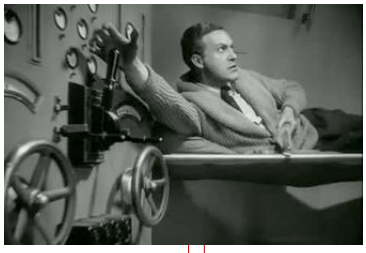


Are these products a novelty, or do they represent real advancement in lighting technology? In this note, we analyze PoE Illumination's potential impact in the integration market.

2012 - Can Integrators Replace Electricians?

●4

- Line voltage switch
- Three way switch
- Contactor
- Low voltage hardwired relay
- Strap and wallbox dimmers
- Preset control dimming
- Luminaire addressable hardwired
- Zone control wireless
- Luminaire addressable wireless
- POE (Power Over Ethernet)
- IOT (Internet of Things)



Hardware Evolution

Courtesy: Cisco

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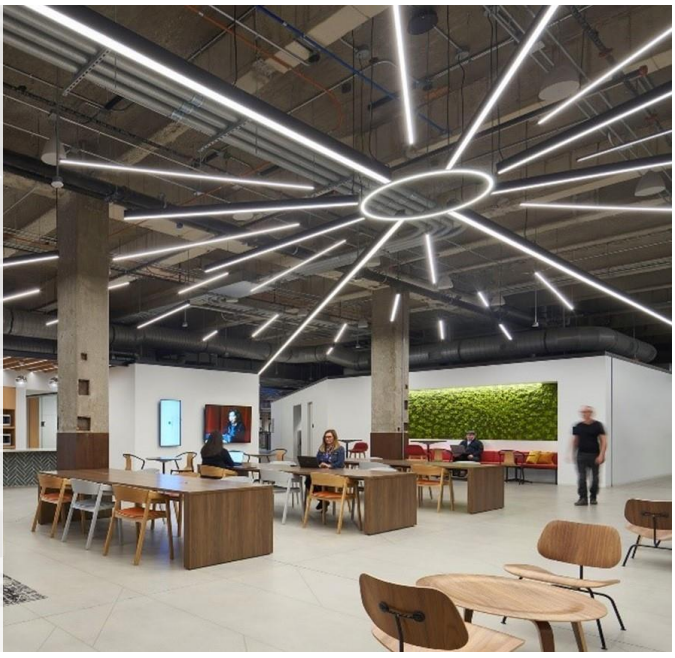
SMART BUILDINGS

What is a Smart Building?

A sustainable and future-ready building that leverages smart technologies and data to create social, environmental, and economic benefits for everyone involved.



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SMART BUILDINGS

CHALLENGES & OPPORTUNITIES

- Decarbonization
- Occupant Experience
- Performance
- Wellness and Safety
- Cyber Security

ESG. Fighting climate change. Reduced energy consumption. Minimize carbon footprint. Etc.

Workforce productivity. Simplicity for employees, FM teams. Consistency and expandable. Etc.

Reducing operating cost. Extending the technical and economic life of assets. Etc.

Employee health and wellness. Improved air quality. Safety and security of people and assets. Etc.

Improve cyber security and intelligence. Protecting data from connected things. Etc.

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The Drivers & Impact of Smart Buildings

A smart building will address so many challenges, and benefit so many stakeholders—an integrated and streamlined approach is warranted.

INVESTOR & FINANCE	ASSET MANAGER	ENERGY MANAGER	FACILITY MANAGER	HOUSEKEEPING
Maximize economic value	Prolong and improve building systems performance	Realtime consumption visibility. ESG reporting. Energy reduction.	Simplify changes, management, and cut OPEX.	Optimize schedule and prioritize in-need spaces.
Eliminate expensive proprietary and disparate infrastructure.	Issue work-order before a failure or malfunction takes place.	Predict temperature and lighting requirements and optimize environmental conditions accordingly.	Reduce need for expensive contractors to move a fixture or change a switch.	Occupancy sensors calculate necessary cleaning and service routes.
Reduce operating cost by 11% or more. Reduce capex by 15% for ME+ICT.	Improve system performance and reduces OPEX by 14% or more.	Instant visibility, reporting, and reduce energy cost by more than 25%.	Automated admin and reporting cuts 18% OPEX.	6% OPEX reduction for streamlined housekeeping services.

SMART BUILDINGS

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Unlocking the value of a "smart building"

- Core to the built environment—part of its DNA
- Central to building operations
- Several uses within the building
- Isolated use within the building

Adapted from OECD, INDEF, WEF

SMART BUILDINGS

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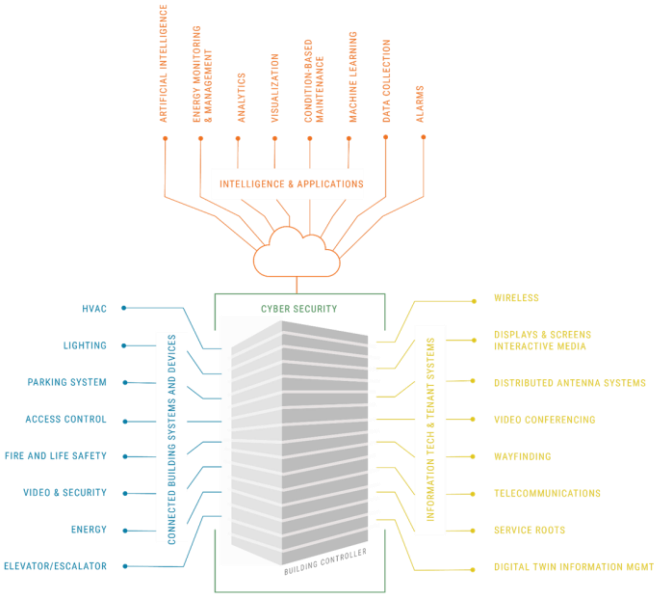
Smart Building: convergence, integration, and intelligence

SMART BUILDINGS

One digital **open-architecture network** infrastructure that **connects, instruments, integrates** building and IT systems, and **turns data into insights** resulting in improved performance, flexibility, and incremental value-creation.



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The Path Toward Smart Buildings

SMART BUILDINGS

Implementing a sustainable and inclusive strategic master plan that breaks through IT, OT, and System siloes and barriers.

Phase 1 VISIONING	Phase 2 FRAMING	Phase 3 ROADMAP	Phase 4 OPERATE
"the why"	"the what"	"the how"	"the value"
Trends and Possibilities Expected Business Outcomes Performance Management	Smart Building solutions Smart infrastructure Strategy Partnerships	Planning Specifications & Standards Procurement	Device on-boarding, testing, & verification. Fault Detection & Diagnostics. Operational Insights. User experience.
STAKEHOLDER ENGAGEMENT	DESIGN THINKING/ CHARRETTES	SMART BUILDING MASTERPLAN	OVERSIGHT & COMMISSIONING

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SMART BUILDING CORE INFRASTRUCTURE

PoE Lighting Design Considerations

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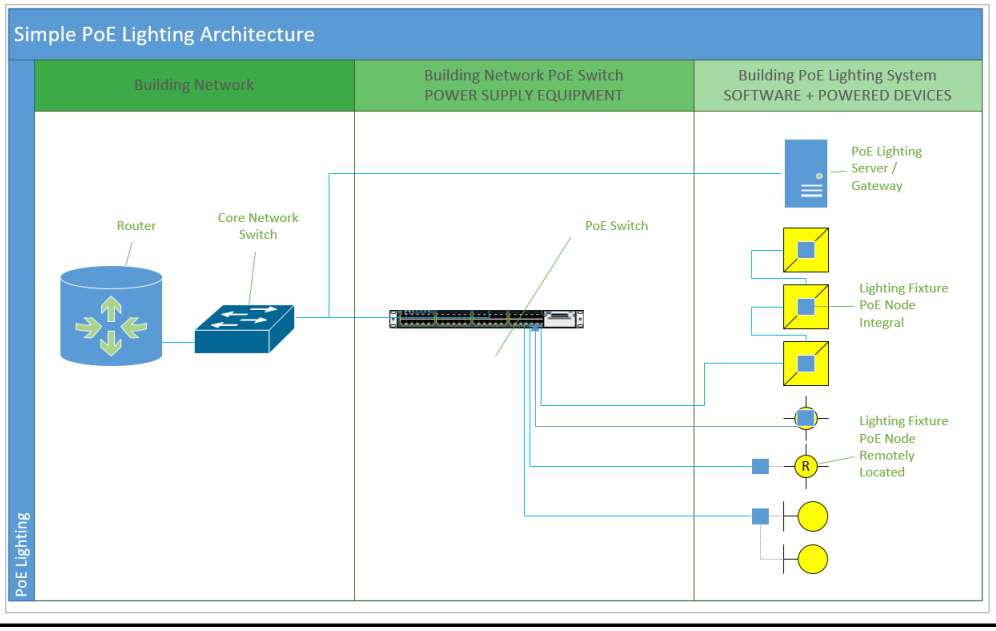
SMART BUILDING CORE INFRASTRUCTURE

NETWORK & PoE LIGHTING ARCHITECTURE



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POWERED DEVICES (PD)

PHYSICAL CHARACTERISTICS – PoE NODES

SMART BUILDING CORE INFRASTRUCTURE

Confirm:

- Are PoE Node and Light fixture compatibility based on constant current or constant voltage
- Can PoE nodes be pre-programmed by fixture manufacturer?
- How do lighting control and sensor devices integrate into the PoE system?
- Do PDs support Project requirements for Cybersecurity?

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POWER SOURCE EQUIPMENT (PSE)

PHYSICAL CHARACTERISTICS – RACK OR ENCLOSURE MOUNTED

SMART BUILDING CORE INFRASTRUCTURE

Confirm:

- PSE re-boot time
- Does PSE provide power to fixtures when OS on PSE during reboots? This is important for IoT endpoints such as PoE-powered lights, so that there is no disruption during switch reboot.
- If power to the switch is terminated, upon restoration, can the PSE provide power to the powered devices before the operating system fully loads?
- Can the PSE power supplies provide adequate power to utilize the maximum available ports?
- Does the PSE include compatibility with Cybersecurity requirements?

PLENUM RATED

18" X 18" X 1.75", REQUIRES ENCLOSURE

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EMERGENCY LIGHTING

SMART BUILDING CORE INFRASTRUCTURE

Emergency lighting luminaires require UL listing of UL924

- PoE Battery Pack and Driver Unit
  - Manufacturer Specific (UL924, 90 Minute Emergency Operation)
  - Requires additional switch port allocation
- Line-voltage fixtures for emergency power
- UL924 Listed PoE switches (PSE) are not currently available

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Regulatory & Standards Guidance for PoE Lighting

SMART BUILDING CORE INFRASTRUCTURE

UL Listing PoE lighting equipment PDs
- UL 2108 “Standard for Low Voltage Lighting Systems”.
- Covers both IEEE 802.3 at and af and other proprietary PoE standards

UL Listing PoE lighting equipment
- UL 60950-1 “Information Technology Equipment”
- UL 62368-1 “AV and Information communication equipment”
- UL 61010-2 “industrial equipment”

NFPA 70 2017
- Article 411
- Article 725.121 (A) 4
- Article 725.144

ANSI C137.3-2017
- Minimum Requirements for Installation of Energy Efficient Power over Ethernet (PoE) Lighting Systems

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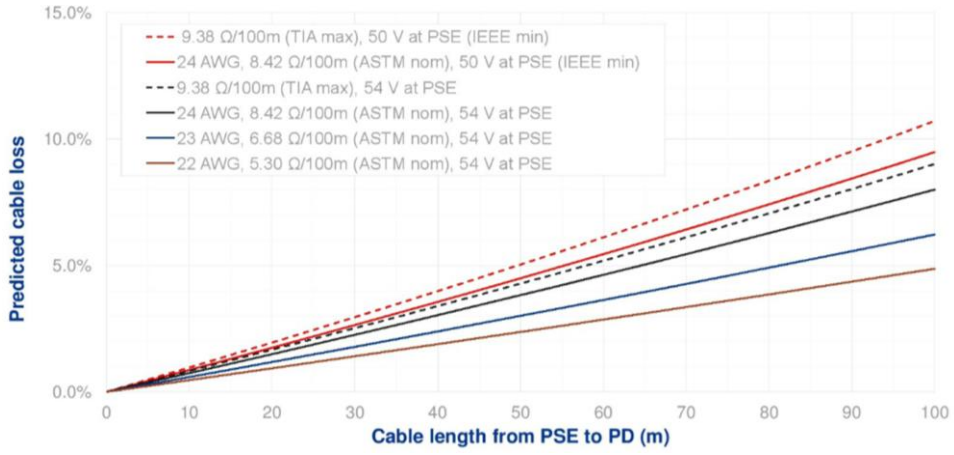
CATEGORY CABLE – VOLTAGE DROP STANDARD, ANSI 137.3

SMART BUILDING CORE INFRASTRUCTURE



TARGET MAX CABLE LOSS IS 5%

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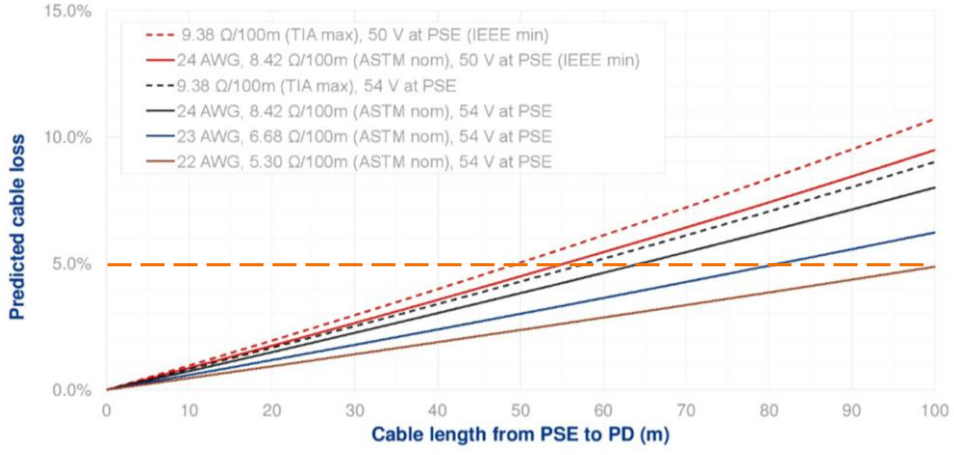
CATEGORY CABLE – VOLTAGE DROP STANDARD, ANSI 137.3

SMART BUILDING CORE INFRASTRUCTURE



TARGET MAX CABLE LOSS IS 5%

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PoE Lighting Design Considerations

It takes a Team.

Define Roles and Responsibilities at the outset.

Team	Planning	Design	Construction	Commissioning	Operations
Owner's Rep	•	•	•	•	
Technology Planning & Design	•	•	•		
Architect	•	•	•		
Lighting Design		•	•		
Electrical Engineer		•	•		
General Contractor		•	•	•	
Electrical Contractor			•	•	
Low Volt Contractor			•	•	
Master System Integrator		•	•	•	
Facilities Management	•			•	•
IT Management	•			•	•
Technology Vendor				•	•

SMART BUILDING CORE INFRASTRUCTURE

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PoE Lighting Design Considerations

It takes a Team.

Documentation & Cost Analysis should include Division 25, 26, and 27 scopes

Division 25

1. Section 25 10 00 Integrated Automation Network Equipment
2. Section 25 30 00 Integrated Automation Instrumentation and Terminal Devices

Division 26

1. Section 26 05 00 Common Work Results for Electrical
2. Section 26 09 23 Lighting Control Devices
3. Section 26 09 43 Network Lighting Controls
4. Section 26 51 00 Interior Lighting Fixtures

Division 27

1. Section 270526 Grounding and Bonding for Communications Systems
2. Section 270528 Pathways for Communications Systems
3. Section 270529 Hangers and Supports for Communications Systems
4. Section 270536 Cable Tray for Communications Systems
5. Section 271100 Communications Equipment Room Fittings
6. Section 271300 Communications Backbone Cabling
7. Section 271500 Communications Horizontal Cabling

SMART BUILDING CORE INFRASTRUCTURE

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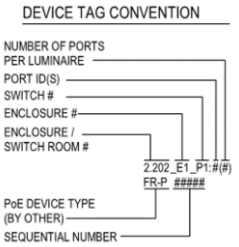
Documentation Considerations

SMART BUILDING CORE INFRASTRUCTURE

	Installation	Operations / Commissioning
Intended Use	Used for the installation of cabling, fixtures, end points	Used for the cataloguing of each piece of data equipment
Level of Detail	Has wiring details and for standard room types	Specific to every device in the building
Device Tag	Not specific to exact room numbers	Needs a standardized naming schema that can be utilized by all software partners

Required level of detail for PD before Installation and Commissioning



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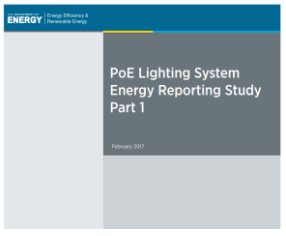
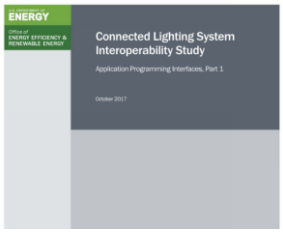
SMART BUILDING CORE INFRASTRUCTURE



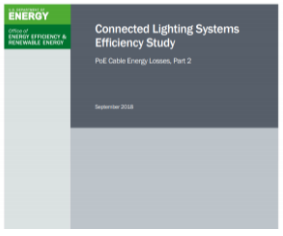
PoE Lighting System Energy Reporting Study, Part 1

Tuenge J.R., and M.E. Poplawski. 2017.PoE Lighting System Energy Reporting Study, Part 1.PNNL-26284. Richland, WA: Pacific Northwest National Laboratory.doi:10.2172/1618835.



Connected Lighting Systems Efficiency Study: PoE Cable Energy Losses, Part 1

Clement Gaidon and Michael Poplawski 2018. Connected Lighting System Interoperability Study:
Application Programming
Interfaces, Part 1. PNNL-26284. Richland, WA: Pacific Northwest National Laboratory.



Connected Lighting Systems Efficiency Study: PoE Cable Energy Losses, Part 2

Tuenge J.R., K.C. Kelly, Y. Chen, A.S. Waghale, and M.E. Poplawski. 2018.Connected Lighting Systems Efficiency Study: PoE Cable Energy Losses, Part 2. PNNL-28099. Richland, WA: Pacific Northwest National Laboratory.

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SMART BUILDING CORE INFRASTRUCTURE

The Future of Our Built Environment is:

People Centric

Purpose Driven

Design Led

and

Technology Powered

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THANK YOU

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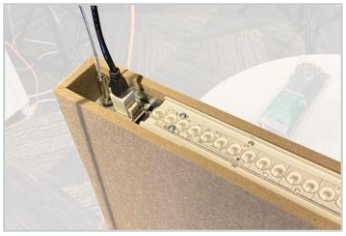
FIXTURE CONSIDERATIONS

INTEGRAL NODE OPTIONS

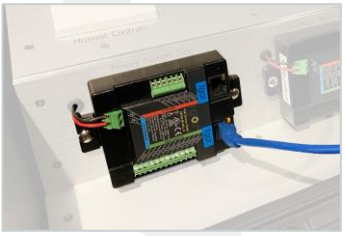


- POE Node required, on average, every 8'.
- Power Drops will be Cat6 Cable
- This solution takes heavy coordination with the rep/manufacturer to ensure nodes are programmed correctly.

REMOTE NODE OPTIONS

- Node is incorporated into remote driver housing. Some manufacturers allow for one remote node housing to power any of their linear series of products.
- Cleaner install as factory standard power drop cables are used

EXTERNAL NODE OPTIONS



- External node can be used where fixtures are supplied without a factory-installed driver.
- Not tested at the factory.
- One node can power multiple fixtures

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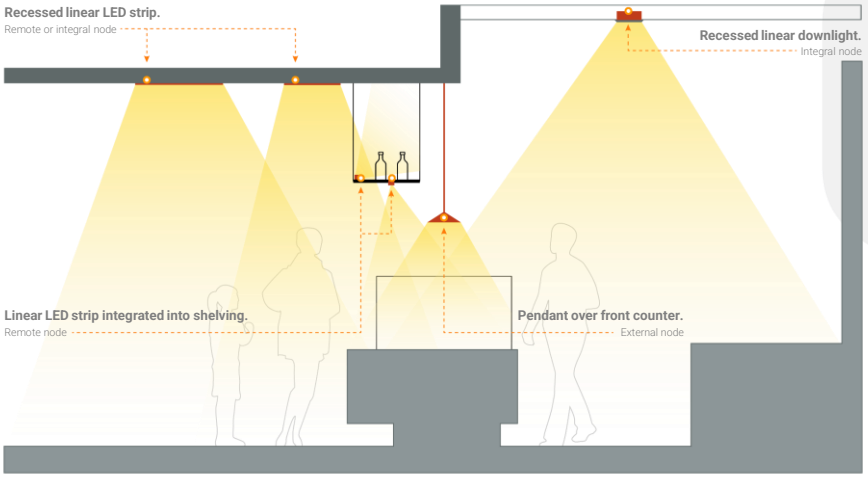
FIXTURE CONSIDERATIONS



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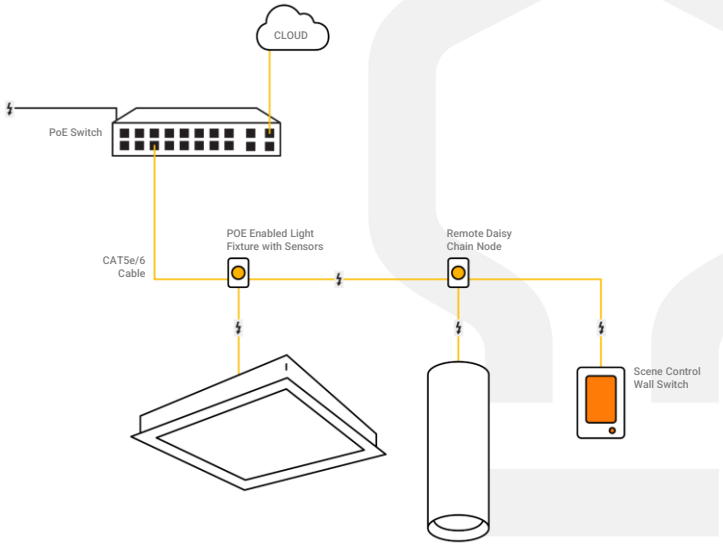
Control and Other Integration Questions

Things to think about

- Can sensors, like occupancy and daylighting, be factory installed into the fixtures and connected to the POE Node for power and control?
- How do control devices communicate into a POE system?
  - Hardwired into POE Lighting Nodes
  - Wireless communication
  - Native POE
- What information is available and desired from sensors back to the system?
- What about non-POE powered lighting fixtures and integrating those into the same control system?
- What is needed for Integration for BACnet, A/V, Fire Alarm, etc.?



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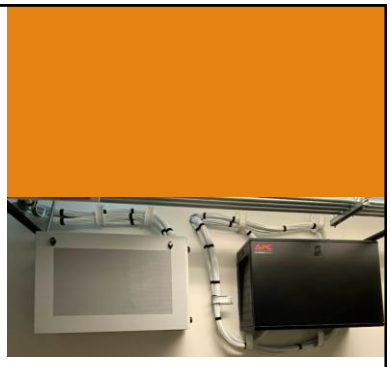
Installation Considerations

- Head End & Layout
  - Electrical/Com Room vs External, distributed vs centralized
  - Heat dissipation
  - Access (security)
  - Acoustics
  - Future Expandability



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VALLEY ELECTRIC – ELPN POE PANEL – INSTALLATION CONSIDERATIONS

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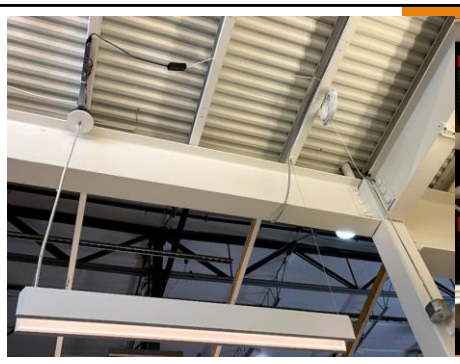
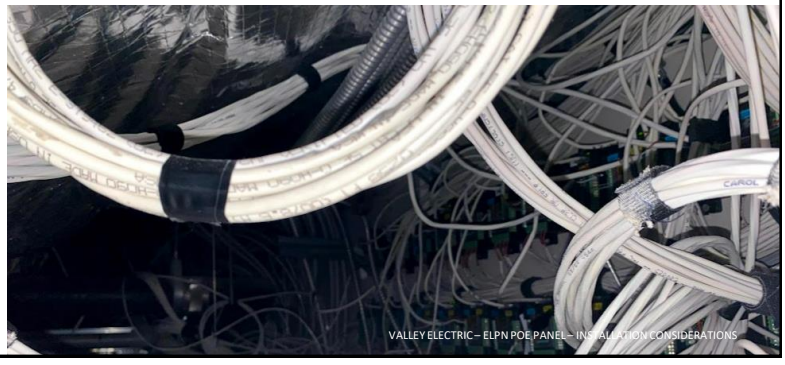
Installation Considerations

- Aesthetics
  - Cable management
  - Cable distances and voltage drop
  - Home runs vs daisy chain
  - Sleeving and LV supports
- Integration of POE and Line Voltage/Conventional Components
- UL924 Compliance





VALLEY ELECTRIC – ELPN POE PANEL – INSTALLATION CONSIDERATIONS

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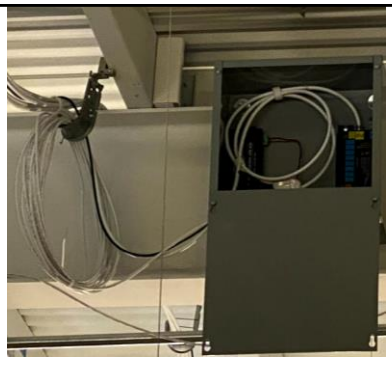
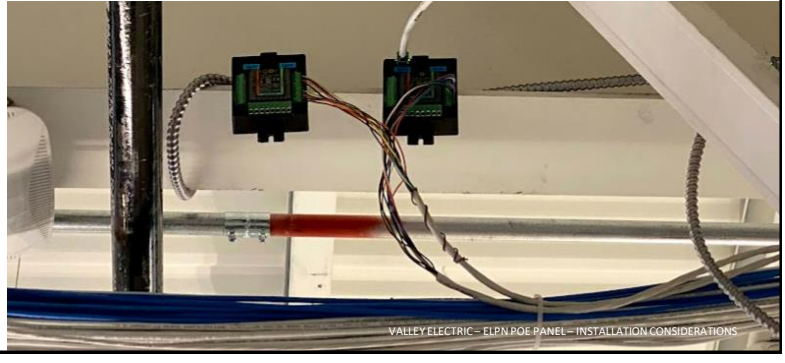
Installation Considerations

- Devices and Cabling
  - Predetermined lengths and service loops
  - Ceiling types and visiblitiy
  - Integral vs remote
  - Jboxes / Housings
  - Compatibility of hardware, MicroUsbs, Ethernet Ports, Environmental sensors, Ethernet extenders
- Prefabrication, preprogramming
- Testing and Commissioning





VALLEY ELECTRIC – ELPN POE PANEL – INSTALLATION CONSIDERATIONS

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Snohomish PUD

ENERGY SERVICES

COMMERCIAL & INDUSTRIAL ENERGY EFFICIENCY PROGRAMS

POE LIGHTING

Rob Marks
Energy Management Engineer
December 2022

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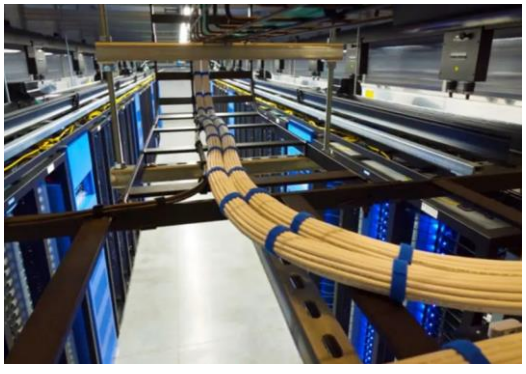
DC power systems – Now mainstream?

Above: indoor agriculture lighting has options for remote power supplies (AC to DC) powering LED lighting. Power supplies installed by electrician and Plug and Play lighting by customer

Below: Modern data centers are centralizing AC to DC power conversion rather than multiple power supplies at each rack



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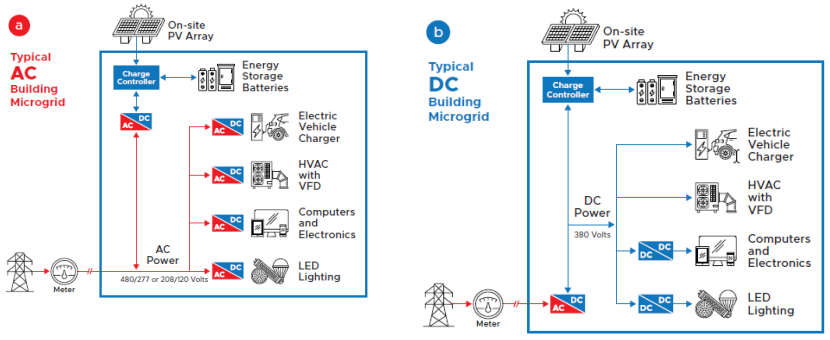
Two types of Microgrids



Renewable power/batteries are native DC power. Microgrid on right is inherently more efficient due to the need for transformation/rectification of power for every separate legacy system on the Left.
From PNNL Pacific NW Laboratory white paper "DC Lighting and Building Microgrids September 2020

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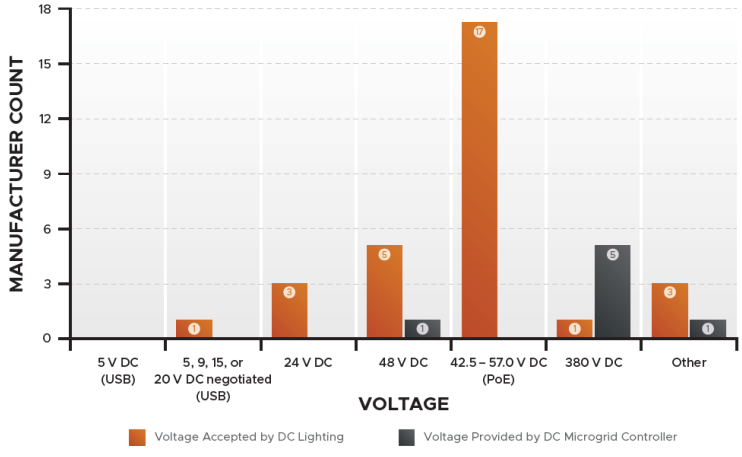

Figure 2: Comparison of the number of DC lighting manufacturers with products that accept each voltage category and the number of microgrid controller manufacturers with products that provide each voltage category.

From PNNL Pacific NW Laboratory white paper "DC Lighting and Building Microgrids September 2020

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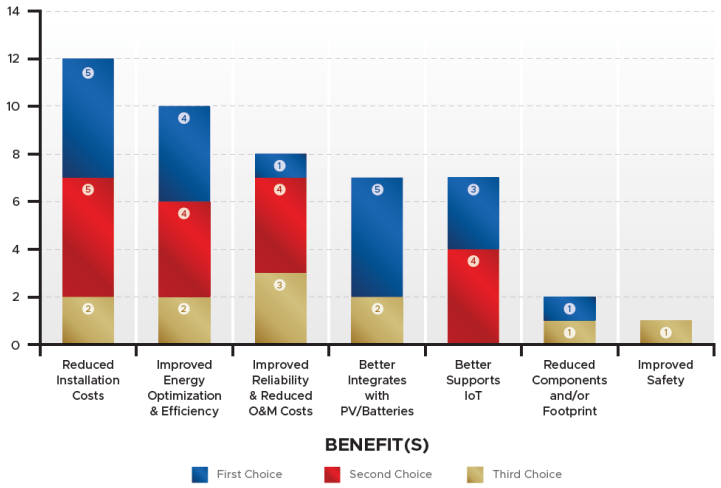

Figure 3: Top three value proposition choices for DC lighting and building microgrids from RFI and interview respondents.

Survey from interview respondents make a strong case for reduced installation costs of DC lighting.

PNNL Pacific NW Laboratory white paper "DC Lighting and Building Microgrids September 2020

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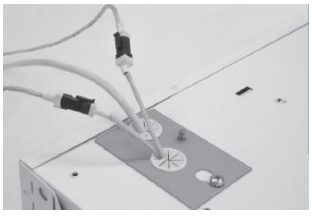
Lighting Efficiency Program - Retrofits

- Higher Incentives for Networked/Integrated/Advanced Lighting Controls
  - Up to $0.33 per kWh Savings, $182 per fixture
  - Covers most of the incremental costs
  - More cost effective to include it when upgrading existing lighting fixtures to LED's
- Additional Benefits with Networked/Integrated/Advanced Lighting Controls
  - Flexible controls (high trim, low trim, time of use, etc.)
  - Demand Response capability



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Incentives for energy-efficient new construction

In our ongoing commitment to help build a sustainable future, Snohomish PUD is offering Energy Design Assistance for new commercial, industrial, and multi-family buildings.

This program includes:

- Performance-based incentives of 20¢ – 50¢ / kWh for highly energy-efficient buildings
  - Additional 25% bonus for all-electric facilities
  - Additional 15% bonus for facilities with a minimum of 51% certified income-qualified units.
- Design meetings with energy-efficiency modeling scenarios
- Design team stipend

Business Rebates & Incentives - Snohomish County PUD (snopud.com)

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More Information

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SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT NO. 1

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Question and Answer

ELECTRIC LEAGUE
OF THE PACIFIC NORTHWEST

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