

GPG Outbrief 17

Advanced Lighting Controls and LED

Emerging Building Technologies, GPG Program | U.S. General Services Administration | November 15, 2018

The logo for the U.S. General Services Administration (GSA), consisting of the letters "GSA" in white on a dark blue square background.

GSA

GPG-037 Advanced Lighting Controls @ gsa.gov/gpg

- ❑ Infographic
- ❑ 4-page Findings
- ❑ Full Report
- ❑ Additional Resources

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Advanced Lighting Controls

After the conversion to LED, light-level tuning and occupancy sensing reduced lighting energy by an additional 43%. At the test-bed site, the added savings from controls did not cover the added expense of the controls themselves. Still, life-cycle cost analysis demonstrates that currently available luminaires with plug-and-play factory integrated lighting controls can provide a positive return on investment for facilities with higher utility rates and longer occupied hours. [View full-size infographic.](#) [PDF - 238 KB]

EMERGING BUILDING TECHNOLOGIES

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 - GSA Technology Deployment Maps

4-PAGE REPORT SUMMARY

[PDF - 686 KB]

FULL REPORT—NOV 2018

[PDF - 1 MB]

GSA DEPLOYMENT MAP

ADDITIONAL RESOURCES

- Case Study: ALC Performance, A Field Evaluation of Five Systems (PNNL, 05-2018)
- Report: Energy Savings from Networked Control Systems (09-2017)
- Fact Sheet: Cree SmartCast (PNNL, 11-2017)
- Fact Sheet: Digital Lumens (PNNL, 11-2017)
- Fact Sheet: Enlighted (PNNL, 01-2018)
- Fact Sheet: Phillips SpaceWise (PNNL, 11-2017)

OPPORTUNITY

How can advanced lighting controls (ALC) support LED?

LED'S DIGITAL NATURE PROVIDES MORE PRECISE DIMMING

MAKING ALC MORE EFFECTIVE

TECHNOLOGY

What advanced lighting control strategies were assessed?

3 CONTROL STRATEGIES

LIGHT-LEVEL TUNING, OCCUPANCY SENSING, DAYLIGHT HARVESTING

M&V

Where did Measurement and Verification occur?

PACIFIC NORTHWEST NATIONAL LABORATORY (PNNL) assessed five different LED and advanced-control systems in open-plan offices at the Fort Worth Federal Center, Fort Worth, Texas.

Webinar Recording and Slides Available on gsa.gov/gpg

Outbrief Webinars | GSA

https://www.gsa.gov/governmentwide-initiatives/sustainability/emerging-building-technologies/ou...

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Outbrief Webinars

GPG Outbrief webinars are presented by national laboratory researchers and include results from real-world evaluations, as well as feedback from facility managers at test-bed locations. Following Outbrief presentations, researchers and other GSA subject experts field participant questions. Attendees are eligible to receive continuing education credits from the American Institute of Architects for attending webinars.

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Open for Registration

Advanced Lighting Controls with LED
Outbrief 17: November 15, 2018 at noon ET
[Register now](#)

Alternative Water Treatments for Cooling Towers
Outbrief 18: January 17, 2018 at noon ET
[Register now](#)

On-Demand Webinars and Presentation Slides

TECHNOLOGY	ON-DEMAND	PRESENTATION
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Upcoming 2019 GPG Outbriefs—Thursdays, 12 PM ET

Jan 17 Alternative Water Treatment for Cooling Towers

Webinar Recordings

Access all webinars on [GSA.gov](https://www.gsa.gov)

[GSA.gov/GPG](https://www.gsa.gov/GPG)

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michael.hobson@gsa.gov



How to Ask Questions

Please chat your questions during the presentation for the Q&A segment



Introduction



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Webinar Agenda

- ❑ Introduction (5 minutes)
Kevin Powell, Program Manager, Emerging Building Technologies
- ❑ Advanced Lighting Controls with LED Lighting (20 minutes)
Michael Myer, Pacific Northwest National Laboratory
- ❑ On-the-ground Feedback R7, Building 23, Fort Worth, Texas (10 minutes)
Frank Campagna, Stuart Lamkin
- ❑ Q & A (20 minutes)

Introduction




Kevin Powell

Program Manager, Emerging Building Technologies

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Emerging Building Technologies' two programs—GSA Proving Ground (GPG) and Pilot to Portfolio (P2P)—enable GSA to make sound investment decisions in next-generation building technologies based on their real-world performance

GPG-037

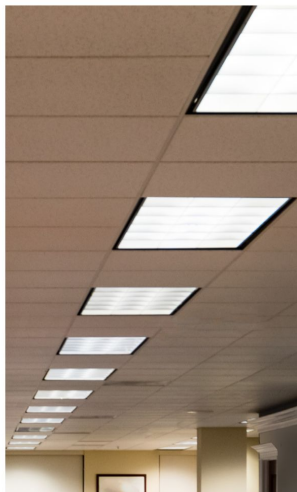
Advanced Lighting Controls and LED

General Services Administration
Public Buildings Service



GPG-037 | NOVEMBER 2018

ADVANCED LIGHTING CONTROLS AND LED



Light-Level Tuning Increases Occupant Satisfaction

Today's light-emitting diode (LED) sources last about twice as long as typical fluorescent lamps and consume roughly half as much electricity. For this reason, among others, they are fast becoming the default light source for new lighting installations. Energy savings from LED fixtures, moreover, can be augmented by integrating LEDs with advanced lighting control (ALC) systems, which are designed to provide light only when and where it is needed. The integration of ALC with LED fixtures is particularly effective in open-office plans, where occupants are engaged in a variety of tasks. In support of GSA's Total Workplace Initiative and its move toward open-office floor plans, GPG commissioned the Department of Energy's Pacific Northwest National Laboratory (PNNL) to evaluate five different LED systems with ALC in 76,000 ft² of primarily open-office space at a large GSA office building in Fort Worth, Texas. After the conversion to LED, light-level tuning and occupancy sensing reduced lighting energy by an additional 43%. Savings from daylight harvesting were minimal because most spaces did not have access to natural light. At the test-bed site, with an electricity rate of \$0.07/kWh, the added cost of the controls was not life-cycle cost-effective. Controls can be cost-effective at the GSA national average utility rate of \$0.11/kWh, when the added cost for

Measurement & Verification



Michael Myer

Energy and Environment Directorate
Pacific Northwest National Laboratory

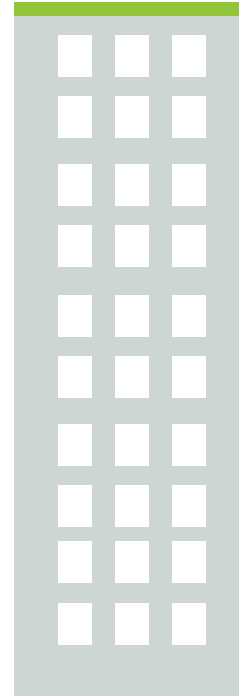
Opportunity for Savings from Advanced Lighting Controls (ALC)

25%–75%

REDUCTION IN LED ENERGY USE

With Advanced Lighting Controls

Savings are affected by many variables including baseline lighting power density, fixture density, occupancy, and availability of daylight

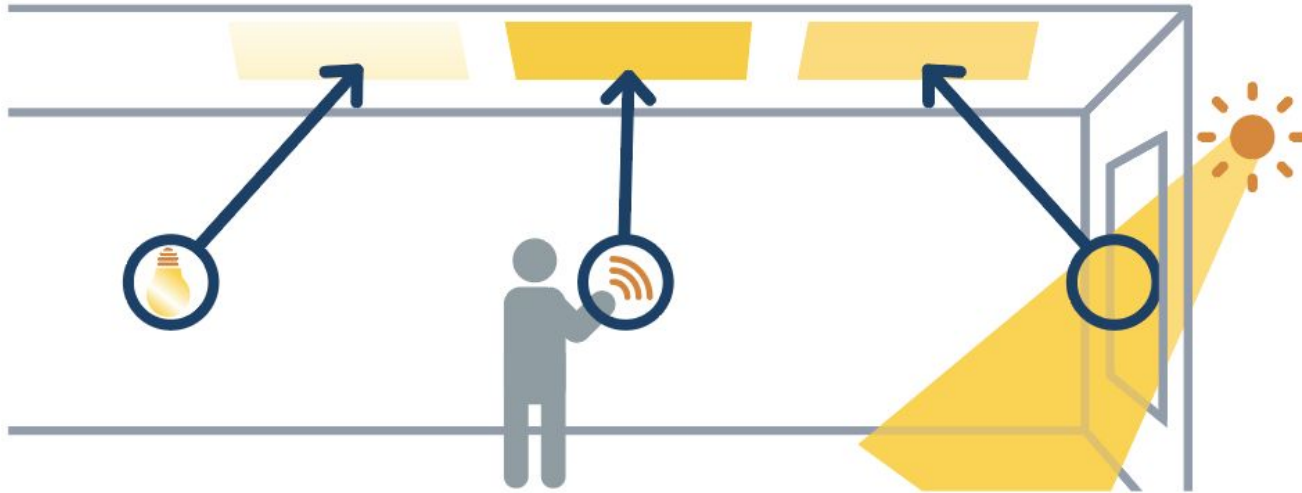


{ 2%

of commercial
buildings
implement ALC

Lighting Controls Assessed

Light-Level Tuning, Occupancy Sensing and Daylight Harvesting



Measurement & Verification, Fort Worth Federal Center



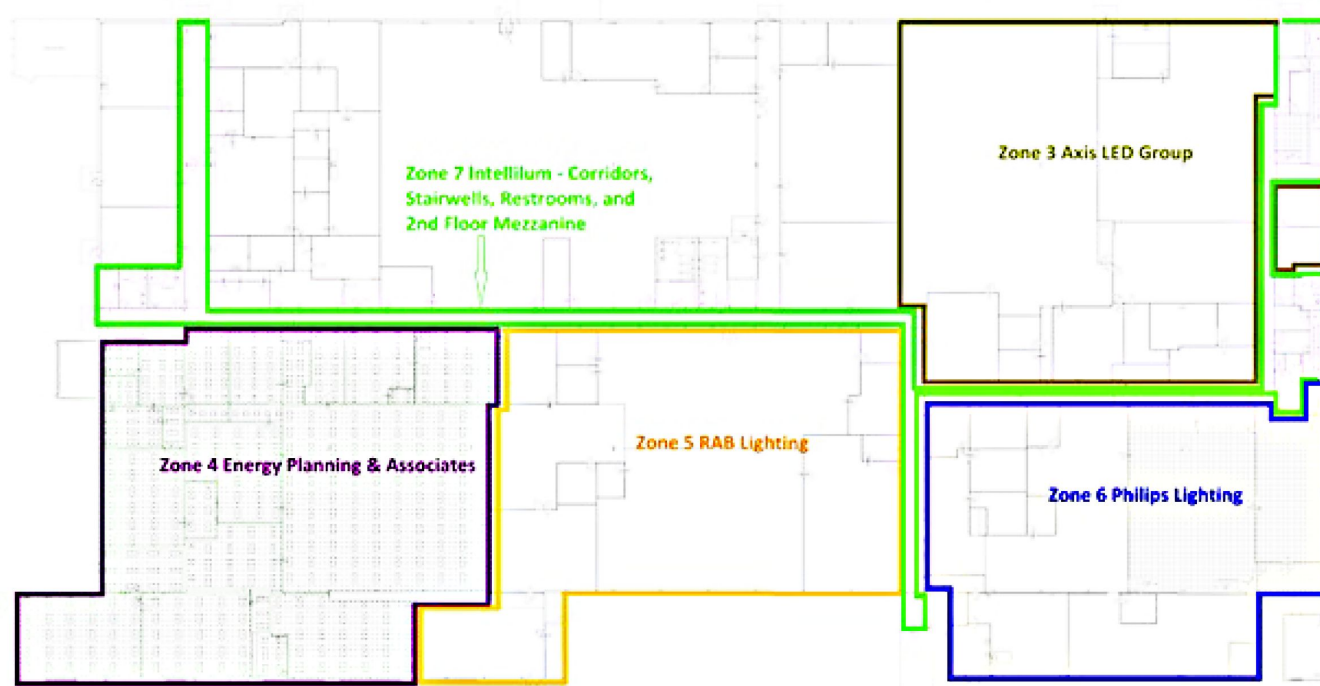
Fort Worth Federal Center, Bldg 23



76,000 ft² of Office Space

Technology for test-bed measurement and verification provided by Patriot, Enlighted, RAB, Philips, Intellium (now Flow Lighting), and Lutron

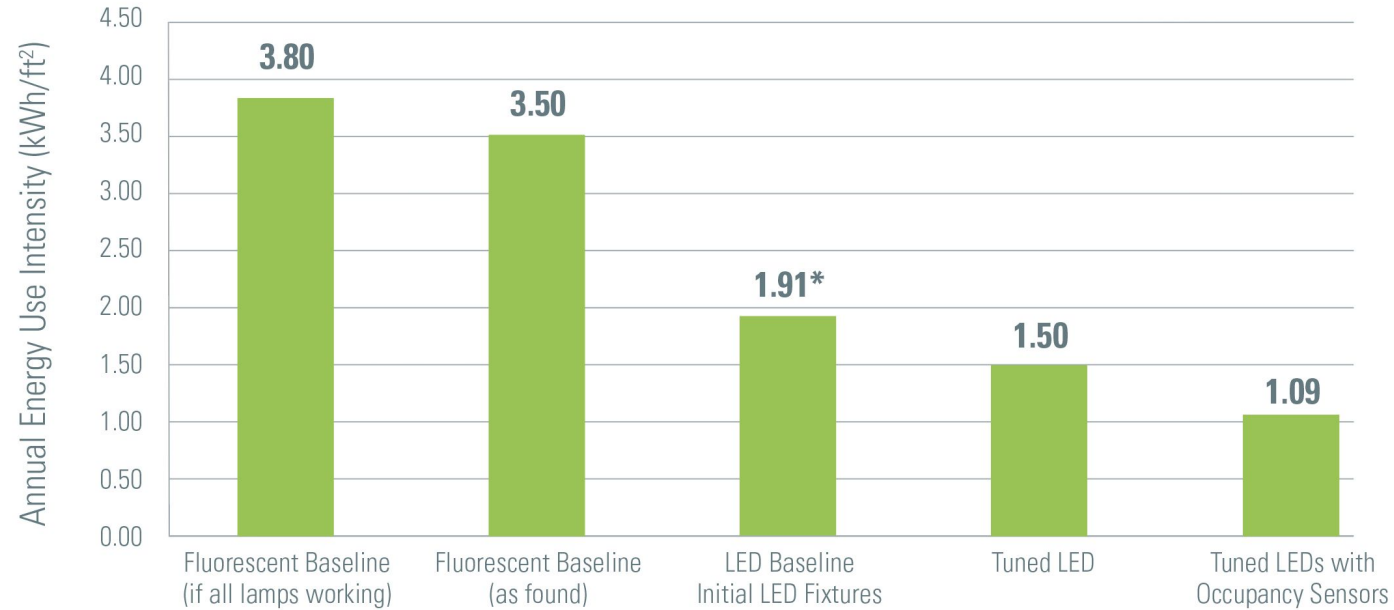
Five Different Zones and Systems Tested



Measured Changes in Illuminance

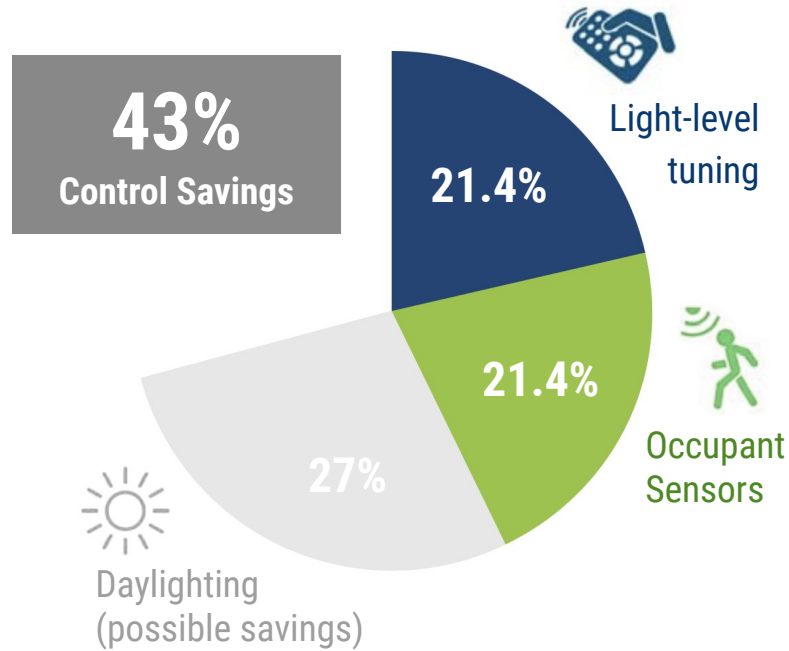
	Zone 3	Zone 4	Zone 5	Zone 6
Baseline Fluorescent (fc)	35.7	30.1	37.7	45.6
Tuned LED (fc)	35.4	7.3	24.7	27.0
Light Level Change (%)	-1%	-76%	-35%	-41%

Measured Energy Use



*Includes fixture count reduction from 1,212 fluorescent to 847 LED

Control Lighting Energy Savings from LED Baseline



Installation

Add-on controls increased installation time (10 to 15 minutes per fixture)

- Installed both retrofit kits and replacement fixtures
- Replacement fixture installation comparable to standard fluorescent
- Retrofit kits: slightly faster installation, ~5-minutes per fixture, cleanup time reduced; no need to open the ceiling





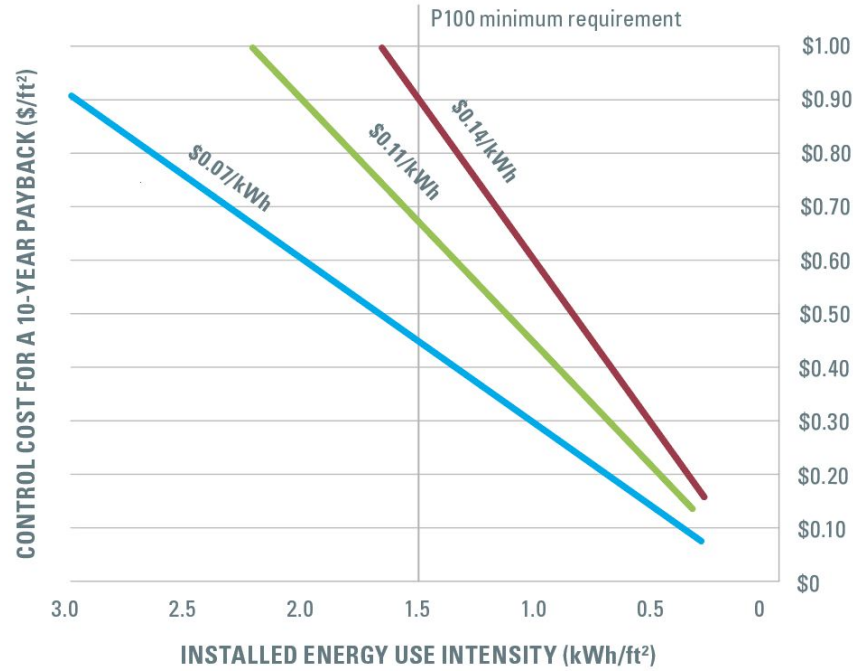
LED FIXTURE COSTS ARE CHANGING RAPIDLY AND VARY WIDELY

Your Mileage May Vary

Normalized Costs and Incremental Savings for Controls

	Fort Worth Average	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Baseline LED EUI (kWh/ft ²)	1.91 kWh/ft²	2.86	0.98	1.99	1.95	1.66
% Savings from Controls from LED Baseline	43%	37%	45%	58%	47%	25%
Control Savings (kWh/ft ²)	0.82 kWh/ft²	1.07	0.44	1.16	0.93	0.42
Annual Savings @ \$0.11 (kWh/ft ²)	\$0.09/ft²	\$0.12	\$0.05	\$0.13	\$0.10	\$0.05
Added Cost of Zone-Level Control \$65 fixture, 1 fixture per 100 ft ² (\$/ft ²)	\$0.65/ft²	\$0.65	\$0.65	\$0.65	\$0.65	\$0.65
Payback (years)	7.1 years	5.5	13.4	5.1	6.4	14.1

Average Control Costs for a 10-year Payback



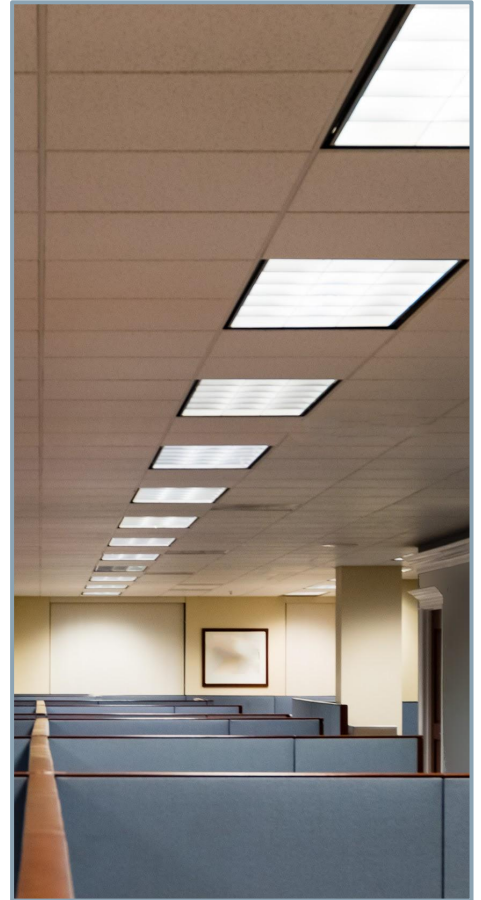
More efficient lighting makes positive ROI more challenging

Assuming a 10-hour, 5-day work week and 43% control savings

ALC Deployment Recommendations

Consider where utility rates are high:

- Prioritize facilities with:
 - no existing lighting controls
 - lighting energy use $> 3.25 \text{ kWh/ft}^2/\text{yr}$
 - open offices where occupants are engaged in a variety of tasks
 - the availability of utility rebates
- If ALC is not cost-effective, consider LED systems with 0-10V drivers. Tuning can be key to occupant satisfaction.



Tune Light Levels to Meet Occupant Needs

- Saves energy while improving quality of light
- Tuning at the time of installation is not widely implemented



Max: 100%



Max: 80%

How Stakeholders Can Support Tuning



Manufacturers

Incorporate task tuning as a standard step into configuration apps and software



Contractors

Include task tuning as a standard installation step—don't forget your light meter



Specifiers, Procurement, End-users

Require task tuning in your specs, include in punchlists



Utilities

Support task tuning in your programs, consider providing rebates or financial incentives for implementing task tuning

ALC Calculator at gsa.gov/gpg

Advanced Lighting Controls Calculator

% Savings Estimates

Institutional Tuning (%)	21.5	<i>GPG evaluation in Ft. Worth, TX found 21.5% savings from an LED Baseline</i>
Occupancy Sensing (%)	21.5	<i>GPG evaluation in Ft. Worth, TX found 21.5% savings from an LED Baseline</i>
Daylight Harvesting (%)	14	<i>PNNL found 14% avg. savings at 2 office sites</i>
Total Savings (%)	57	

Local Inputs

# of workdays that lights will be on	260	<i>Standard 5 day work week, 52 weeks a year = 260</i>
# of hours per day the lighting operates	10	<i>Typical day is 10 hours</i>
Blended electricity rate (\$/kWh)	\$0.11	<i>GSA average utility is \$0.11</i>
Cost of Controls (per sf)	\$0.65	<i>GSA estimates \$65/fixture for zone-level control, avg. density is 1 fixture every 100/sf</i>
Utility Rebate		<i>Rebates range from x to y</i>
Baseline LPD	0.60	<i>Lighting Power Density, uncontrolled LED LPD estimate is 0.60</i>

Payback (years) **6.65**

GSA Feedback—Fort Worth, Texas



Frank Campagna

Supervisory Energy PM
GSA Region 7



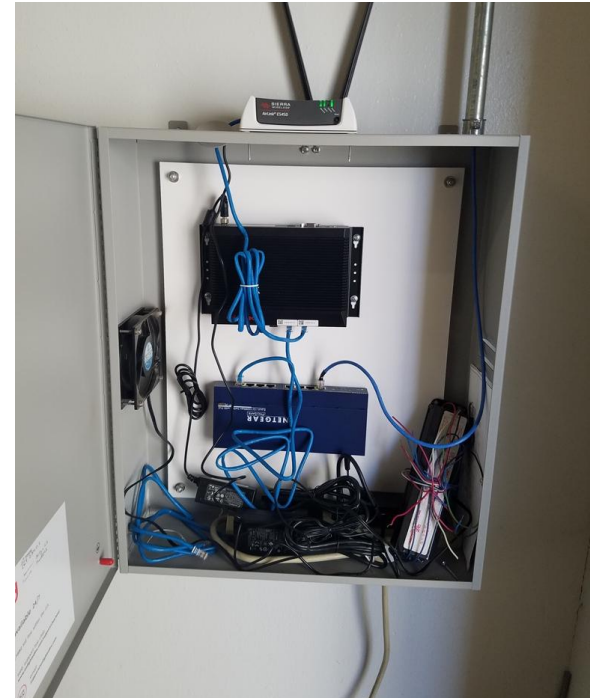
Stuart Lamkin

Property Manager
GSA Region 7

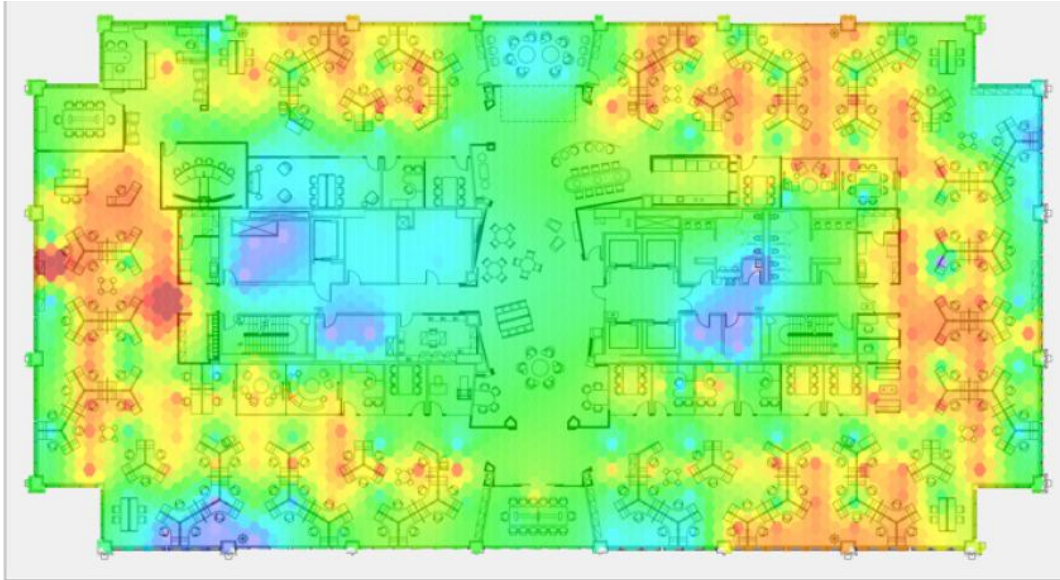
Installation/Commissioning

Installed both retrofit kits and new fixtures

- Identical look from the ground
- Different types of systems, had a lot of support from manufacturers



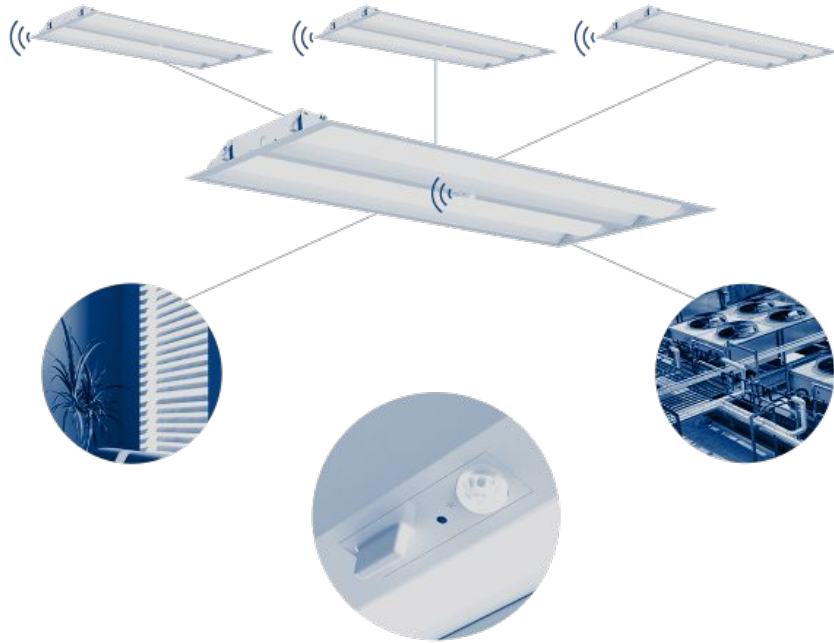
Enlighted



Granular information
on energy savings,
individual fixture
control

HVAC and space
utilization control

Flow Lighting



Can drill down to individual fixtures

Offers additional functionality such as HVAC and blind control

RAB and Patriot LED + Lutron Controls



Installed in the field

Individual fixture control

User-friendly interface can operate on tablet or phone

Easy-to-read user guides

Philips, now Signify



Simple system with no granular information

Easy to commission; somewhat challenging to make changes with remote

Occupant Feedback

Most important feature was dimming

- Between lights going in and tuning, occupants covered lights with cardboard and paper, built barricades to block glare
- Occupants preferred a dark space, many fixtures had been de-lamped
- No windows, so any change in lights was perceived as bright



Cyber Security

Hurdle to deployment

- Test bed used an islanded approach, not behind the GSA firewall
- All IT connected devices need to be reassessed every 3 years and with all major updates
- Enlighted, Flow Lighting, Lutron, Philips (now Signify) now all cleared GSA IT-Security for use behind firewall



Best Practices

Do your homework

- Match existing lumen output and color temperature
- Document before and after foot candles
- Consider dimming controls that don't need network access, simplifies IT security
- Mock-up proposed lighting to evaluate for any glare issues



Q & A

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AIA Number

Your answer

First and Last Name

Your answer

The information presented in the Outbrief webinar was helpful.

1 2 3 4 5
Strongly Disagree Strongly Agree

I am interested in installing advanced lighting controls.

- Yes, in the next 2 years.
- Yes, in the next 5 years.
- Maybe
- No

Thank you



For more information: gsa.gov/GPG

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