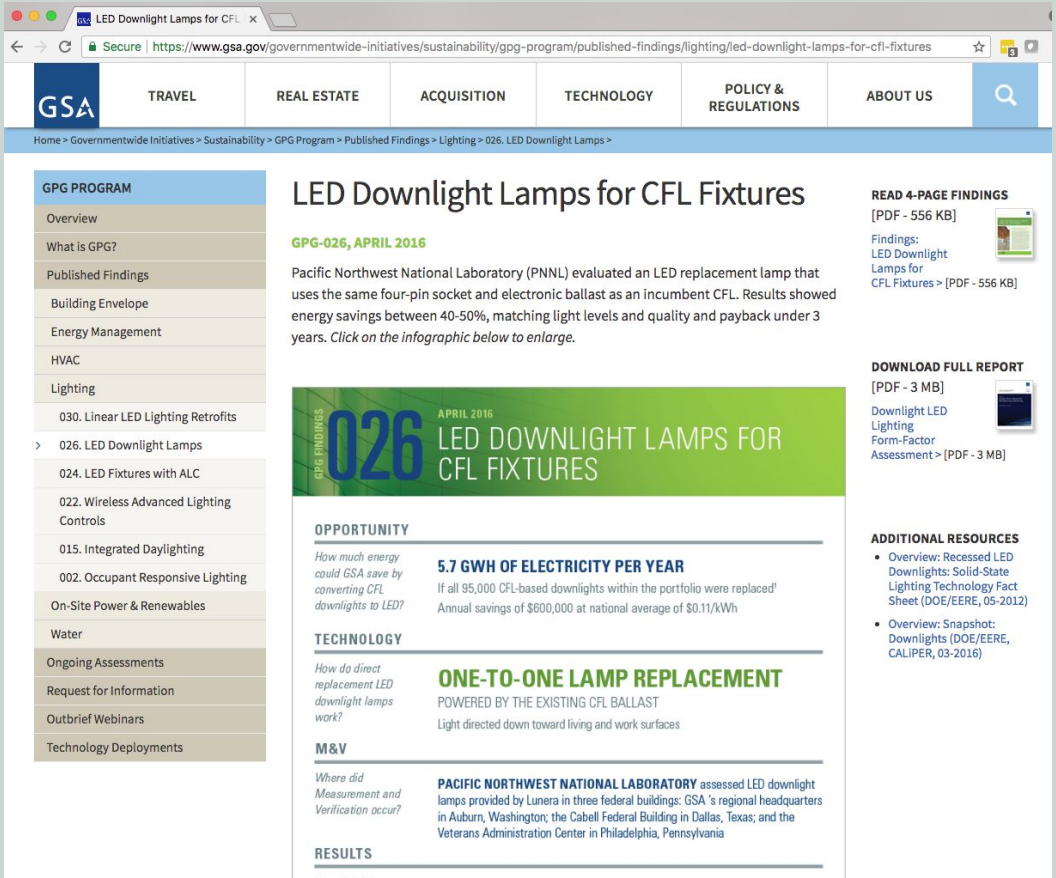
GPG Outbrief 11

LED Downlight Lamps for CFL Fixtures

Emerging Technologies, GPG Program | U.S. General Services Administration | March 22, 2018

GPG-026 LED Lamps for CFL Fixtures @ gsa.gov

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



Upcoming GPG Outbriefs - Thursdays, 12 PM ET

April 19	Electrochromic Windows
May 10	HoneyComb Solar Thermal Collector
June 7	Variable Refrigerant Flow

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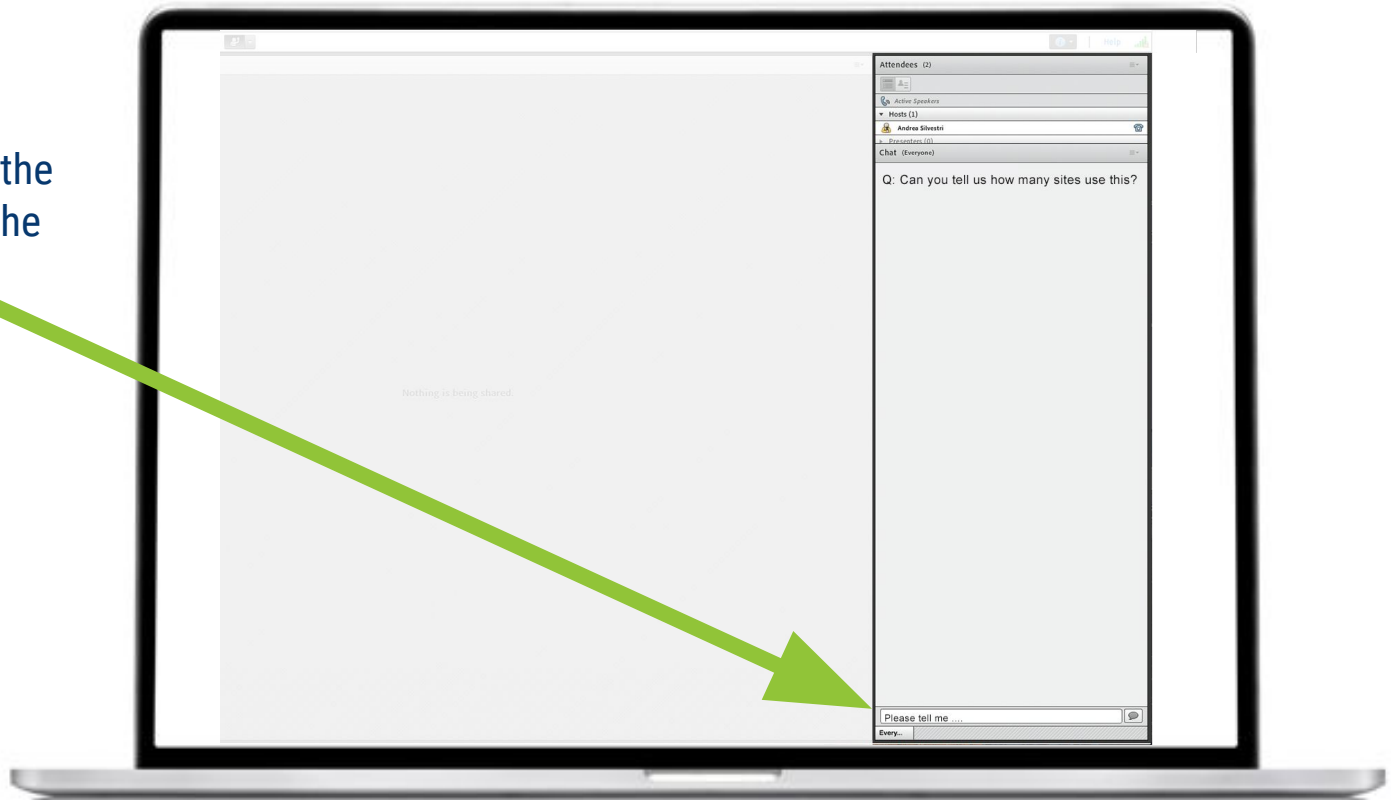

LED Downlight Lamps for CFL Fixtures

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Webinar Agenda

- Overview of GPG (5 minutes)
  Kevin Powell, Program Manager, Emerging Technologies
- LED Lamps for CFL Fixtures (15 minutes)
  Eric Richman, Pacific Northwest National Laboratory
- On-the-ground Feedback (15 minutes)
  Marty Novini, GSA Region 10
  Frank Campagna, GSA Region 7
- Q & A (15 minutes)

Introduction

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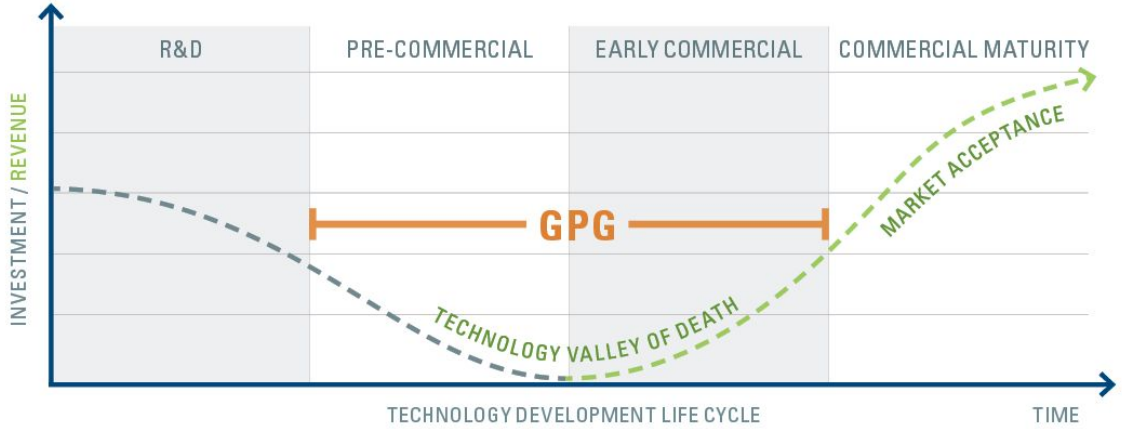
Emerging Technologies' two programs — GSA Proving Ground (GPG) and Pilot to Portfolio (P2P) — enable GSA to make sound investment decisions in next generation building technologies based on their real world performance

Leading by Example

GSA's Proving Ground accelerates market acceptance by objectively assessing innovative building technologies in real-world environments, and deploying those that deliver. To date, GSA has installed 9 technologies across more than 200 buildings. In aggregate, these technologies are delivering $7 Million in annual O&M savings.



GPG Process

Identify promising technologies at the edge of commercialization

Pilot technology installations within GSA's real estate portfolio

Partner with Department of Energy national laboratories to objectively evaluate real-world performance

Recommend technologies with broad deployment potential for GSA

Measurement & Verification

Eric Richman
Senior Research Engineer
Energy Systems Analysis
Pacific Northwest National Laboratory

GPG-026

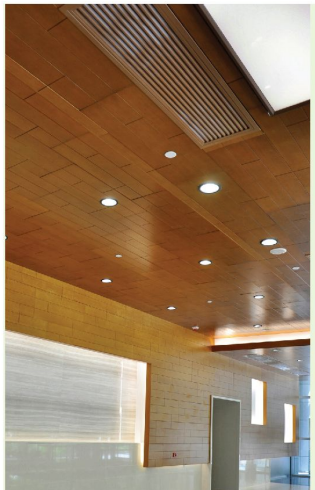
LED Downlight Lamps for CFL Fixtures

General Services Administration
Public Buildings Service

GSA

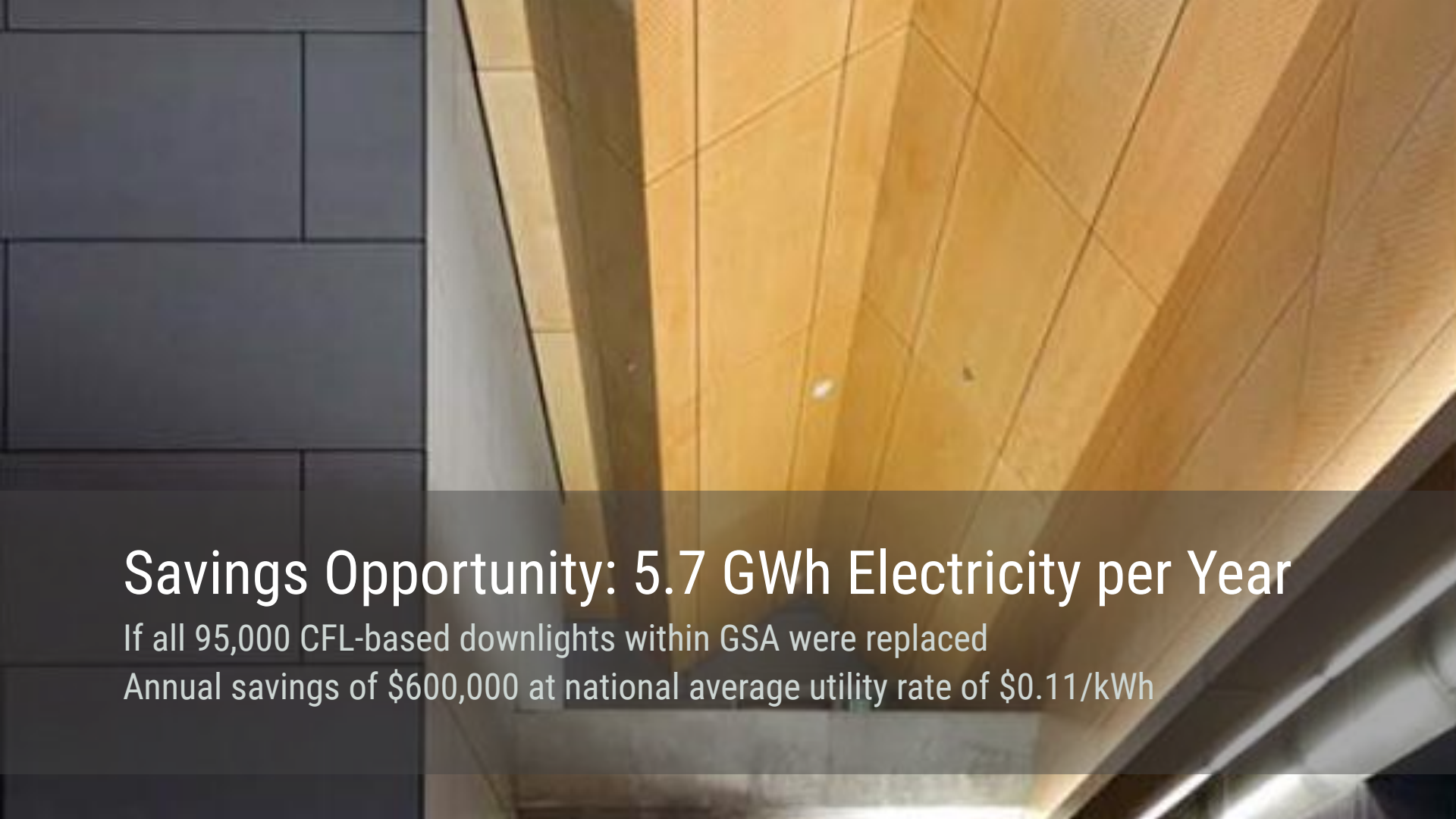
GPG-026 | APRIL 2016

LED DOWNLIGHT LAMPS FOR CFL FIXTURES



LED Downlight Lamps Save Energy, Match Pre-Existing CFLs for Light Level and Quality

According to a 2013 U.S. Department of Energy (DOE) survey, the General Services Administration (GSA) has approximately 95,000 compact fluorescent (CFL) downlights in its commercial building portfolio.1 CFL downlights provide illumination in hallways, lobbies, and other common areas, and are often used as accent lights. Compared with light emitting diode (LED) lamps of similar form factor, however, they are relatively short-lived and therefore require frequent replacement. They also consume considerable amounts of energy. For these and other reasons, replacing CFLs with LED lamps represents a significant cost- and energy-savings opportunity. LED downlight lamps last four to six times as long as CFLs and consume roughly half as much electricity. There are many options for retrofitting pin-based CFLs, and in 2014, GSA's GPG program worked with researchers from the Pacific Northwest National Laboratory (PNNL) to evaluate the simplest of them—a replacement lamp that uses the same four-pin socket and electronic ballast as an incumbent CFL. In



Savings Opportunity: 5.7 GWh Electricity per Year

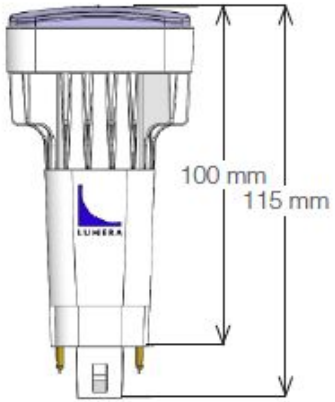
If all 95,000 CFL-based downlights within GSA were replaced

Annual savings of $600,000 at national average utility rate of $0.11/kWh

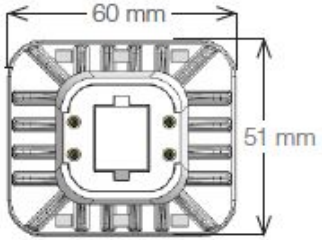
GPG-026. LED Downlight Lamps for CFL Fixtures

One-to-One Lamp Replacement Powered by the Existing CFL Ballast

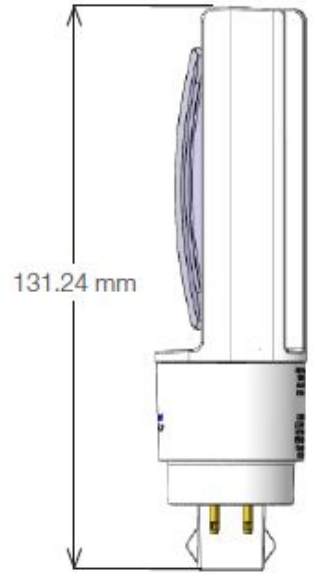
Light directed down toward living and work surfaces; vertical or horizontal orientation



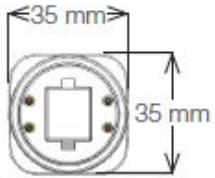
Front View Vertical



Bottom View 4-pin



Side



Bottom View

End View

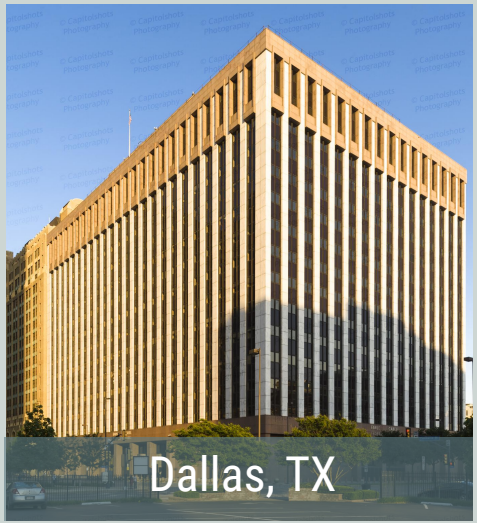
Image source: Lunera

Measurement & Verification

Researchers Monitored Performance at 3 Federal Locations

GSA regional headquarters, Auburn, WA; Cabell Federal Building, Dallas, TX; Veterans Admin Center, Philadelphia, PA

Auburn, WA


Dallas, TX

Philadelphia, PA

Technology for test-bed measurement and verification provided by Lunera

Basecases

Auburn, WA

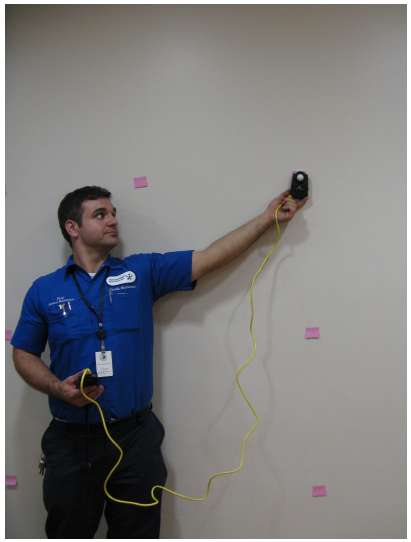
6” aperture
Vertically oriented
1-lamp, 6’ x 6’ on-center

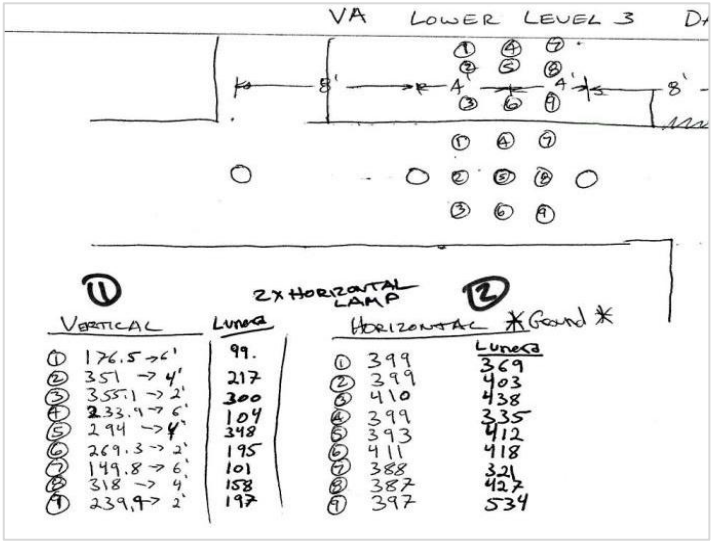
Dallas, TX and Philadelphia, PA

8” aperture
Horizontally oriented
2-lamp, 4’ on-center

Achieving Desired Light Levels is Key in Retrofits

Test Plan for Measuring Light Levels—A Grid of Measurements for Each Location





Light Level Measurements

Light Levels Between CFL and LED Were Comparable

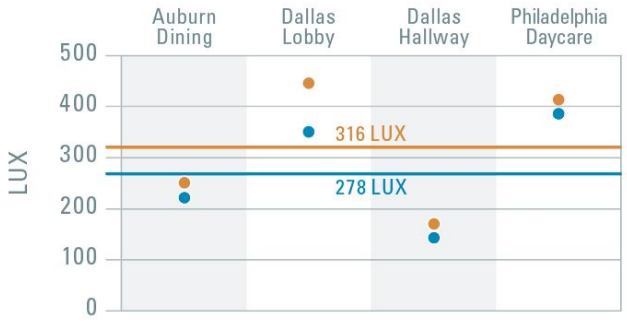
LEDs approximated CFLs, occupants noticed little difference

Key

- CFL
- CFL AVG. ACROSS TEST BEDS
- LED
- LED AVG. ACROSS TEST BEDS

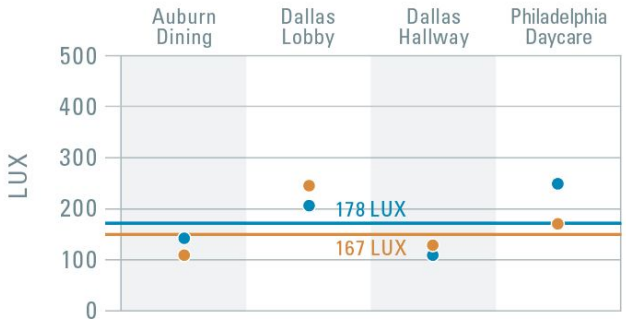
Average Horizontal Light Levels

Work Surface or Floor



Average Vertical Light Levels

Wall



A difference of less than 100 Lux is typically not noticeable by the human eye.

Testbed Results

40-50%

ENERGY SAVINGS

$6.37 ANNUAL SAVINGS

Over typical CFL lamp at avg. utility rate of $0.11/kWh

< 3

YR PAYBACK

AT AVERAGE UTILITY RATE

Replacement Options for CFL Downlights

Consider Compatibility and Controls When Selecting an LED Replacement

	REPLACE LAMP IF :	INSTALL RETROFIT KIT IF :	INSTALL NEW FIXTURE IF :
COMPATIBILITY	CFL ballast is verified to work with LED replacement lamp (per manufacturer or by testing).	Lamp is incompatible with CFL ballast (consult manufacturer specifications).	New construction or renovation.
CONTROLS	No controls are necessary.	Dimming is desired and CFL ballast does not support it.	Integrated advanced lighting controls are desired (tuning, occupancy sensing, daylighting).
	PAYBACK–2.9 years* Cost $39 Material $22§, Install $17 With ballast replacement $94 (Material $38, Install $56) PAYBACK 7.1 years	**PAYBACK –10.4 years*** Cost $137 Material $81, Install $56	**PAYBACK–12.4 years*** Cost $165 Material $109, Install $56

Downlight Installation Considerations

- If replacement lamps operate on existing CFL ballasts, verify that the new LEDs will function on all ballast types.
- If existing ballast types are unknown, or it is impractical to verify their compatibility, consider using an LED retrofit kit or new downlight fixture.
- When considering retrofit kits, make sure it fits properly within the existing downlight housing, If a kit sits too low in the recessed fixture, glare might be an issue. Confirm proper fitting with the manufacturer and with a trial installation.

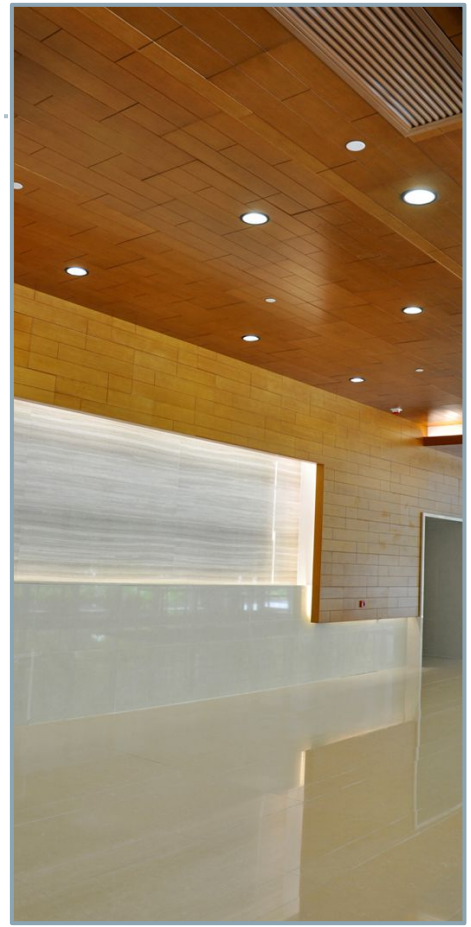
Issues to Consider When Replacing CFL Downlights

- **Lamp Use:** If used infrequently or a remodel is in the near future, a long-lived lamp might not be cost-effective.
- **Light Output:** Because LEDs are directional in nature, the LED replacement lamp typically only needs 70% of the CFL total lamp lumens to match light levels.
- **Color Temperature:** Temperature ranges between warm white (2700K) to cool white (5000K). Occupant spaces are commonly lighted with warmer color temperatures (3000K to 4100K) because of the truer treatment of skin tones.

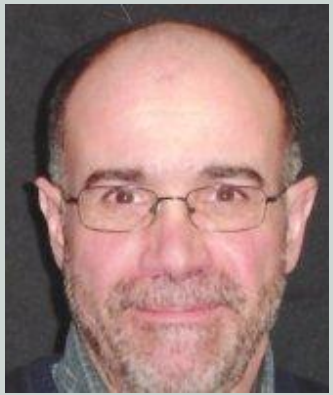
Deployment

Best Suited for Broad Deployment Where Advanced Lighting Controls are Not Desired or Useful

- Because this is such an easy technology to install it's literally as easy as plugging in a lightbulb



GSA Feedback, R10



Marty Novini
Energy Program Manager
Northwest Arctic Region 10

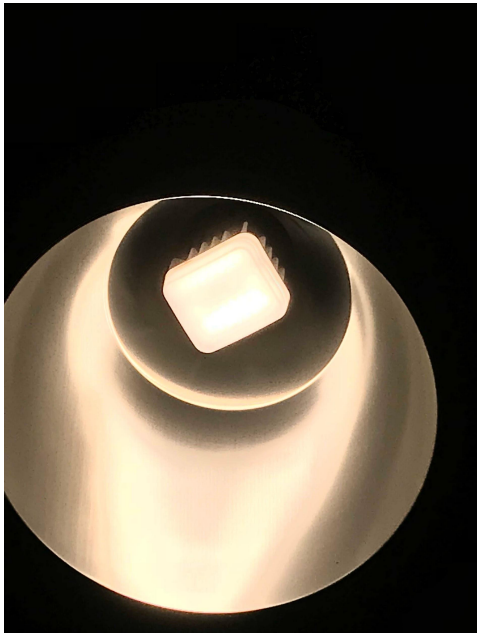
Northwest Arctic Region 10—Lessons Learned

1. Check ballast compatibility. Magnetic ballasts won't work.
2. The height of the bulb inside the can will determine the light spread. If the bulb sits farther inside the can light, it will provide better spread, however, at lower light intensity. If the bulb is sitting too far outside the can light its light spread is limited, but at higher intensity.
3. The same manufacturer sells other retrofit products for HID light fixtures, that we tested and are operating without a glitch.
4. The replacements were accomplished with O&M hours. We purchased the lamps using our BA 63 funds, and asked our O&M crew to replace the bulbs on an ongoing basis.

Northwest Arctic Region 10—Deployment

We have not installed many LED downlight lamps for 3 reasons:

1. **Maintenance**. The ballast remains a maintenance issue. If/when the ballast fails, we have to track down and find a ballast that works, which can be a maintenance hassle years down the road.
2. **Utility incentives**. Utilities don't offer incentives for lighting technologies that do not remove the existing ballasts.
3. **Energy savings**. Other retrofit options can provide higher energy savings.



GSA Feedback—Greater Southwest Region 7

Frank Campagna
Supervisory Energy PM
Greater Southwest Region 7

Greater Southwest Region 7—Feedback

- Good practice to interview facility maintenance before the project to discover how many ballasts have been replaced and how old the system is.
- If failure is higher than 25%, a ballast replacement may be in order before installing the LED lamp. Have seen ballasts fail after installing new lamps.
- Let ballasts cool down for 10-15 minutes before replacing with LED to avoid latency start-up issues with LED lamp.

Greater Southwest Region 7—Deployment

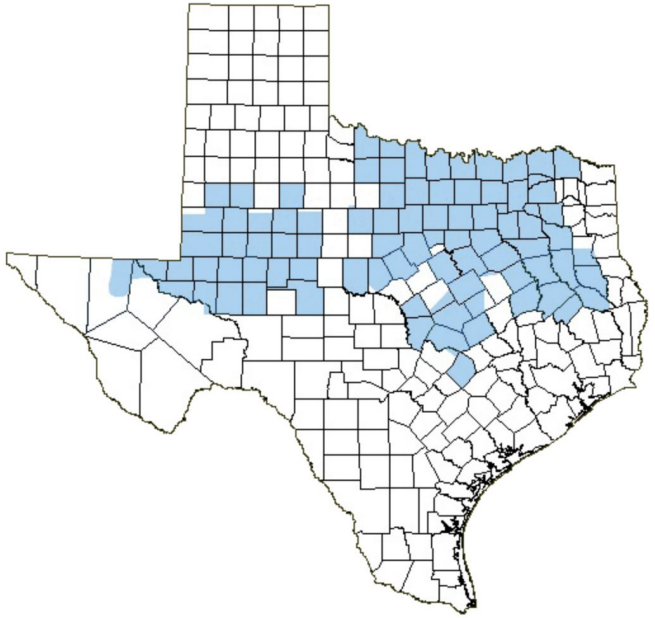
1 batch of lamps had a manufacturing defect that caused flickering. Lunera identified the problem and replaced all defective lamps.

Lunera spec'd in several of upcoming projects though there are now other options that meet these specs.

Greater Southwest Region 7—Deployment

ONCOR utility incentive in Texas for downlight LED lamps, though not for linear LED bulbs without the ballast.

1,200 26W CFLs to 13W LEDs
$4,200 incentive



Q & A

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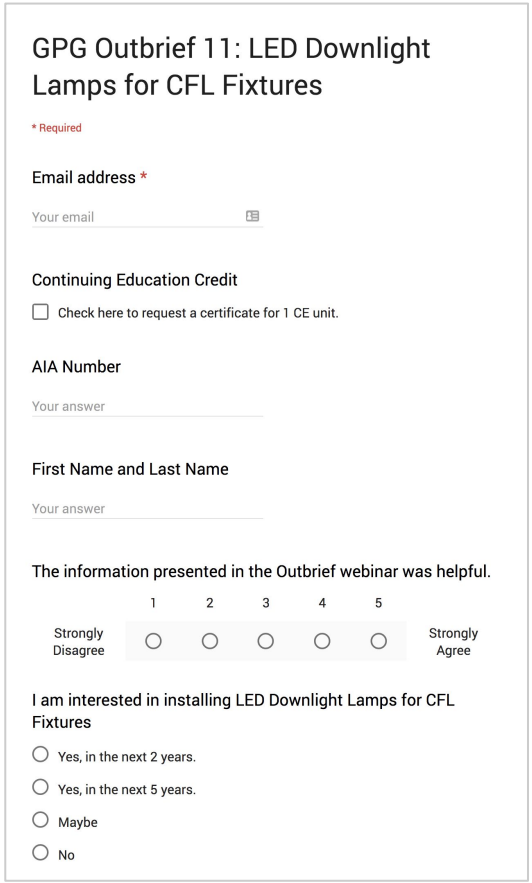

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AIA Number

Your answer

First Name 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 LED Downlight Lamps for CFL Fixtures

- ○ 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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