

## Byron G. Rogers Federal Building Harvests Daylight and Super Savings

The U.S. General Services Administration (GSA)’s efforts to modernize a mid-Twentieth Century office building in downtown Denver, Colorado, have netted them a 2016 Interior Lighting Campaign award for “Best Use of Lighting Controls in a Single Building” from the U.S. DOE’s Interior Lighting Campaign.

Existing T12 and T8 luminaires were replaced with LED dedicated troffers with advanced controls; together these measures cut lighting energy use from 814,200 to 337,200 kWh on an annual basis in the Byron G. Rogers Federal Office Building. This represents an estimated 59% savings in lighting energy use for the 18-story, 791,000-square-foot building that houses 11 federal agencies.

The lighting upgrade was part of an extensive retrofit to radically reduce energy and water consumption in the building while modernizing the space for more flexible and efficient use. The deep-energy-saving retrofit incorporated as many load reduction measures as possible. Updating the lighting and lighting control systems was a major contributor to capturing energy savings.

### Project at a Glance - Byron G. Rogers Federal Building

Project Location	Denver, CO
Total Area of Project	791,000 square feet
# of Troffers Upgraded	3,300
Annual Energy Savings	477,000 kWh
Equals the Energy Usage of	41 Homes
Energy Use Reduction	59%
Adjusted Internal Rate of Return	13%

At the time the project was awarded in 2009, LED fixtures were not being widely manufactured for large commercial projects. Many LED fixtures produced poor light quality and low luminous efficacy. The GSA project team spent numerous hours researching and working with vendors to identify LED luminaires and controls that produced an efficient and desirable light. The lighting vendor identified LED products and created mock-ups to test options in an office setting. The project team and occupants assessed each product for light quality, efficacy, and light levels.

Ultimately, GSA teamed with a lighting manufacturer capable of mass-producing a luminaire that met their quality and efficacy requirements. They also teamed with a controls manufacturer to develop and produce the driver that would enable the advanced controls for daylight harvesting to maximize energy savings.

### Project Drivers and Successes

Project drivers included helping the GSA to reach the federal goal of reducing fossil fuel-generated energy consumption to zero in federal buildings by 2030.

Once the energy model and life cycle cost analysis were developed, the retrofit project was easily justified. The analysis illustrated the significant cost savings the project would yield each year from reduced energy use. Operation and maintenance costs were also a major factor. Because LEDs last so much longer, the maintenance contractor no longer has to replace light bulbs so frequently. Also, the intuitive lighting control system can diagnose problems, reducing the maintenance contractor’s investigative time in the field.

Benefits of the lighting include significantly longer light source life. Maintenance costs are also reduced as



GSA replaced 3,300 troffer lights at the Byron G. Rogers federal building in downtown Denver to gain lighting energy savings of \$49,200 annually.  
*Photo courtesy of GSA*

fewer lamps need to be purchased and changed out.

The lights located within 15 feet of the perimeter of the building are dimmed in response to available daylight. The lighting controls also work to control the mechanical system, which provides added energy savings. When an occupant enters a space, the same occupancy sensors that communicate with the lighting control device to turn the lights on will also communicate with the Building Automation System (BAS) to

### Before and After Retrofit

	Before	After
	Fluorescent	LED
Number of Troffers	3,300	3,300
Wattage per Troffer	80-W	45-W
Annual Energy Use	814,200 kWh	337,200 kWh
Controls	All	All
Controls included on Daylight Harvesting Sensors	None	3,300

## ILC Award Won

- Best Use of Lighting Controls in a single Building



The Byron G. Rogers Federal Building modernization project includes daylight sensors. The lighting control system provides automated dimming of electric lights down to 0% output when daylight provides adequate light levels.

*Photo courtesy of GSA*

## Lessons Learned

- Use of advanced lighting controls like daylighting controls and sensors that communicate with building energy control systems can increase project savings.
- Intuitive control systems can diagnose problems early on, reducing time and labor required for troubleshooting and repairs.
- Including operations and maintenance costs in the equation can strengthen the business case as LED fixtures and lamps have a longer life than standard equivalents.
- Performing mock-ups with proposed lighting fixtures and products facilitates choosing the fixture with the best efficacy and light distribution while promoting occupant buy-in.
- Energy efficiency rebates for LED lighting are offered by many utilities and can positively effect project economics.

activate the HVAC system in that zone thus saving lighting energy and reducing heating and cooling loads.

Project savings have been significant. The GSA estimates the net present value of the new overhead lighting at \$2.2 million, and calculates an internal rate of return over 13%. The reduction in energy use resulting from the lighting upgrade is expected to cut life-cycle CO<sub>2</sub> emissions by 16,000 metric tons or 21%.

The project team worked with the local utility, Xcel Energy, to receive energy efficiency rebates for the lighting system (both LED luminaires and controls), which also positively effected the bottom line.

## Overcoming Challenges

Several users had difficulty adjusting to the daylight harvesting and relying more on daylight and desk light. Education combined with some personnel being relocated within the building increased occupant satisfaction.

Another challenge was associated with the communication cable (CAT6). The cables between each device were cut and connections were made in the field by daisy chaining the devices together. Several faulty connectors found throughout the building were replaced over the first several months

after installation. The devices were daisy chained, so when one device fails all upstream devices go offline simultaneously.

“Building occupants have been very satisfied with the reliability of the lighting and lighting controls. Occupants find the illumination levels to be more than adequate and don’t even rely on task lighting when the electric lighting is at the lowest set point. Tenants often express how the modernization project has increased productivity and overall well-being,” said Bryan Zach, Project Manager at the GSA Denver Federal Center.

## Next Steps

GSA expects this building to attain LEED Gold certification because of replacement of the major building systems (including lighting), with overall energy use cut by 70%. They anticipate using similar lighting fixtures, controls, and daylight harvesting in other projects given the proven efficiencies and effectiveness of the Byron G. Rogers retrofit.

### Learn More

**United States General Services Administration**  
<http://www.gsa.gov/portal/category/100000>

**Byron Rogers Federal Building Site**  
<http://www.gsa.gov/portal/content/101723>



The Byron G. Rogers Federal Building is considered a net zero-ready building thanks to extensive energy upgrades. Several systems, including lighting, electrical, HVAC, and plumbing, were replaced in the building which was constructed in 1962. All together, the lighting upgrades resulted in energy savings of 477,200 kWh, and a reduction in energy use of 59%.

*Photo courtesy of GSA*

## Federal Energy Efficiency Requirements for Interior Lighting

Although every site, whether federal, private, commercial, or industrial, can benefit from the energy savings, maintenance savings, and lighting quality improvements, offered by energy-efficient lighting, federal sites have another motivator. They must ensure compliance with the multiple laws, executive orders, and Federal Acquisition Regulations, which mandate that federal agencies meet efficiency requirements in all procurement and acquisition actions that are not specifically exempted by law.

### ENERGY STAR® Lighting

Federal purchasers must buy, specify, and contract for ENERGY STAR®-compliant products. To find ENERGY STAR-qualified lighting products, see [www.energystar.gov/productfinder/](http://www.energystar.gov/productfinder/).

### Federal Efficiency Requirements

In cases where there is no ENERGY STAR® product category, the agency should comply with FEMP-designated efficiency requirements.

The table below lists the minimum federal efficiency requirements that various categories of interior LED lighting must meet to be eligible for purchase by federal agencies.

### LED Luminaire Efficiency Requirements for Federal Purchases

Luminaire Type	Light Output	Luminaire Efficiency (LE)
Commercial, linear ambient	≥375 lm/ft	≥103 lm/W
Commercial, 1-foot by 4-foot troffers	≥1,500 lm	≥99 lm/W
Commercial, 2-foot by 2-foot troffers	≥2,000 lm	≥100 lm/W
Commercial, 2-foot by 4-foot troffers	≥3,000 lm	≥103 lm/W
Industrial, low bay	≥5,000 to <10,000 lm	≥103 lm/W
Industrial, high bay	≥10,000 lm	≥100 lm/W

Last Updated October 2015

### FEMP LED Purchasing Guidance

For more information on high-efficiency lighting technologies and information for federal agencies, including lighting requirements language for contracts, visit [energy.gov/eere/femp/purchasing-energy-efficient-commercial-and-industrial-led-luminaires](http://energy.gov/eere/femp/purchasing-energy-efficient-commercial-and-industrial-led-luminaires).

FEMP and the DOE LED Lighting Facts® program have partnered to offer a tool that allows federal users to identify LED lighting products that meet the minimum federal efficiency requirements.

The FEMP Acquisition Guidance Product List allows users to search for interior lighting products in the six categories in the table below that meet federal requirements. The tool provides a pre-screened list of products and federal users can screen on a large range of other product metrics, including color temperature, power factor, and beam angle. Find qualifying products at [www.lightingfacts.com/LFPowered/FEMP](http://www.lightingfacts.com/LFPowered/FEMP).

### Helpful Guides

*Wireless Occupancy Sensors for Lighting Controls: An Applications Guide for Federal Facility Managers* — This guide describes the different types of sensors, appropriate applications, and expected energy savings. [www.energy.gov/sites/prod/files/2016/03/f30/wireless\\_occupancy\\_sensor\\_guide.pdf](http://www.energy.gov/sites/prod/files/2016/03/f30/wireless_occupancy_sensor_guide.pdf)

*Measurement and Verification of Energy Savings and Performance from Advanced Lighting Controls* — This document provides a framework for measurement and verification. [energy.gov/sites/prod/files/2016/03/f30/mv\\_lighting\\_control\\_wireless.pdf](http://energy.gov/sites/prod/files/2016/03/f30/mv_lighting_control_wireless.pdf)

### Proven Specifications

Use these specifications, developed by DOE’s Better Buildings Alliance and the Designlights Consortium, to specify performance expectations, warranty, and testing requirements for your lighting projects.

*Better Buildings Alliance Model Technical Specification: High-Efficiency Troffers*  
[betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/High Efficiency Troffer Performance Specification.pdf](http://betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/High%20Efficiency%20Troffer%20Performance%20Specification.pdf)

*Designlights Consortium Networked Lighting Control Systems Specification*  
[www.designlights.org/content/CALC/SpecificationAndQPL](http://www.designlights.org/content/CALC/SpecificationAndQPL)

“The marketplace is seeing a rapid adoption of highly-efficient indoor lighting and green leasing practices, as the price of cutting edge technologies and the risk of creative market approaches continue to decline. This is exemplified by the increasing number of organizations partnering with DOE to adopt the next technology or novel market strategy—and through this, showing the will to push the limits and benefits of energy efficiency in commercial buildings.”

**Kathleen Hogan,**  
 Deputy Assistant Secretary for Energy Efficiency, U.S. Department of Energy

## Interior Lighting Campaign



On June 27, 2016, the GSA was one of 13 organizations recognized for exemplary energy savings at an award ceremony conducted in Washington, DC, by the ILC, an effort to promote high-efficiency troffer lighting and control systems in buildings. The U.S. GSA won Best Use of Lighting Controls in a Single Building for the Byron G. Rogers Federal Building upgrades.

In one year alone, 650,000 new high-efficiency troffer upgrades were planned or completed, equating to savings of 130 million kWh, and \$13.5 million. With nearly 50 participants and over 130 supporters, the ILC continues to accelerate the reduction in the amount of energy consumed by lighting in buildings nationwide.

The ILC encourages facilities to install energy-efficient lighting and to install lighting occupancy or daylight controls to cut energy use and deliver occupant satisfaction. By adopting more efficient troffer lighting, such as systems that meet the Better Buildings Alliance [specification](#) for troffers, building owners can save up to 70% on a one-for-one basis, and up to 80% with the use of controls.

The ILC's overall goal is to achieve the replacement of 1 million planned or installed high-efficiency troffer lighting systems by April 2017.

The ILC is sponsored by the Building Owners and Managers Association International, the Illuminating Engineering Society, the International Facility Management Association, the U.S. General Services Administration, and the U.S. Department of Energy Better Buildings Alliance.



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For more information, visit:  
[www.interiorlightingcampaign.org](http://www.interiorlightingcampaign.org)

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**FEMP**  
Federal Energy Management Program



Through the Better Buildings Alliance, members in different market sectors work with the U.S. Department of Energy's (DOE) exceptional network of research and technical experts to develop and deploy innovative, cost-effective and energy-saving solutions that lead to better technologies, more profitable businesses, and better buildings in which we work, shop, eat, stay, and learn. Join today to start saving energy in your commercial buildings through programs like the Interior Lighting Campaign, [www.interiorlightingcampaign.org](http://www.interiorlightingcampaign.org).

*Photo courtesy of Pacific Northwest National Laboratory.*

### Join the ILC

Federal sites are encouraged to join the ILC. The ILC will provide you with:

- technical assistance
- information on financing and incentives
- lighting savings calculators.

Federal sites commit to:

- building or retrofitting at least one building space with high-efficiency lighting. (Sites built or retrofitted with complying fixtures any time after January 1, 2013, are eligible to compete.)
- Share your results.

Report your actual energy savings by April 2017 for a chance to be recognized at the ILC awards event at the Building Owners and Managers Association 2017 International Conference & Expo, June 24-27, 2017, in Nashville, Tennessee.

### ILC Award Categories

The award categories for the interior lighting campaign include the following:

- Highest Absolute Annual Savings for Troffer Lighting Retrofits
- Highest Percentage of Annual Savings for Troffer Lighting Retrofits
- Highest Absolute Annual Savings for Troffer Lighting New Construction
- Highest Percentage of Annual Savings for Troffer Lighting New Construction
- Special Recognition Categories:
  - Best Use of Lighting Controls in a Single Building
  - Largest Number of Facility Projects
  - Largest Portfolio-wide Annual Absolute Energy Savings
- Exemplary Performance Awards may also be presented to participants in the federal sector.