Resource Conservation District
Greater San Diego County

LED Troffer and Downlight Interior General Illumination Lighting Assessment Final Report

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Prepared for:

SDGE
A Sempra Energy utility™

Prepared by:

Emerging Technology Associates, Inc

PREFACE

PROJECT TEAM

This project is sponsored by San Diego Gas & Electric's (SDG&E®) Emerging Technologies Program (ETP) with Jerine Ahmed as the project manager. Marty Leavitt, District Manager, was the contact and project manager for Resource Conservation District. Daryl DeJean (daryl.eta@gmail.com) from Emerging Technologies Associates, Inc. provided technical consulting, data analysis, overall coordination of all parties involved, and finalized the report.

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ACKNOWLEDGEMENTS

We would like to acknowledge the Resource Conservation District and SDG&E® for assisting in reviewing the products and installation of the LED fixtures. Without their participation, this assessment project would not have been possible.

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Abbreviations and Acronyms

CALiPER Commercially Available LED Product Evaluation and Reporting

CCT Correlated Color Temperature

DOE Department of Energy

ETP Emerging Technologies Program

FC Foot Candle

IESNA Illuminating Engineering Society of North America

K Kelvin

kWh Kilowatt Hour

LED Light Emitting Diode

LPD Lighting Power Density

RCD Resource Conservation District

SDG&E San Diego Gas & Electric

SQ FT Square Foot

SSL Solid State Lighting

US United States

W Watt

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EXECUTIVE SUMMARY

In May 2009, the Resource Conservation District of Greater San Diego County and San Diego Gas & Electric's (SDG&E®) Emerging Technologies Program (ETP) agreed to conduct an assessment project to evaluate solid state lighting (SSL) light emitting diode (LED) technology. The goal of the project was to determine the energy savings potential provided by LED as the light source for general illumination lighting compared to the standard Title 24-2008 base case fluorescent in a small office setting.

In addition to the assessment project goals, the Resource Conservation District's goal was to eliminate disposal concerns of fluorescent lighting.

The project site was selected due to the Resource Conservation District's willingness to allow for general illumination of their entire office space to be provided solely by LED light sources to determine how the LED compared to the Title 24-2008 base case fluorescent.

Quantitative light and electric power measurements were taken. A 16% reduction in energy usage and demand were recorded with LED luminaires compared to the lighting power density (LPD) requirement for office space illumination as per Title 24-2008. Additionally, the light levels meet the minimum of 30 foot candles (fc) as recommended by Illumination Engineering Society of North America (IESNA).

The below tables illustrate how the manufacturer's product data provided on its product data sheet compare to the project's measured data and the CALiPER testing data.

Table 1: LED Downlight Performance Data

	Manufacturer	Measured	CALiPER 07-47
Power (W)	10.5	11.8	10.8
CCT (K)	3,500	3,377	3,402
Power Factor	> 0.90	0.98	0.97

Table 2: LED Troffer Performance Data

	Manufacturer	Measured	CALiPER 09-41-01
Power (W)	44	46.7	41
CCT (K)	3,500	3,377	3,250
Power Factor	0.90	0.98	0.97

This assessment project will assist offices across the country to determine the applicability of LED light sources for general illumination. Consideration of design, functionality and occupant behavior, acceptance and tolerance of a new "emerging" light source technology, luminaire quality, and economic considerations may directly impact the decision to select LEDs for the purpose of office general illumination. **Therefore, readers are advised that each situation is unique. It is recommended the reader exercise due diligence in determining the appropriateness of LEDs for general illumination, luminaire selection, lighting design and layout.**

It is recommended that a larger scale assessment project of interior offices where day lighting is not prevalent be conducted. Such a project would allow for an in-depth constituent survey which may provide valuable insight as to the perception and reception of such general illumination technology.

Based upon the findings of this project, it is recommended that future projects conducted consider: 1) an actual situation where the base case fluorescent lighting system can be measured allowing for a direct comparison of all relevant aspects; 2) multi-level lighting scenarios e.g. the use of dimming; and 3) task ambient lighting relationship by incorporating a lighting control system or photosensors to determine the impact on energy savings

INTRODUCTION

In response to an overwhelming interest in innovations in LED general illumination lighting technology among clients in its territory, San Diego Gas & Electric's (SDG&E®) objective with this assessment was to:

- assess LED lighting technology, validating manufacturer claims regarding energy savings, light levels and light characteristics
- perform a comparison of LED technology against minimum requirements of Title 24-2008 and Title 24-2005 as well as meet the minimum lighting levels recommended by IESNA for an office environment.

The Resource Conservation District selected and arranged for the installation of new LED overhead general illumination for the renovation of its small commercial office building.

In collaboration with the Resource Conservation District and its contractors, SDG&E® agreed to assess the performance of the selected LED luminaires. Installation of the LED luminaires was completed mid-year 2009. Measurements of power [W] and illuminance [fc] and light quality [K] were taken post installation. The base case for comparison is based on prescriptive Title 24-2008 and Title 24-2005 requirements for office illumination.

Figure 1: LED Troffer in Open Work Space

PROJECT BACKGROUND

Project Overview

The LED Troffer and Downlight Interior General Illumination Lighting Assessment project was conducted as part of the Emerging Technologies Program of San Diego Gas & Electric Company. The Emerging Technologies program "is an information-only program that seeks to accelerate the introduction of innovative energy efficient technologies, applications and analytical tools that are not widely adopted in California. The information includes verified energy savings and demand reductions, market potential and market barriers, incremental cost, and the technology's life expectancy." Project Management and Methodology was provided by Emerging Technologies Associates, Inc.

The LED Troffer and Downlight Interior General Illumination Lighting Assessment project studied the applicability of overhead general illumination lighting consisting of light emitting diode (LED) luminaires in a small non-residential office. This was a renovation of a vacant space in which the occupant selected LED technology in lieu of the traditional fluorescent lighting technology. The general lighting was designed in accordance Title 24-2005 which required an LPD of 1.1 W/sq ft. However, since this project was completed after Title 24-2008 came into effect, it was decided to compare against the 2008 version which establishes 0.85 W/sq ft as the standard. The applicability of the technology was determined by light output, energy and power usage, and economic factors.

Technological Overview

At the time of this assessment, LED lighting in general illumination applications, i.e. downlights, were gaining momentum. Due to the luminaires' ability to provide greater control of light dispersion, greater operating and maintenance savings and desire for higher quality light, RCD decided to pursue the use of LEDs for general illumination of their entire office space.

LED downlights were used in the office restrooms. LED troffers were used in this project for general office and common area overhead illumination. The Department of Energy's Commercially Available LED Product Evaluation and Reporting (CALiPER) program has also evaluated the product designed for this application. We have included their results for reference.

Currently, lighting retrofits for general indoor overhead illumination are mostly done with T8 or T5 fluorescent and compact fluorescent lamps. Fluorescent technology is used primarily because of their long rated life and high efficiency relative to other conventional options. In California, Title 24-2008 which became effective on January 1st, 2010, requires an office to have a lower lighting power density (LPD) of 0.85 W/sq ft for general illumination lighting. The prior version, Title 24-2005, required 1.1 W/sq ft instead.

New lighting technologies like LEDs have the potential for long life, reduced maintenance, good color rendition, and reduced operating cost when compared to fluorescent. Currently however, the initial cost of this technology is higher than conventional light sources such as fluorescent.

According to a Navigant Consulting, Inc. report, "Energy Savings Estimates of Light Emitting Diodes in Niche Applications October 2008" prepared for Building Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, LED recessed downlights have the greatest energy savings potential of applications currently being considered for white light LEDs. The report states that "electricity is saved in white-light applications where LED sources are used to replace incandescent, halogen, and in some cases, CFL and some types of fluorescents."

Due to the directional nature of the light provided, recessed downlights have become the most common fixture used for general illumination ambient lighting in both residential and commercial buildings. Currently recessed troffer fixtures commonly used with linear fluorescent lamps are not included as part of the above mentioned Navigant report.

Below are the Navigant report details on the emergence of LEDs in the recessed downlight market.

"While some LED-based products have been offered as "substitutes" for incandescent reflector lamps for these applications, only in 2007 were products introduced to the market which offered a sufficiently bright lumen level and quality of light that they could be considered adequate substitutes for incandescent reflector lamps.

These LED recessed downlight products, as measured by the DOE's Commercially Available LED Product Evaluation and Reporting (CALiPER) program, can be more efficient *in situ* than both conventional incandescent reflector and compact fluorescent technologies (DOE, 2007b). In addition to being an efficient lighting technology, LED reflector lamps can also be designed for either directional or ambient lighting unlike reflector compact fluorescent lamps which are best suited for ambient lighting conditions."

The LED downlight (Figure 2) and LED troffer luminaire (Figure 3) was used in this project. Appendix B contains the product data sheets for both products.

Figure 2: LED Downlight

Figure 3: LED Troffer

According to the US Department of Energy, LED technology is changing at a rapid pace. The performance of LED technology is quickly gaining efficiency but the first cost remains a barrier to market entry. However, it should be noted that the costs for LED technology seems to be getting more competitive in the market place with each year that passes and technological advances are applied to ambient lighting luminaires. This is particularly true for the recessed downlight application.

The LED troffer application is so new that it may take some more time before costs will become more competitive. In direct replacement applications, payback times for LED troffers are very long. However, LED troffers are much brighter, and may therefore lend themselves to new lighting designs that can result in cost savings. For example, task lighting may be eliminated, and luminaires may be spaced farther apart while maintaining the same light levels than with traditional means. These factors are likely to reduce payback times in the future.

In this project, the LED troffer provided illuminance at the task plane of 50 foot candles. For an open office plan, the IESNA recommended illuminance level is 30 foot candles at the task plane. Therefore, even in this project, a lighting design to IESNA recommended lighting levels would have resulted in much better simple payback. RCD opted for the tighter spaced troffers for two reasons: 1) they wanted to provide "better" light than the required minimum, and 2) they wanted to be able to retrofit the ceiling panes with traditional fluorescent lighting easily without extensive rewiring in case of product or project failure. It should be noted that despite LED troffer providing adequate lighting in open office areas sometimes task lighting is required when cubicle walls cause shading.

Market Overview

The anticipated escalation rate for electricity is an increasing concern. Both energy costs to operate traditional lighting technology and the environmental disposal issues of various light sources including fluorescent technology, will inevitably increase over time. The market for new energy efficient interior white light sources will continue to grow due to increasing demand for electricity and the cost to operate and maintain interior lighting. Increasing electricity rates and a growing awareness of energy efficiency will increase the economic feasibility of new general illumination ambient lighting technologies in future years to come.

Figures 4 and 5 provide the breakdown of both electric energy use by building type and end use, i.e. interior lighting according to the California Commercial End-Use Survey (CEUS) conducted 2006 by Itron, Inc. As Figure 4 indicates, offices comprise 28.8% of the entire segments energy use in terms of kWh. Figure 5 indicates the dominance of interior lighting, 28.4%, as the largest application for electric energy.

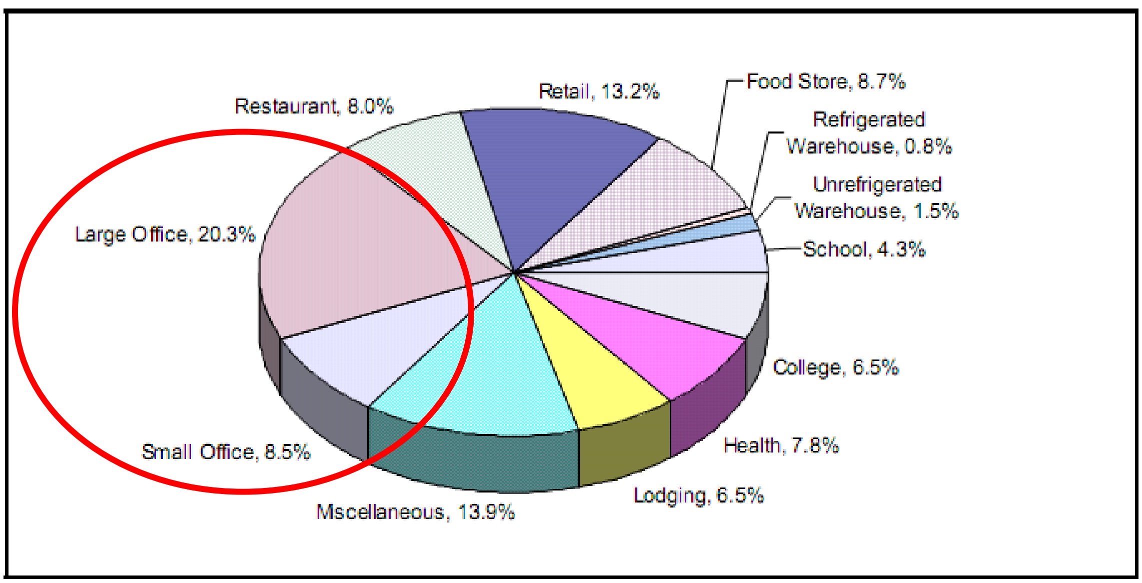

Figure 4: Electric Use by Building Type in SDG&E® Service Territory

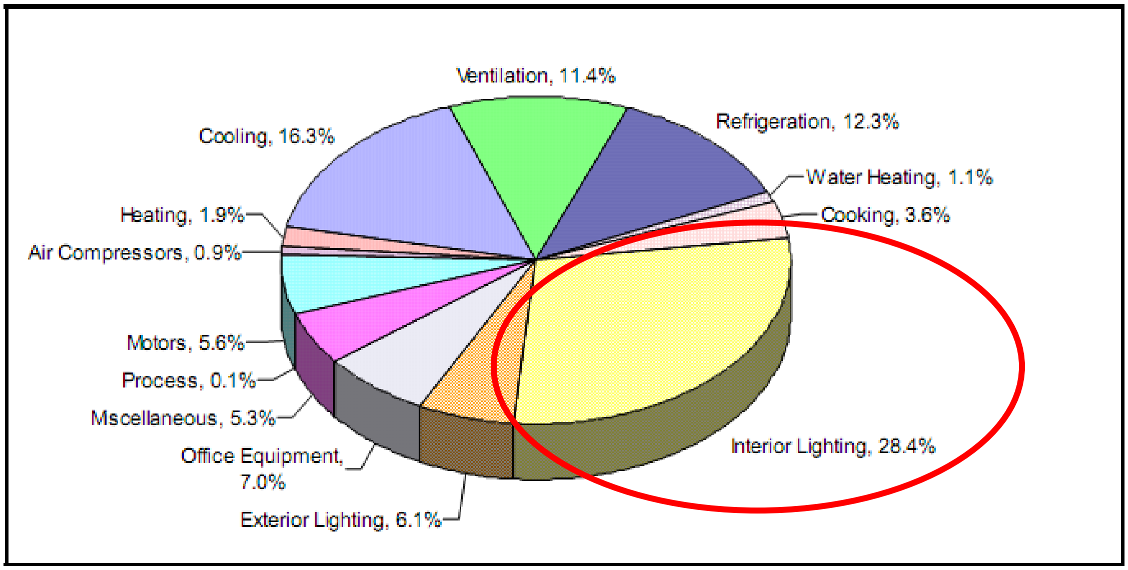

Figure 5: Electric Usage by End Use in SDG&E® Service Territory

According to CEUS, in SDG&E®'s service territory, the entire commercial segment utilizes 4.16 kWh/sq ft for interior lighting. The small and large commercial office space utilizes 3.94 kWh/sq ft and 4.45 kWh/sq ft, respectively.

The results of this project indicate the potential for small office to utilize only 2401 kWh for the entire 1566 square feet, or 1.53 kWh/sq ft electric energy intensity for the interior lighting. This is a significant reduction when compared to the above 3.94 kWh/sq ft referenced in the CEUS report. This is based upon operating approximately 8 hours/day 260 days per year.

PROJECT OBJECTIVES

The objectives of this project were to examine electrical, lighting, and economic performance of LED troffer and recessed downlight luminaires as compared to the requirements of Title 24. The potential electrical demand and energy savings were measured in terms of instantaneous system wattage and annual kWh usage was based on the Resource Conservation District office's annual operating hours. Lighting performance was measured in terms of illuminance in foot candles and correlated color temperature (CCT) measured in Kelvin. Finally, economic performance was calculated as simple-payback for the incremental cost of utilizing LEDs in lieu of fluorescent fixtures meeting Title 24-2008 minimum requirements in a new installation.

Figure 6: LED Troffers in Open Office Area

METHODOLOGY

Host Site Information

The site selected for this assessment was the Resource Conservation District for Greater San Diego County office located in Lakeside, CA. The project was considered a “new construction” project since it was a complete renovation of an entire space. As such, it had to meet the standards established by Title 24-2008.

The office ceiling height was 7’9” throughout the 1566 square foot office space. In lieu of traditional fluorescent fixtures, twenty-two LED troffer fixtures were used in the general office spaces and common areas, i.e. break room. Two restrooms had one LED recessed can light installed in each. The annual operating hours of the office was 2142 hours. The customer pays on average $0.21/kWh.

Measurement Plan

The LED Troffer and Recessed Downlight Assessment Project studied the suitability and performance of LED luminaires in a small office general illumination lighting application. In lieu of traditional fluorescent fixtures, LED luminaires were used throughout the entire office space. Quantitative and electrical power measurements were taken.

Due to this being a “new construction” project design was performed using Title 24 lighting power density (LPD) requirements. Since this project was completed under Title 24-2005, the required LPD was 1.1 W/sq ft versus the current effective version’s 0.85 W/sqft for office general illumination. As part of the measurement plan, we have verified the actual LPD.

The office area has a significant amount of natural daylight. Therefore, all light measurements were taken after dusk to obtain the actual lighting performance of the LED luminaires without any influence of natural daylight.

The luminaires were mounted flush to the ceiling at a height of 7'9” above the finished grade. The illuminance levels were taken at the task plane, specifically the occupants’ work surface, in each work space and in the common areas.

Equipment

Illuminance and Correlated Color Temperature Meter:
Konica Minolta Chroma Meter, Model CL-200 (last calibrated 10/2007)
Accuracy: +- 2.0%

http://www.konicaminolta.com/sensingusa/products/Light-Measurement

Power reading:
Fluke Clamp Meter, Model 332

http://www.fluke.com

PROJECT RESULTS AND DISCUSSION

Electrical Demand and Energy Savings

The LED luminaires used less power than the lighting system required by Title 24 with an annual reduction of energy usage. Tables 3 and 4 show the demand and energy savings achieved with LED lighting technology.

Table 3: Project Demand Savings

Light Source	Stated Power (W)	Measured Power (W)	Power Savings (W)	Power Savings (%)
Title 24-2005	1,722	-	-	-
Title 24-2008	1,331	-	-	-
LED vs. Title 24-2005	989	1,051	671	39
LED vs. Title 24-2008	989	1,051	280	21

Table 4: Project Electric Energy Savings

Light Source	Annual Energy (kWh)	Annual Energy Savings (kWh)	Energy Savings (%)
Title 24-2005	3,689	-	-
Title 24-2008	2,851	-	-
LED vs. Title 24-2005	2,401	1,288	35
LED vs. Title 24-2008	2,401	450	16

Lighting Performance

Photopic illuminance measurements were taken at the task plane of each occupant's work surface as described in the above section, "Measurement Plan."

Correlated Color Temperature

Correlated color temperature (CCT) measurements were taken using a Konica Minolta Chroma meter under the LED luminaires. The average color temperature under the LED luminaire was 3377 K.

Validation of Manufacturer Data

The below tables, 5 and 6, illustrate how the manufacturer's product data provided on its product data sheet compare to the project's measured data and the CALiPER testing data which can be found at http://www1.eere.energy.gov/buildings/ssl/caliper.html

Table 5: Performance Results of LED Downlight

	Manufacturer	Measured	CALiPER 07-47
Power (W)	10.5	11.8	10.8
CCT (K)	3,500	3,377	3,402
Power Factor	> 0.90	0.98	0.97

Table 6: Performance Results of LED Troffer

	Manufacturer	Measured	CALiPER 09-41-01
Power (W)	44	46.7	41
CCT (K)	3,500	3,377	3,250
Power Factor	0.90	0.98	0.97

Figure 7: LED Troffer in Kitchen Area

Economic Performance

It is important to note that the cost and equipment assumptions made in this section apply only to the Resource Conservation District. Readers should consider their specific variables such as maintenance, energy, luminaire efficacy, luminaire costs and type of distribution before drawing any conclusions about the cost effectiveness of LED luminaires. LED luminaire lifetime is a function of all the manufacturer's components of the luminaire (LEDs, driver, housing, coatings, etc.), electrical and thermal properties. Therefore, manufacturer claims, with regard to the aforementioned factors, are highly variable. The cost and savings estimates for this section is based upon the Resource Conservation District's situation to evaluate economic performance of the base case Title 24 requirements and the LED luminaires assessed in this project.

1. Energy Cost Estimates

The energy cost is based upon the Resource Conservation District's electric rate of $0.21/kWh. The annual operating hours of 2142 hours was provided by the District Manager. This project focused on the substitution of LED luminaires in lieu of fluorescent fixtures in a "new" construction scenario. Table 7 provides the energy and energy cost savings results of this project.

Table 7: Project Energy Savings Achieved

Light Source	Annual Energy (kWh)	Annual Energy Savings (kWh)	Annual Energy Cost ($)	Annual Energy Cost Savings ($)	Annual Energy Cost Savings (%)
Title 24-2005	3,689	-	775	-	
Title 24-2008	2,851	-	599	-	
LED vs. Title 24-2005	2,401	1,288	504	271	35
LED vs. Title 24-2008	2,401	450	504	95	16

Simple payback calculations were calculated for a new construction scenario only. Due to the fact that the results of this project reflected a payback that far exceeded the lifetime of the luminaires, no calculations for maintenance or retrofit scenarios were calculated. Table 8 provided the simple payback for this project.

Table 8: Project Simple Payback

Light Source	Total Installed Cost ($)	Incremental Cost ($)	Energy Cost Savings ($)	Simple Payback (years)
Title 24-2005	6,500	-	-	-
Title 24-2008	6,500	-	-	-
LED vs. Title 24-2005	17,471	10,971	271	40
LED vs. Title 24-2008	17,471	10,971	95	116

2. Luminaires and Lamp Life

For the purposes of this project, the end of useful life for each luminaire is 50,000 hours.

LEDs require a properly designed fixture, meaning electrically and thermally, to achieve the life expectancy. If the fixture has poor electrical or thermal design the LED life is adversely affected resulting in a much shorter life.

James Brodrick, Lighting Program Manager, U.S. Department of Energy, Building Technologies Program, in a recent article entitled "Lifetime Concerns", when discussing how best to define the longevity of LED luminaires stated: "That's not a simple matter, because it doesn't just involve the LED themselves, but rather encompasses the entire system-including the power supply or driver, the electrical components, various optical components and the fixture housing."

The manufacturer of the LED luminaires assessed in this project claim life expectancies of up to 50,000 hours (approximately 23 years at 2142 operating hours per year). ***This report uses 50,000 hours, or 23 years in this situation, as the LED life expectancy.*** The Title 24 base case fluorescent system has an expected life of 20,000 to 30,000 hours (approximately 9 to 14 years based upon the 2142 annual operating hours).

3. Life Cycle Cost Analysis

No economic analysis taking into consideration maintenance savings and other savings was conducted. However, to fully assess this technology a complete life cycle cost analysis is recommended. There are many variables and considerations which are specific to each reader's situation. It is recommended that variables such as labor, cost of materials, maintenance practices, cost of financing, inflation, energy rates, material cost, etc. be determined for the specific project under evaluation. Due to the uncertainty as to future labor, product and other costs, especially for LED technology, readers are recommended to use their judgment regarding the future costs.

CONCLUSION

This assessment demonstrated that LED general illumination ambient lighting technologies deliver lighting power densities which meet or exceed Title 24 requirements. LEDs exhibited potential for energy savings and the potential for better operation and maintenance savings. In fact, this project demonstrated how LEDs provide more ambient lighting at 38% less power.

The lessons learned from this assessment are as follows:

- LED technology is a viable functional alternative for general illumination ambient lighting.
- Further studies are required to determine exactly how LEDs compare to fluorescent lighting systems in several respects
- The manufacturer of the LEDs used in this project did exercise due diligence in their marketing materials providing accurate information. However, do not rely on marketing brochures and technical data sheets. A full assessment is recommended.

The results of this project attest to the leaps in technological enhancements of LED luminaires. However, the high incremental first cost required in new construction with LEDs as the light source providing general illumination ambient lighting will be the main barrier to significant market adoption. The energy savings and potential reduce maintenance costs do not adequately offset this high initial first cost. Performance of the LED luminaires combined with growing industry desire for more eco-friendly lighting products may provide early adopters the impetus to invest in the emerging technology.

Due to the as yet proven long life of LEDs, economic and reliability claims are based on the best available information from the manufacturer and DOE reports. James Brodrick, Lighting Program Manager, U.S. Department of Energy, Building Technologies Program, wrote an article in which he states, *"The question of LED luminaire and reliability is a complex one, fraught with nuance and ramification."*

Although the results of this assessment indicate an extremely long payback period for LED, one in which the LED will never pay for itself, other performance attributes such as environmental disposal issues combined with operating cost savings may be such that longer than typically acceptable commercial payback periods are acceptable. As LEDs gain acceptance as a viable alternative to existing general illumination technology and LED technologies continue advancing at such a fast rate, expectations are that these luminaires will be more economical in the near future. Utility incentives could also help in the short-term to make the luminaires cost-effective for customers fueling earlier adoption of the new technologies.

Based upon the findings of this project and others, it is important to note that each situation is different. It is highly recommended that prior to committing to a technology readers conduct their own pilot or mini assessment of the available options to determine the economic feasibility of their particular project.

APPENDIX A

Data Collection Sheets

LED Troffer Data

Desk	IIlluminance	CCT
1	35.6	3339
	69.09	3464
2	20.56	3294
	25.83	3393
3	63.47	3426
	14.29	3221
4	64.73	3401
	34.8	3328
5	68.51	3476
	35.8	3366
6	53.21	3482
	28.71	3305
7	62.57	3357
	41.21	3380
Office	68.5	3471
	91.3	3400
	63.9	3338
	74.01	3362
	43.8	3377
File cabinet 1	34.4	3352
File cabinet 2	38.6	3302
Bookcase	44.1	3370
Credenza	59.24	3349
Print Area	58.08	3375
	70.02	3395
	35.9	3348
	60.05	3413
Xerox	72.16	3442
	46.41	3455
Kitchen	43.48	3359
	38.21	3357
AVERAGE	**50**	**3377**

Task Lights		1566	sq ft	Dimensions			
				55.3' X 30.2'			
Wattage				Height of Ceiling			
22.1				7'9"			
23.5							
23							
22.8							
22.9							
23.1							
22.9							
23.7							
22.9							
206.9	Total						
Task light	**LPD**						
	0.13	**watts/sq ft**					
Overhead					LR 24 Sample Wattage		
					46.4		
Wattage	1106.7				46.4		
					47.2		
Overhead Light LPD				**Average**	**46.67**	**22**	**1026.667**
	0.71	watts/sq ft			LR Wattage		
				Average	**11.8**	**2**	**23.6**
Total LPD	**0.84**	**watts/sq ft**			Fluorescent		
					35	**2**	**70**
						Total	**1120.267**
		power factor					
		98%					

Power Measurements to Calculate LPD which includes Task Lighting

APPENDIX B

Product Data Sheets

Architectural luminaire designed for offices, schools, hospitals, and retail environments.

World-Changing Technology

The LED troffer combines numerous technical innovations, including breakthroughs in optical design, electronics design, mechanical design, and thermal management. The core innovation is a new way to generate white light with LEDs.

A Better Way to Generate White Light

The technology is elegantly simple, yet incredibly effective. It delivers high efficacy light with beautiful, warm color characteristics by mixing the light from yellow and red LEDs. This approach enables active color management to maintain tight color consistency over the life of the product.

A Fresh Solution Not Possible with Fluorescent Technology

The design of traditional lay-in fixtures is limited by the use of fluorescent technology. Lighting requirements dictate the use of multiple large sources that are challenging to accommodate, restricting aesthetic possibilities. LED technology does not have these constraints, enabling products like the LED troffer that break the norms of lay-in fixture design and create fresh and contemporary solutions.

Create a Quiet Ceiling

Many fluorescent luminaires are very bright when viewed from a distance. This creates a busy appearance with scores of bright squares scattered across the ceiling. The LED troffer lens is recessed into the lower reflector to provide mechanical shielding and a soft, low brightness appearance when viewed at a distance — blending into the ceiling plane.

Save Energy

48 to 58 Watts
3200 and 3800 lumens
0.5 to 0.75 W/ft² with high ambient light levels

Sacrifice Nothing

92 CRI
3500K
Dimmable to 5% (0-10V DC Control)

Reduce Maintenance Costs

Designed to last 50,000 hours
8 to 12 years with commercial use
Waste no time changing lamps

Protect the Environment

Long life, energy savings, no toxic mercury
Enable multiple LEED points

The first viable LED downlight for commercial and residential application.

World-Changing Technology

The LED downlight is an amazing combination of technical innovations, including breakthroughs in optical design, electronics design, mechanical design, and thermal management. The core of the innovation is a new way to generate white light with LEDs.

A Better Way to Generate White Light

The technology is elegantly simple, yet incredibly effective. It delivers high efficacy light with beautiful, warm color characteristics by mixing the light from yellow and red LEDs. This approach enables active color management that maintains tight color consistency over the life of the product.

Effective Thermal Management

Ensuring the long life of an LED product depends on effectively controlling the operating temperature of the LEDs. The LED downlight was designed to utilize all components to effectively transfer heat and keep the maximum LED temperature at or below acceptable levels- even its worst-case environment.

Save Energy

12 Watt Input Power
with output of 65W
Incandescent

Sacrifice Nothing

92 CRI
2700K or 3500K
Dimmable to 20%

Reduce Maintenance Costs

Designed to last
50,000 hours

Protect the Environment

Long life, energy
savings
No mercury