BOUENDEU
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Supply & Design Energy-Saving Eco-Products
Fournir & Concevoir les Produits Econergétiques

REPORT OF LIGHTING AUDIT

Version 1.0

[redacted]

[redacted] Industrial Road, London, ON, Canada, N5V 3N5

11/24/2012

Property & Confidentiality

Verified by: Dr.-Ing. Bouendeu

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Summary

The proposed LED-based solution which intends to retrofit the existing light sources of [redacted] located at located at [redacted] Bank Street, Unit 2, Gloucester, ON, Canada K1T 1N8, can yield an annual electricity cost saving of $3,433. This value represents a reduction of the annual electricity bill of 46% of the existing light sources. The payback period of the retrofit investment is 4 years with an initial investment of $14,044. The minimum lifetime of the LED-based solution under the same operation condition as the existing light sources is 11 years. With the LED-based solution, over 6 kW of electrical power can be saved in the facility.

The electricity bill of the facility can be further reduced by adding a 10 kW solar PV system to the facility. The annual saving achieved by combining the LED-based lighting solution and solar PV system is $5,091 which represents 67% of the present annual electricity cost of the facility. The table below summarizes the key findings of the lighting audit of the facility.

Summary of Lighting Audit

LED-based solution only	**Value**
Annual Savings on Electricity Bill	$3,433.00
Payback Period	4 years
Return On Investment	24%
Investment without retrofit labor	$14,044
Lifetime	11 years
LED-based solution + Solar PV System	**Value**
Annual Savings on Electricity Bill	$5,091.00
Payback Period	12 years
Return On Investment	8.3 %
Total First Year Investment	$62,044.00
Lifetime	35 years

Introduction

This document is the report of the lighting audit requested by [redacted] of the retrofit lighting project of [redacted] which is a store facility located at [redacted] Bank Street, Unit 2, Gloucester, ON, Canada K1T 1N8.

The purpose of the project is to replace existing light sources of the store with energy-efficient light sources with the sufficient brightness and way to reduce the electricity cost of the facility.

The investigations done include:

1. Initial site survey of the store
2. Analysis of the electricity bill of the store
3. Power and energy assessment of the store
4. Power and energy savings calculation
5. Comparison of LED-based solutions with and without government incentive
6. Payback and Return On Investment
7. Recommendations

1. Project Overview

The project consists of the replacement of the fluorescent tubes of [redacted] located at [redacted] Bank Street, Unit 2, Gloucester, ON, Canada K1T 1N8. The [redacted] appliances are composed of:

- 166 units of Philips fluorescent lamps T12 – 60 W – 96 in – single pin
- 6 units of Philips fluorescent lamps T12 – 40 W – 48 in – double pins
- 7 Philips fluorescent lamps T12 – 34 W – 48 in – double pins
- Others appliances (fridges, computers, fans and printers)

Table 1 summarizes the key characteristics of the existing light sources of [redacted]'s facility. All light sources are supplied by 120 V – 60 Hz and use electronic ballast to limit the current through the fluorescent tube. Figure 1 shows sections of the existing light sources and luminaires.

Table 1: Key characteristics of the existing light sources of [redacted]'s facility.

Key Characteristics of existing light sources of the facility	
Philips fluorescent lamps T12 – 60 W – 96 in – single pin	
Parameter	**Value**
Light output	5400 lm
Lifetime	16000 h
Color rendering index	62
Color temperature	4000 K
Philips fluorescent lamps T12 – 40 W & 34 W – 48 in – Double pins	
Parameter	**Value**
Light output	2650 lm
Lifetime	24000 h
Color rendering index	62
Color temperature	4100 K

Figure 1: Section of the existing light sources and electronic ballast

2. Power & Energy Analysis

2.1. Analysis of Electricity Bill

The average annual electricity consumption of the facility with the existing fluorescent lamps is 56889 kWh, representing an annual electricity consumption cost of $7,545 as shown in table 2. This electricity consumption is based on a normal operation of the lighting system of 12 hours per day.

The analysis of the consumption of the facility revealed that the lighting represents 97% of the electricity consumption of the facility. Figure 2 shows the electricity consumption share of the facility.

Table 2: Characteristic values of the electricity bill of [redacted]'s facility.

Characteristic Values of Electricity Bill	
Parameter	**Value**
Active power demand	25.98 kW
Apparent power demand	28.68 kVA
Electricity consumption of month 1-2	$1,261.22
Electricity consumption of month 3-4	$1,056.95
Electricity consumption of month 5-6	$1,320.43
Electricity consumption of month 7-8	$1,918.28
Electricity consumption of month 9-10	$9,56.86
Electricity consumption of month 11-12	$1,031.96
Annual electricity cost	$7,545.70
Annual electricity consumption	56889 kWh
Power factor of the facility	0.9

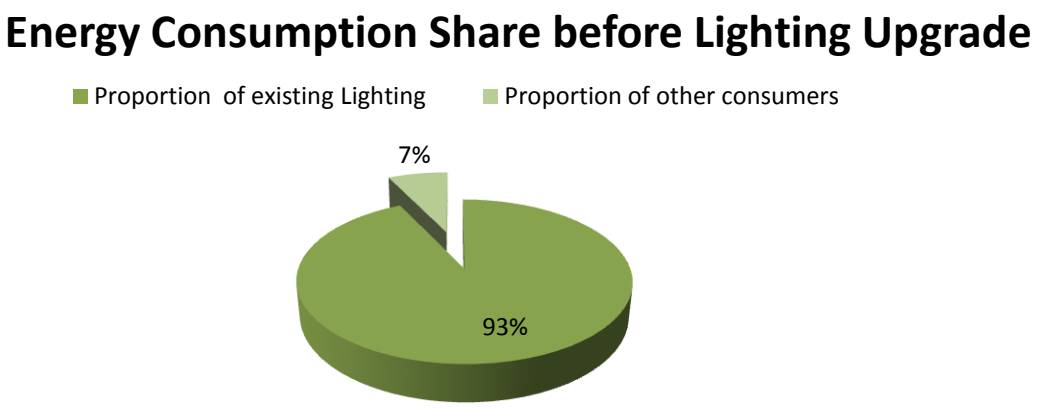

Figure 2: Electricity consumption share of the facility

2.2. Power & Energy Balance Sheet of Existing Lights

The power requirement of the existing lights of the facility is 12.2 kW and the monthly electricity consumption of the light sources is 4402 kWh. Table 3 lists the existing light sources of the facility.

Table 3: Existing light sources of the facility and power and electricity consumption.

Item #	Quantity	Description	Power	Daily operation hour
1	166	Philips T12 – 60 W – 96 in - 1 pin	60 W	12 h
2	6	Philips T12 – 40 W – 48 in - 2 pins	40 W	12 h
3	7	Philips T12 – 34 W – 48 in - 2 pins	44 W	12 h
Power requirement of existing lights			**12.2 kW**	
Monthly Energy consumption of existing lights			**4402 kWh**	

2.3. Power & Energy Balance Sheet of LED-based Lights

The power requirement of the LED-based lights of the facility is 6.2 kW and the monthly electricity consumption of the light sources is 2230.5 kWh. Table 4 lists the existing light sources of the facility.

Table 4: Power and electricity consumption of the LED-based solutions.

Item #	Quantity	Description	Power	Daily operation hour
1	166	LED-based solution – 36 W – 96 in	36 W	12 h
2	6	LED-based solution – 18 W – 48 in	18 W	12 h
3	7	LED-based solution – 16 W – 48 in	16 W	12 h
Power requirement of LED-based solution			**6.2 kW**	
Monthly Energy consumption of LED-based solution			**2230.5 kWh**	

2.4. Energy Consumption Distribution of the LED-based Solution

With the LED-based lighting solution, the lighting represents 86% of the total energy consumption of the facility.

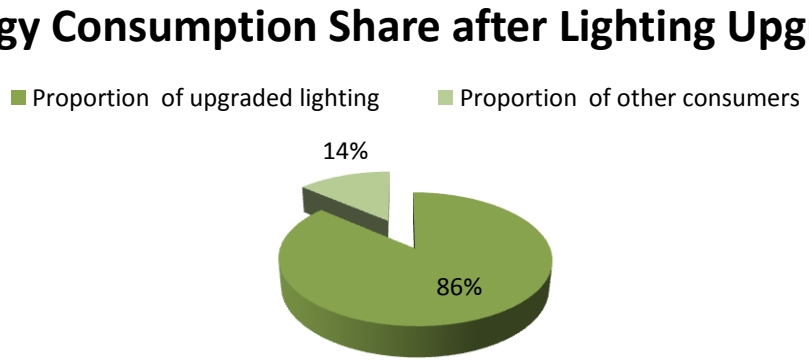

Figure 3: Electricity consumption share of the facility with LED-based solutions

3. Saving Assessment

3.1. Power Savings

The upgrade of the light sources with the LED-based solution has the capability to save 6.03 kW of the electricity which can drop down the power requirement of the facility by 23.2%.

3.2. Annual Energy Savings

The electrical energy expected to be saved by upgrading the existing light sources of the facility with LED-based solution is 25887.24 kWh. This value represents 46% of the annual electricity consumption of the facility before the upgrade of the light sources.

3.3. Annual Savings of Electricity Consumption Costs

With the LED-based solution, the facility will be able to annually save $3433.6 which **is 46%** of the annual electricity cost of the facility without LED-based light sources.

4. Comparison of LED-based Solution with and without incentives

Table 5 shows the price comparison of the LED-based solution with and without government incentives. Although the government incentives are granted to certain retailers to support buyers of energy-efficient light sources, their prices are still higher than the price practiced by certain retailers which do not provide government incentives in the form of "Year-Round Coupons, Coupon Event, Small Business Lighting, Retrofit program".

Table 5: Price comparison the LED-based solution.

Quantity	Description	BCT-Price	InitialLED-Price	Incentive HomeDepot-Price
166	LED-based solution – 36 W – 96 in	$13612.0	$19073.4	$19256.0
6	LED-based solution – 18 W – 48 in	$222.0	$269.4	$258.0
7	LED-based solution – 16 W – 48 in	$210.o	$293.3	$287.0
	Total	**$14044.0**	**$19639.10**	**$19801.0**

5. Economic Assessment

5.1. Payback Period

The payback period of the LED-based solution is 4 years if the total material cost of $14,044.00 is considered. Figure 4 shows the accumulated saving over the expected lifetime of the LED-based solution.

Figure 4: Accumulated savings achieved with LED-based solutions

5.2. Return On Investment

The return on investment of the lighting upgrade of the facility with LED-based solution is 24%. The total saving over the lifetime of the LED-sources is $25,168.72.

6. Characteristics of Proposed LED-Based Solutions

6.1. LED-Tubes

Figure 5 shows the picture of the suitable LED-based solution to retrofit the existing light source of the facility. The 60W-fluorescent tubes will be replaced with the 36W-LED-tubes of single pin 96 inches while the 40W- and 34 W-fluorescent tubes will be replaced with 18W- and 16W-LED tubes of double pins 48 inches respectively.

6.2. Characteristics of the proposed LED-tubes

The key characteristics of the proposed LED-tubes are summarized in table 6.

Table 6: Key characteristics of the proposed LED-tubes.

Characteristic	36 W-LED Tube	18 W-LED Tube	16 W- LED Tube
Base	G13	G13	FA8
Power	36 W	18 W	16 W
Input voltage range	85 – 265 V AC	85 – 265 V AC	85 – 265 V AC
LED type	3528HB	SMD3528/SMD3014	SMD3528/SMD3014
Luminous flux	3920 lm	2160 lm	1920 lm
Color temperature	65000 K	65000 K	65000 K
Color rendering index	>70	>70	>70
Expected lifetime	50000 hours	50000 hours	50000 hours
Power factor	>0.9	>0.9	>0.9
Tube material	Aluminum alloy	Aluminum alloy	Aluminum alloy
Cover	Transparent	Transparent	Transparent
Tube length	96 in	48 in	48 in
Replacement of	60 W fluorescent tube	40 W fluorescent tube	34 W fluorescent tube

Figure 5: LED-based solution for the retrofit of the facility

6.3. Chromaticity Diagram of the proposed LED-based solution

The chromaticity of the proposed LED-based solution of the facility is shown in figure 6.

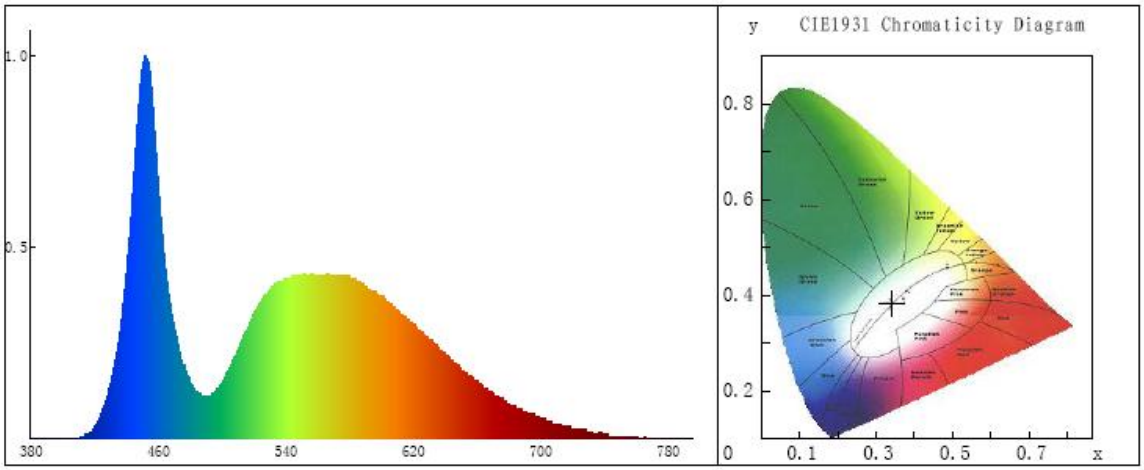

Figure 5: LED-based solution for the retrofit of the facility

7. Further Option for Electricity Cost Reduction

The electricity bill of the facility can be further reduced by adding a 10 kW solar photovoltaic system to the facility using the net metering connection of Hydro Ottawa. With this additional option, the annual electricity bill of the facility can be dropped down from $4,112 of the LED-based solution to $2,454. This represents an annual energy cost saving of $5,091 compared to the present annual electricity cost of the facility. The installation of a net-metering connected solar PV system in combination with the LED-based solution would yield a reduction of the 67% of the present electricity cost which is $7,545.7. The additional investment for the 10 kW PV system is about $48,000 and the lifetime of the PV system is 35 years.

Notes

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