

## RETROFIT PROGRAM

### Sample Measurement & Verification (M&V) Plan

#### Lighting Controls

**Disclaimer:**

- This sample plan is an example for projects installing lighting controls as an energy conservation measure.
- The plan was developed with reference to the Save on Energy Project Measurement and Verification Procedures.
- It is suitable for use as a sample or reference M&V Plan for projects requiring 'Enhanced' M&V through the Save on Energy Retrofit program.
- However, approval of the M&V Plan is at the discretion of the Save on Energy Technical Reviewer.
- Details need to be revised for the specifics of your project.
- This sample M&V Plan is provided for guidance purposes only.
- The savings estimation methodology, input assumptions or other considerations may vary depending on your actual baseline and project details.

#### 1.0 Project General Information

**Application Identifier**

**Building Name:** ABC Warehouse and Assembly

**Building Address:** 123 Front St., Pleasantville ON, A1B 2C3

**Building Type:** Manufacturer/Warehouse

**Local Distribution Company (LDC):** City Hydro Inc.

**Application #:** 123,456

**This M&V Plan is provided for:** Mr. John Doe

**Company Name:** Corporation of the City of Pleasantville

**Company Address:** 123 Main St, Pleasantville ON

**Contact Information:** [john@watersidecc.ca](mailto:john@watersidecc.ca)

**This M&V Plan is provided by:** Ms. Jane Smith, CMVP

**Company Name:** Energy Consulting Inc.

**Company Address:** 123 Elm Drive, Pleasantville ON, D4E 5F6

**Contact Information:** [jane@energyconsulting.ca](mailto:jane@energyconsulting.ca)

### **Facility Overview**

ABC Warehouse and Assembly is a commercial manufacturing and warehouse building of 17,700 m<sup>2</sup>, which was built in 1986.

Areas of the building are used as office space and for warehouse/assembly and storage.

The building energy use is detailed below.

### **Exhibit 1: ABC Warehouse and Assembly Energy Use Metrics**

<b>ABC Complex</b>	
Energy source	Electricity, natural gas
Reference period	January 1 to December 31, 2016
Energy consumption and demand	Electricity: 34,915 GJ (9,698,888 kWh) Natural Gas: 9,484 GJ (250,303 m <sup>3</sup> )
	Summer peak of 900 kW
Energy intensity	2.50 GJ/m <sup>2</sup>

A lighting study revealed that there are currently 3,449 F40T12 fluorescent 4' long lamps, with four lamps per fixture.

Currently the lamps are turned on 24/7 with no shut down periods.

The lights are turned on outside of usual operation hours (8:40AM-8:40PM) for occasional warehouse and office use and security reasons.

### **Exhibit 2: Facility Lighting Inventory**

<b>Zone</b>	<b>Area (m<sup>2</sup>)</b>	<b>Quantity of Fixtures</b>
Office space	7,700	1,449
Warehouse	10,000	2,000

### **Project Timelines and Dates**

**Estimated Start Date:** July 1, 2018

**Estimated Completion Date:** July 1, 2019

**Note to reader:** dates are for illustration purposes only.

## 2.0 Energy Conservation Measures (ECM) Intent

- The energy conservation measure (ECM) involved the installation of dimming sensors for efficient lighting controls.
- Savings from the ECM are 1,296,652 kWh with the corresponding incentive amount of \$64,832.58 based on \$0.05 per kWh.
- Sensors placed on the ceiling measure lighting intensity (lumens per square foot) and occupancy of the warehouse/office space.
- The lighting controls are outfitted with dimming features and occupancy sensors, which will reduce the number of full capacity operating hours.
- Based on security logs of personnel in and out of the warehouse space, it is anticipated that 12 hours of the day the lights will be dimmed to 50% and remaining 12 hours at maximum capacity.

## 3.0 Reporting Period

The reporting period began on July 13, 2019, and ended July 29, 2019.

During this time, continuous measurements of the operating hours was achieved by recording the light intensity from the lighting controls system. Instantaneous fixture light levels were measured to verify that the lighting levels were the same before and after installation of the lighting controls, in accordance with the measurement procedure detailed in Section 4 of the M&V Plan.

## 4.0 Measurement Results

EP M&V Engineering Consulting was retained to measure the light level intensity at predetermined locations in the baseline and reporting periods, including energy data.

### Fixture Wattage

Wattage Measurements	Number of Sample Measurements	Average Wattage (W)
Fluorescent 40W T12 4 Lamp	6	171.7

### Operating Hours

Zone	Summary of Operating Hours from Control Signal Logs (data file provided separately)	Dimming Levels
Office space	8,760	50% and 100% (full capacity)
Warehouse	8,760	50% and 100% (full capacity)

## Lighting Levels

Zone	Base Case Average Lux (lumens/sq ft)	Efficient Case Average Lux (lumens/sq ft)
Office space	85.5	85.4
Warehouse	91.7	91.7

### 5.0 Basis for Adjustment

The avoided energy use adjusted to the conditions of the reporting period approach is used in this M&V Report.

### 6.0 Analysis Procedure

The following avoided energy use equation will be used to calculate the monthly energy savings expressed in kWh:

$$E_{Savings} = E_{Baseline} - E_{Reporting}$$

$$E_{Reporting} = \frac{P_{fixture} * Dimming \% * Operation Hours * No of Fixtures}{1000}$$

Where:

$E_{Baseline}$  is the baseline energy consumption in kWh

$E_{Reporting}$  is the reporting period energy consumption in kWh

$P_{Fixture}$  is the measured power consumption (W) of the fixture type.

**Operation Hours** is the measured reporting period of lighting hours.

**Dimming%** is the dimming percentage level for the lights.

The following equation will be used to calculate peak demand savings:

$$P_{Savings} = (P_{Baseline} - P_{Retrofit})$$

Where:

$P_{Baseline}$  is the peak monthly baseline load in kW.

$P_{Retrofit}$  is the peak monthly load in kW after the retrofit.

## 7.0 Energy Prices

For the purpose of the Save on Energy conservation program, energy prices are not considered in the calculation of cost savings; energy and demand savings are rather expressed in kWh and kW respectively to determine the incentive amount.

## 8.0 Energy Savings

Based on the measured parameters and analysis approach detailed above, the efficient case electricity consumption is summarized in the table below.

Zone	Area (m <sup>2</sup> )	Measured Average Fixture Wattage (W)	NB Fixtures	Operating Hours from Control System (hours)	Efficient Case Consumption (kWh/year)
Office space	7,700	171.7	1,449	8,760	1,634,254
Warehouse	10,000	171.7	2,000	8,760	2,255,700
Total	17,700		3,449		3,889,954

### Note To Reader:

The above Efficient Case Consumption is calculated using the  $E_{Reporting}$  formula from section 6.0 Analysis Procedure.

Each Zone spends 4380 operating hours at 50% dimming and 4380 operating hours at 100% dimming.

Use the  $E_{Reporting}$  formula multiple times and sum the totals if a Zone has multiple fixture wattages, quantities, dimming %, and/ or system operating hours.

For example:

$$E_{Reporting,warehouse} = \frac{171.7 * 50\% * 4380 * 2,000}{1000} + \frac{171.7 * 100\% * 4380 * 2,000}{1000} = 2,255,700$$

Compared to base case consumption of 5,186,606 kWh/year, this results in annual electricity savings of 1,296,652 kWh.

## 9.0 Input From Operating Staff

Operating staff provided assurances that all systems are operating as planned and verified the accuracy of measurement data contained in this report.

## 10. Accuracy and Uncertainty for M&V

The accuracy of the M&V results, including the accuracy of the instruments and sampling, can be expressed as a combined accuracy value as shown below.

Base Case Period - combined accuracy:  $\pm 3\%$  accuracy with 90% confidence

Retrofit Case Period - combined accuracy:  $\pm 2\%$  accuracy with 90% confidence

### **11.0 Quality Assurance**

- EP M&V Consulting and the customer agree to share information in preparing the M&V report according to the M&V Plan.
- Without the proper data and structure, the M&V report will be rejected.
- To ensure that all measurements are performed according to the procedure detailed in this document, a representative of the ABC Complex was present during all measurements