

The City of Calgary

EnviroSmart Streetlight Retrofit

Offset Project Report

April 2012

Version 1.1



Reporting Period: 2003 to 2010



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Reliance upon the VERR and Project related information posted or otherwise made available or obtained through the GHG CleanProjects Registry is subject to independent review, verification and interpretation by those third parties.

This document and the associated GHG Assertion have been prepared in accordance with the Specified Gas Emitters Regulation and all relevant guidance documents and Protocols.



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1 Project Document Information

Offset Project Report Title: EnviroSmart Streetlight Retrofit Offset Project Report, V1.1

Reporting Period: January 1, 2003 to December 31, 2010 (Inclusive)

2 Project Scope and Project Site Description

The Project title is:	EnviroSmart Streetlight Retrofit Offset Project ("Project")	
The Project's purposes and objectives are:	The purpose of the Project is to reduce carbon dioxide equivalent emissions from the electricity consumed to power City of Calgary owned and operated streetlights in residential roads and collector class roads.	
Date when the Project began:	Retrofitting was commenced in 2002 and was completed in late 2005. All Project actions were taken after January 1, 2002.	
Credit start date:	January 1, 2003	
Credit duration period:	8 years (January 1, 2003, to December 31, 2010 inclusive)	
Expected Lifetime of the Project	20 Years+	
Actual emissions reductions:		Total (t CO₂e)
	2003	2,035
	2004	5,099
	2005	9,496
	2006	9,428
	2007	9,428
	2008	9,428
	2009	9,428
	2010	9,428
	Total	63,770
Applicable Quantification Protocol	Alberta Environment Quantification Protocol for Energy Efficiency Projects, September 2007, Version 1 ("Protocol")	
Protocol Justification	<p>The Project is located in Alberta, and includes the avoidance of electricity consumed off the local distribution grid in Calgary.</p> <p>The Project also aligns with all applicability requirements stated in the Protocol. Specifically:</p> <ol style="list-style-type: none"> 1. The retrofits rely on a functionally equivalent input and output where, kWh consumed per burn hour are compared between the baseline and Project to ensure equivalence; 2. The amount of electricity (kWh) consumed per hour of service provided (burn hour) is considered a suitable unit of production for the Project. This is due to the intent of the Project, which was to reduce the amount of electricity consumed in providing an hour of lighting in residential areas by reducing excess 	

	<p>illumination/luminance on residential and collector roads;</p> <ol style="list-style-type: none"> 3. There are no biological or chemical components related to the Project which would yield any increase in non-biogenic GHG emissions compared to the baseline condition; 4. The nature of streetlight systems does not facilitate the quantification of reductions achieved by the Project based on actual measurement and monitoring, as direct metering of electricity consumption is not feasible. As such, a Contingent Data Collection Procedure, as defined in Table 2.5 of the Protocol has been exercised to reconcile the power requirements for the streetlighting system as per equipment output ratings (see Contingent Procedure for B10 Electricity Usage); and 5. The Project does meet the requirements for offset eligibility as specified in the applicable regulation and guidance documents for the Alberta Offset System.
Other Environmental Attributes	This Project has not generated any “other” environmental attributes such as white tags which are applicable to energy efficiency Projects.
Legal land description (LLD) of the Project or the unique latitude and longitude	<p>The Project is made up of installations which have occurred across The City of Calgary, a municipality in the province of Alberta.</p> <p>A summary of the unique geospatial locations of all retrofitted luminaires will be provided to Alberta Environment & Water as part of this submission.</p>
Ownership	All retrofitted luminaires addressed under this Project are the property of The City of Calgary and are operated by the Roads Business Unit.
Reporting and verification details	<p>After the initial reporting period, reporting is anticipated to occur periodically.</p> <p>The Project verifier for the first reporting period is:</p> <p>Williams Engineering Canada Lead Auditor: Doug Mulley, P.Eng. Verification Lead: Julia Beresford, B.Sc., EPt, GHG-V Suite N195, 3015 – 5th Avenue NE Calgary Alberta T2A 6T8 T: (403) 263 - 2393 F: (403) 262 – 9075</p> <p>The Verifier is an independent third party, with significant experience in energy efficiency Projects and municipal street lighting.</p> <p>Williams Engineering Canada’s lead auditor and key team members have training in the appropriate audit methodology related to this Project. This training includes completion of the CSA America Green House Gas Verifier’s Exam that is approved and recognized by the Canadian Standards Association.</p>
Project Activity	The Project is located in Alberta and is a result of actions taken after January 1, 2002. The Project activity is not required by law and is beyond business as usual practices. The Project is real, demonstrable,

	quantifiable, and verifiable, as demonstrated in this Offset Project Plan. The Project has clearly established ownership by The City of Calgary.
Project Registration	The Project is not registered under any other offset schemes and will only be listed on the Alberta Emissions Offset System.
Other	No additional information is provided.

3 Contact Information

The Project proponent is The City of Calgary. Contact information is provided below.

Project Developer Contact Information	The City of Calgary Arsheel Hirji Environmental Specialist Environmental & Safety Management Calgary Public Building 6 – 205 8 th Ave SE Calgary, Alberta T2P 2M5 Canada P: (403) 268-5978 F: (403) 268-8291 Arsheel.Hirji@calgary.ca www.calgary.ca	The City of Calgary Jessica Lajoie Environmental Technologist Environmental & Safety Management Calgary Public Building 6 – 205 8 th Ave SE Calgary, Alberta T2P 2M5 Canada P: (403) 268-2628 F: (403) 268-8291 Jessica.Lajoie@calgary.ca www.calgary.ca
Verification Organization:	Williams Engineering Canada Lead Auditor: Doug Mulley, P.Eng. Verification Lead: Julia Beresford, B.Sc., EPT, GHG-V Suite N195, 3015 – 5 th Avenue NE Calgary Alberta T2A 6T8 T: (403) 263 - 2393 F: (403) 262 – 9075	

4 Project Description

In 2001, The City of Calgary Roads undertook a study of The City's streetlight system, to determine whether the existing lighting levels in residential areas are excessive and if operating efficiencies and improvements could be achieved in the system. The study concluded that amongst other things, technology in streetlighting had advanced and the illumination provided by higher wattage luminaires, resulted in lighting provided by the majority of residential streetlights to exceed guidelines of the Illuminating Engineering Society (I.E.S)¹.

From 2002 to 2005, the City of Calgary undertook a retrofitting of over 37,000 High Pressure Sodium, dropped lens luminaires to a flat lens, lower wattage luminaire. Prior to the retrofit, luminaires ranged from 150W to 250W, whereas, after the retrofit, luminaires ranged from 100W to 150W on local residential and collector roads.

¹ Illuminating Engineering Society, RP-8-00, American National Standard Practice for Roadway Lighting.

5 Project Implementation & Variances

No changes have been made in calculation procedures, data collection/record keeping, emission factors or any other variables than what has been described in the Offset Project Plan, (March 2012, Version 1.2).

6 Reporting Period

The reporting period addressed by this Project Report is January 1, 2003 to December 31, 2010 (Inclusive).

7 Greenhouse Gas Calculations

The Protocol was implemented by reviewing the list of sources, sinks and reservoirs (SSRs) of greenhouse gases applicable to the Project and determining which SSRs are applicable specifically to the Project. The SSR review and applicability determination is detailed in the EnviroSmart Streetlight Energy Efficiency Offset Project Plan. The conclusion of the review is that the following SSRs are applicable to the EnviroSmart Project and require quantification:

1. **B10 Electricity Consumption:** An indirect source of carbon dioxide equivalent emissions from the electricity consumed by high pressure sodium, dropped lens luminaires in the absence of the EnviroSmart retrofit program (the Project).
2. **P10 Electricity Consumption:** An indirect source of carbon dioxide equivalent emissions from the electricity consumed by retrofitted, lower wattage high pressure sodium, flat lens luminaires.

7.1 Quantification Parameters & Procedures

Protocol Parameter / Variable	Project-specific Data	Measurement or Estimation Procedure	Measurement Frequency	Measurement Specifications or Estimation Justifications
B10 Electricity Usage				
Electricity Consumption in Baseline Luminaires	Historic quantity of power consumed (Watts) by the number of streetlights retrofitted in the Project.	Based on the power consumption rating of luminaires prior to retrofitting. Total power consumption is calculated by taking the product of the number of luminaries retrofitted in a single year and the related consumption rating for the luminaire.	Annual	Described in the Contingent Data Collection Procedures (Table 2.5) of the Protocol, using equipment power consumption ratings is considered a reasonable estimate of the parameter, as the more accurate (direct metering) method is not feasible for streetlight systems.
Consumption Rating of Baseline Luminaries	The number of baseline luminaries which were rated at 150W, 200W, and 250W.	An extraction of The City of Calgary's Environmental Systems Research Institute (ESRI) Geodatabase conducted in 2001 provides a summary of the number of streetlights, and their associated watt classes, on residential and collector road types. Based on this extraction, the percentage of each watt class of luminaire on each	Annual	In order to maintain functional equivalence between the baseline and the Project, the number of luminaries retrofitted during the Project is used to determine the number of baseline luminaries. The Watt class distribution of luminaires is known by referencing retrofit program tracking worksheets which were maintained over the

		road type is determined. Combining the distribution of streetlights in the baseline and their associated wattages, the retrofit parameters, and the number of luminaires retrofitted, the inventory of baseline luminaires and their associated consumption ratings are determined.		course of the Project. See Section 4 for more details on the baseline distribution methodology.
Burn Hours in the Baseline	4,177 Hours	Streetlights are operated by a photocell relay which turns lights on at dusk and off at dawn.	Annual	Burn hours are determined by The City's electricity service provider and The City of Calgary. Streetlight electricity invoicing for the period spanning 2001 to 2011 indicates that burn hours have not changed between the baseline and Project conditions.
Electricity Intensity Factor for Electricity Consumption in the Baseline.		Based on prescribed emission intensity factor for electricity.	N/A	Electricity is generated by a mix of resources on Alberta's transmission grid, a prescribed intensity factor of 0.65 kg CO ₂ e per kilowatt-hour of electricity consumed by streetlights in Calgary.
P10 Electricity Usage				
Electricity Consumption in Retrofitted Luminaires	Quantity of power consumed (kilowatts) by the number of streetlights retrofitted in the Project.	Based on the power consumption rating of retrofitted luminaires. Total power consumption is calculated by taking the product of the number of luminaires retrofitted in a single year and the related consumption rating for the luminaire.	Annual	Described in the Contingent Data Collection Procedures (Table 2.5) of the Protocol, using equipment power consumption ratings is considered a reasonable estimate of the parameter, as the more accurate (direct metering) method is not feasible for streetlight systems.
Number of Luminaires Retrofitted and Associated Consumption Rating of Retrofitted	The number of retrofitted luminaires which are rated at 100W and 150W.	A luminaire retrofit shape file was created in The City's Geodatabase, which provides X,Y coordinates, unique identification numbers, and watt classes for each luminaire retrofitted during the span of The Project. Tender documents are also referenced	Annual	The City of Calgary Geodatabase is considered the most accurate inventory of retrofitted luminaires and their associated consumption ratings. Tender documents between The City of Calgary and the retrofit Contractor which

Luminaries		to determine approximate quantities of retrofits contracted by The City of Calgary with a third-party service provider.		completed the retrofit also provide an indication of the approximate quantities of luminaires retrofitted and provide a second proof that the work was completed.
Burn Hours in the Project	4,177 Hours	Streetlights are operated by a photocell relay which turns lights on at dusk and off at dawn.	Annual	Burn hours are determined by The City's electricity service provider and The City of Calgary. Streetlight electricity invoicing for the period spanning 2001 to 2011 indicates that burn hours have not changed between the baseline and Project conditions.
Electricity Intensity Factor for Electricity Consumption in the Project.		Based on prescribed emission intensity factor for electricity.	N/A	Electricity is generated by a mix of resources on Alberta's transmission grid, a prescribed intensity factor of 0.65 kg CO ₂ e per kilowatt-hour of electricity consumed by streetlights in Calgary..

7.2 Flexibility Mechanisms

The Protocol identifies eight (8) flexibility mechanisms for Project developers in quantifying offsets. **Table 2** below identifies which of these flexibility mechanisms has been applied in quantifying offsets from the Project. A justification of why the flexibility mechanism has been exercised is also provided.

Flexibility Mechanism as per the Protocol²	Exercised (Yes/No)	Justification
The Project developer must provide and justify an appropriate model for any biological or chemical processes altered at the facility. However, if these processes do not exist or are not altered, the Project developer may exclude these SS's under this Protocol;	No	No biological or chemical processes are affected by the Project.
The requirement for an energy assessment for the Project may be waived in situations where the baseline energy use per unit of production can be justified using available records;	Yes	Baseline energy use data per unit of production is estimated based on the parameters of the retrofit. A table identifying the number of baseline luminaries in each class for all luminaries identified for potential retrofitting is included in Section 7 This breakdown is extracted from tracking data collected during the retrofit program.
New processes and/or facilities may be included under this Protocol where a justification of a baseline condition can be made with reasonable certainty based on current industry practise, per unit of production;	No	No new process or facilities are included in the quantification.
Sources and sinks that can be shown to be equivalent or not applicable for the Project can be excluded from the analysis;	Yes	As the Project only addresses electricity savings as a result of the luminaire retrofit, only SSR B10 and P10 are considered relevant. All other SSRs are excluded from quantification.
Project proponents may link to external ambient temperature data as a means of adjusting for equivalence;	No	Temperature normalization is not relevant to this Project.
The process changes may occur within a single unit or across	Yes	The City of Calgary's Geodatabase of uniquely identified luminaires specifically retrofitted under

² Quantification Protocol for Energy Efficiency Projects (September 2007, Version 1)

Table 2: Summary of Flexibility Mechanisms Applied

Flexibility Mechanism as per the Protocol ²	Exercised (Yes/No)	Justification
multiple units. Further, the affected units may include multiple processes, equipment, etc. Defining the units that are altered is to be justified by the Project developer;		the EnviroSmart initiatives are the only luminaires included in quantifying offsets. Section 6 and 7 provides further details on the process by which field data on luminaire retrofitting activities was transferred to the Geodatabase. The geospatial coordinates and nearest address to each retrofitted luminaire has been provided to the third-party verifier and to the Registry in the form of a geospatial locator along with this Project plan.
Site specific emission factors may be substituted for the generic emission factors indicated in this Protocol document. The methodology for generation of these emission factors must ensure accuracy; and	No	No site specific emission factors have been used in quantifying offsets from this Project.
The process changes may impact the production efficiency and gross production. However, the Project developer must justify any changes in this regard and ensure that the impact of these changes are appropriately considered as part of the per-unit-production means of calculation.	Yes	The focus of the Project was to reduce the amount of excess light in residential areas of the city of Calgary, thereby reducing the amount of electricity consumed in powering this excess. As such, the relevant “per-unit-production” calculation for retrofitted luminaires is the kilowatt-hour of electricity consumed to deliver an hour of illumination (kWh/hour).

7.3 Quantification Methodology (As Per Approved Protocol)

The following three equations serve as the basis for calculating the emission reductions from the Project, using the emission profiles of the baseline and Project conditions. Note that only SSRs determined to be relevant to this Project are included here.

$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$ $\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Electricity Usage}}$ $\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Electricity Usage}}$

Individual equations to calculate the emissions from each SSR are provided in the Protocol and reproduced here. The details of the parameters, including emission factors, used for each equation are included above in **Table 1**.

The following Project-specific formulae were used to quantify the emission reductions from the Project. Quantification of the emission reductions generated by the Project is conducted using

the equations incorporated into an Excel based calculator. A sample calculation using the equations is provided in **Table 3**.

7.3.1 B10/P10 Electricity Usage

The relevant greenhouse gas species applicable to this SSR is carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), however, emissions are expressed in carbon dioxide equivalence (CO₂e). The general equation for this SSR, as presented in the Protocol, is:

$$\text{CO}_2\text{e Emissions}_{\text{B10}} = \text{Electricity Consumed} * \text{EF}_{\text{Electricity}}$$

Where:

Electricity Consumed is expressed in KWh and is determined by:

$$\sum([\text{Quantity}_{\text{Baseline/Project}} \text{ in each Watt class} * \text{consumption rating (W)}] * \text{total annual burn hours (h)}) / 1000 \text{ Watts/KWh}$$

Quantity_{Baseline} =

The quantity of luminaires in the baseline is determined as follows:

Luminaire retrofits were tracked during the course of the EnviroSmart Project. Retrofit program tracking worksheets are a data source referenced in determining the quantity of 250, 200, and 150 Watt luminaires removed over the period spanning 2002 to 2004 inclusive.

The quantity of baseline luminaires and their associated consumption ratings (Watts) are determined by taking the quantity of luminaires retrofitted annually and applying the baseline distribution. Section 4.2 describes the baseline distribution methodology.

The quantity of retrofitted luminaires is determined as follows:

The quantity of luminaires retrofitted during the Project is determined by referencing The City of Calgary's Geodatabase. During the course of the Project, shapefiles were created to track retrofits completed for the period spanning 2002 to 2005.

A shapefile stores non-topological geometry and attribute information for the spatial features in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates.

The associated attribute tables for the EnviroSmart retrofit shapefile indicate the retrofit year, the bulb consumption rating and the spatial location of the retrofitted luminaire.

The electricity emissions factor is determined as follows:

EF_{Electricity} is expressed in kg CO₂e/KWh and is **0.65 kg / KWh** as prescribed by Alberta Environment & Water.

7.4 Sample Quantification

The following is a sample calculation using the Project specific equations outlined in Section 7.3. The data used to perform the sample calculation is fictitious and represents one year of data.

Parameter	Source	Value	Units
Quantity of Baseline luminaires	Project specific tracking worksheet indicating annual removals of luminaires during the EnviroSmart Program.		
150 W		150	-
200 W		1500	-
250 W		200	-
Quantity of Retrofitted luminaires	Shapefile of luminaires retrofitted during the EnviroSmart Program.		
100 W		1000	-
150W		850	-
Annual Burn Hours Baseline	Utility invoices	4177	Hours
Annual Burn Hours Project	Utility invoices	4177	Hours

SSR	Parameter	Equation	Sample Calculation Result
B10 Electricity Usage	Total amount of electricity consumed in the baseline condition	$CO_2e \text{ Emissions}_{B10} = \text{Electricity Consumed} * EF_{\text{Electricity}}$ <p>Where:</p> $\sum([\text{Quantity}_{\text{Baseline}} \text{ in each Watt class} * \text{consumption rating (W)}] * \text{total annual burn hours (h)})/1000 \text{ Watts/KWh}$	$= ((150 \text{ luminaires} * 150W) + (1,500 \text{ luminaires} * 200W) + (200 \text{ luminaires} * 250W)) * 4,177 \text{ hours/year} / 1,000 \text{ Watts/KWh}$ $= 1,555,932.5 \text{ kWh/year}$ $\text{Emissions}_{\text{Baseline}} = [(1,555,932.5 \text{ kWh/year}) * 0.65 \text{ kg CO}_2\text{e/kWh}] / 1000 \text{ kg/ metric tonne}$ $= 1,011.36 \text{ tonnes CO}_2\text{e}$
P10 Electricity Usage	Total amount of electricity consumed during the Project	$CO_2e \text{ Emissions}_{P10} = \text{Electricity Consumed} * EF_{\text{Electricity}}$	$= ((850 \text{ luminaires} * 150W) + (1,000 \text{ luminaires} * 100W)) * 4,177$

	condition	Where: \sum [(Quantity _{Baseline} in each Watt class * consumption rating (W)) * total annual burn hours (h)]/1000 Watts/KWh	hours/year)/1,000 Watts/KWh = 950,267.5 kWh/year Emissions _{Project} = [(950,267.5 kWh/year)*0.65 kg CO ₂ e/kWh]/1000 kg/ metric tonne = 617.67 tonnes CO ₂ e
Emission Reductions	Total emission reductions	Emission Reduction = Emissions_{Baseline} – Emissions_{Project}	= 1,011.36 tonnes CO₂e - 617.67 tonnes CO₂e = 393 tonnes CO₂e

8 Greenhouse Gas Assertion

	Total (t CO ₂ e)
2003	2,035
2004	5,099
2005	9,496
2006	9,428
2007	9,428
2008	9,428
2009	9,428
2010	9,428
Total	63,770

9 Project Developer Signatures

I am a duly authorized corporate officer of the Proponent mentioned above and have personally examined and am familiar with the information submitted in this Offset Project Report including the accompanying Greenhouse Gas Assertion on which it is based. Based upon reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, I hereby warrant that the submitted information is true, accurate and complete to the best of my knowledge and belief, and that all matters affecting the validity of the emission reduction claim or the Protocol upon which it is based have been fully disclosed. I understand that any false statement made in the submitted information may result in de-registration of credits and may be punishable as a criminal offence in accordance with provincial or federal statutes.

The Project developer has executed this Offset Project Report as of the 23 day of April, 2012.

Project Title: EnviroSmart Streetlight Retrofit Offset Project

Project Developer: The City of Calgary

Signature



Date: April 23, 2012

Name: Sharon E. Young

Title: Director, Environmental and Safety Management, City of Calgary