COMMUNICATIONS

To: Committee of the Whole  
Date: July 8, 2016

From: Fraser Work, Director of Engineering & Public Works

Subject: LED Streetlight Conversion Project Update

RECOMMENDATION

That Council direct staff to:
- Install warm white (3,000K) LED fixtures throughout the City, with the exception of coolwhite (4,000K) LED streetlight fixtures in all signalized intersections and marked crosswalks;
- Develop a "smart" LED streetlight control pilot program, to demonstrate suitable applications of controllable LED technology to further improve energy savings potential, public safety and security and report back to Council with recommendations for the City’s streetlight network in early 2017;
- Introduce an LED communication plan to provide the public with pertinent information and opportunity for feedback concerning LED streetlight installations; and
- Report back to Council regarding outcomes of the BC Hydro streetlight funding application and connection-fee decisions, with associated financial implications and recommendations.

EXECUTIVE SUMMARY

As part of the 2015 financial planning process, Council approved a budget to replace current streetlights with LED streetlights and requested that staff report back on the proposed colouring of the LED bulbs before installation begins. The purpose of this report is to seek approval for the proposed colouring and outline the overall project plan.

The City's streetlights consume 12% of municipal energy use. Conversion to LED streetlights will save approximately 50% of this energy burden, and decrease the associated streetlight maintenance and labour by a factor of four. Many cities have recently converted their streetlights to LEDs, and Victoria is planning to start its conversion program in the fall of 2016.

Industry now offers a LED streetlight with a warmer hue, rated as a ‘temperature' of 3,000K. This new LED option provides cities with a streetlight output at a similar temperature of the existing HPS units (-2,700K). These 3,000K options provide a less disruptive and warmer light quality when compared to standard 4,000K units, which have been installed at various locations throughout the City. The 4,000K units still provide an attractive option for applications where increased lighting and true-colour contrast is required for enhanced safety and security. The 3,000K units are preferred by international agencies due to their improved light pollution performance and reduced glare, over the 4,000K alternatives. Staff are recommending the installation of 3,000K units throughout the City streets and 4,000K units at intersections and crosswalks, for improved safety.
Staff are currently working with BC Hydro to finalize project management and funding arrangements, and are awaiting final clarification on utility-related funding awards and associated electrical connection costs.

Staff are planning to commence LED conversion in residential areas across the City in Sep/Oct 2016, and will progress to completion of all 6,500 City streetlights by early in Q1, 2018.

Additional project and financial information related to BC Hydro will be provided to Council in the coming weeks, as information is made available.

PURPOSE
The purpose of this report is to update Council on the progress of the LED Streetlight Conversion Project and to seek approval for the colour of lighting to be installed, and outline the overall project plan and next steps.

BACKGROUND
LED lights reduce energy consumption, maintenance burden (longer life, less components, more robust), improve lighting quality and performance and reduce hazardous risks and material management costs.

The LED Streetlight Conversion Project was brought forward to GPC as part of the 2015 financial planning process. Council approved the plan to convert the City’s 6500 streetlights to LED luminaires (fixtures) at the February 16, 2015 GPC, to reduce streetlighting energy and associated costs and greenhouse gas emission.

The business case for Energy Efficient Street Lighting (attached at Attachment) substantiated the benefits and opportunities, and set the project budget. Key points are as follows:

- Energy for streetlights comprises 12% of the City’s total energy use, is 30% of the City’s total electrical use, and is the City’s single highest energy user;
- The City’s 6,500 street lights (not including ornamental lights) consumed over nearly 5 million kWh of electricity at a cost of just over $500,000 annually, and constitute a large portion of the $1 million in maintenance/labour costs;
- LED streetlights will result in a 45 to 55% energy savings over the currently installed HPS fixtures;
- Energy expenses represent an attractive opportunity to reduce operating costs, while also advancing the City’s carbon and greenhouse gas reduction objectives.
- The lifecycle of the new LED streetlights is expected to be over 15 years, as compared to the 4 year life of the current HPS streetlights, thereby reducing maintenance costs by approximately 3 times the current burden;
- LED light prices have dropped significantly in recent years, and are now competitive with legacy HPS lights;
- The return on investment for LED streetlights is estimated at 9 years.

ISSUES & ANALYSIS
Staff have been consulting with industry experts and other municipalities to assist in planning the streetlight replacement project, and have been assessing LED technical considerations (colour, type, power, efficiency, cost, design and reliability), in order to develop a streetlight LED conversion plan that maximises both performance and value. In the past year, industry has increased the number and quality of LED options for streetlight applications. Staff have recently completed a detailed inventory of all existing streetlighting, trials of various LED fixtures and colours, project guidelines and a City streetlight inventory, all of which was required for the BC Hydro LED streetlight rebate program.
Municipal LED Applications
Numerous cities have already begun transitioning their street lights to LEDs, to achieve significant energy savings and reduction of carbon emissions. LEDs can also improve lighting quality and public safety, which has been a key factor for cities like Las Vegas and New York to switch from HPS to LED streetlights. Los Angeles, currently the largest USA LED streetlight conversion program, has installed over 140,000 LED streetlights and realized efficiency savings of 65% and noted significant reduction in crime rates in various areas1. Other cities are in process of wholesale changes to LED streetlights, including Vancouver, Surrey, Calgary, Medicine Hat, Hamilton, Edmonton, Kitchener, Waterloo and Mississauga.

LED Performance Characteristics
Some of the key considerations, when switching to LED streetlights are the performance of the new fixtures, the colour of the light, and light pollution / privacy.

LED Performance:
LED streetlights are 45 to 55% more energy efficient compared to HPS units. LED’s are also expected to last up to four times longer than HPS, which will significantly reduce through- life maintenance costs, and resource requirements. LED’s also have improved ‘colour rendering’, which is the ability of a light source to reveal the true colour of an object, which can be important in areas

with safety concerns, such as intersections, crosswalks and security zones. HPS lights have relatively poor colour rendering, resulting in reduced pedestrian and vehicle contrast and illumination. LED’s also offer fast start-up time and better cold weather performance.

LED Colour Temperature:
LED streetlights come in various hues of white, commonly referred to as "temperature". The temperature of the light depends on the amount of red (warm) or blue (cool) colour in the output (see figure below). The streetlight industry has historically offered units in the "cool" white end of the colour spectrum (4,000K to 5,000K). The cooler temperature LEDs have been criticised in the past due to increased glare and their stark contrast from the warmer yellowish light associated with incandescent and the HPS streetlights, which are a warmer -2,700K temperature. During periods of low natural light, our eyes have developed to be more sensitive to the bluish or white light, and less sensitive to yellow and reddish light. The streetlight industry has recently begun to supply LED fixtures in the "warmer" 3,000K temperatures, at a similar efficiency and equivalent price of the cool, 4000K units.

![LED Colour Scale](source: www.ledradiant.com)

Several cities are now implementing the warmer white LED streetlights (3,000K) in residential areas. Cool white (4,000K and 5,000K) has been commonplace for busier roads outside of residential zones (highways, arterial and collector roads). On Vancouver Island, the District of North Cowichan has started installing 3,000K fixtures in their residential neighbourhoods.

Roadway lighting levels are stipulated in various civil design standards, and depend on use and safety requirements. Staff has consulted with an electrical lighting engineer to help assess and determine the best LED options for applications across the City. The 3,000K fixtures at the correct wattage and design meet streetlighting standards set by the Illuminating Engineering Society (IES) of North America.

LED Light Pollution and Health/Well-Being
Light emitted away from an intended location is considered ‘light pollution’. The International Dark-Sky Association (IDA), who builds awareness of the negative impacts of light pollution, notes that light pollution has negative impacts on energy usage, operating costs, natural ecosystems, and human circadian rhythms.

Light pollution that enters private, undesirable space is referred to as light ‘trespass’. LED fixtures
are designed to manage both light pollution and light ‘trespass’, using the inherently good directional properties of LEDs, and a flat lens, which reduces the amount of light radiating from it compared to the round glass style HPS fixtures. Trespass can be further controlled by physical shields to block directional light, (current practice) and will be applied where required. To promote privacy and lighting effectiveness, staff assess the wattage and reflector/optic design for each location to control the amount and directional properties and prevent unwanted trespass.

The 3,000K warm white LED fixtures are endorsed by the IDA, as they minimize glare and intensity, and the American Medical Association has recently (June 2016) endorsed 3,000K LED streetlights as the preferred option for streetlight applications, for health and well-being. The AMA also endorses dimmable LEDs for suitable applications where infrequent lighting can meet service needs.²

![Figure 4. 4,000K LED Luminaire Installations – View from behind streetlights (Kimta Road), demonstrating the lack of light pollution due to LED’s superior optics and direction control. Note the lack of light emitting from behind or the side of the fixture.](image)

**Victoria LEDs and Public Feedback**

Various LED streetlight fixtures have been installed across Victoria as part of the City’s trials on LED light characteristics. Staff have installed a total of 399 LED light fixtures to date, on an opportunity basis, as part of construction projects or to replace failed HPS bulbs. 265 (67%) of current installations are on non-residential streets and 134 (33%) are installed in residential areas.

Various LED lights at different temperatures and wattage have recently been installed around Pioneer Square to improve the lighting levels and increase illumination/safety.

The LED fixtures installed in the City are currently the 4,000K blue-white lights. 4,000K LED lights are installed on the Point Ellice Bridge, the Songhees development along Kimta Road, and at a few other locations throughout the City. Staff have received approximately eight complaints and two statements of support from adjacent residents in residential neighbourhoods related to eight LED

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streetlights due to the intensity of the bluer, 4,000K LED colour.

**STREETLIGHT CONVERSION PLANNING**

The conversion of streetlights to LEDs must be completed by external contractors in order to meet the stipulations for Gas Tax funding. The tender for the streetlight conversion will be administered once the final funding decisions have been provided by BC Hydro. A BC Hydro-approved contractor will install LED fixtures that have been vetted by utility and provincial lighting quality control processes.

Work is planned to commence in the Sep/Oct 2016, starting with replacement programs along residential streets, and then shifting to arterial and collector streets in the spring of 2017. The downtown core is currently planned as the final phase for completion, by early in Q1, 2018, prior to the Christmas season. More detailed planning and project management activity will be managed by the LED Replacement project manager, which is a temporary position, jointly funded with BC Hydro, in accordance with their 2016 LED Street Light Conversion Project Manager Agreement.

**ALIGNMENT WITH CITY PLANS**

Official Community Plan (Section 11)
"Sustainable infrastructure for municipal and regional services such as...electricity, gas and telecommunications is critical for community resiliency."

The following infrastructure goal supports the development of a business case for energy efficient lighting and conversion to LED streetlights:

- Victoria’s well-maintained infrastructure and facilities meet the needs of residents and business utilizing best management practices.

**2015-2018 Strategic Plan**

A. The following service principles support the development of a business case for more energy efficient streetlighting.

- Future oriented: We consider the needs of future generations when making decisions today.
- Continuous improvement: We embrace innovation, best practices, and continuous learning.
- Value for money: We strive to deliver high quality services and excellent value for your tax dollars.

B. The following priorities for 2013 to 2015 are served by the development of a business case for LED streetlights

- Enhance community well-being: Transportation, housing, recreation public safety, parks and climate change will be areas of focus. LED lighting will decrease greenhouse gases from City energy consumption, and will improve streetlighting and decrease light pollution.
- Improve financial sustainability: the City must focus its efforts on growing the tax base, identifying efficiencies inservice delivery, pursuing alternative revenue sources and effectively managing its assets. LED lighting has the potential reduce energy costs and preventative maintenance.

**2016-2020 Financial Plan**

The LED replacement project is to be funded from Gas Tax funding, at an overall investment of $2.16m over three years, with a return-on-investment estimated at 9 years, from energy savings and associated reduction in operational and maintenance costs. The business case for the conversion
of LED streetlights was endorsed by Council in February 2015, and budgeted in the 2015, 2016 and 2017 financial plan.

In April 2016, staff submitted a funding application to BC Hydro, and await final determination of any subsidy offered by the utility that would offset the above costs. Staff are also in discussions with BC Hydro to ascertain if any electrical connection fees would be applied to the installation process. Any costs for connections would be extraneous to the 2015 business case, and additional funding sources and trade-offs may have to be identified if this charge is to be imposed. Staff will report back to Council with any pertinent updates and recommendations, as soon as utility funding information is available.

OPTIONS & RECOMMENDATIONS

Staff is recommending a few decisions related to the conversion of the City's streetlights to LEDs:

a. Colour Temperature: Installation of 3,000K, 4,000K (or other) colour LEDs.
   i. 3,000K lights are equivalent in cost and efficiency of other cooler LEDs, but pose reduced risks of light pollution, and improved human health and aesthetic performance (recommended throughout the City except high conflict traffic zones).
   ii. 4,000K lights provide increased illumination and colour-rendering (true colour and contrast), but pose undesirable glare and may be inappropriate for residential applications. (recommended for high conflict traffic zones only, in order to promote safety).

b. Light Pollution and Privacy: The design of LEDs offer improved directional control when compared to legacy HPS fixtures and can be configured with light-shields that can be used to limit trespass.
   i. Installation and design of streetlighting to minimize trespass and light pollution is recommended.

c. "Smart" / Controllable Technology: Determination of suitable and priority applications of this technology and development of a pilot program can be progressed for future planning. All LED fixtures for the City can be 'fit-for-but-not-with' adaptive technology, at no extra cost (recommended).

d. Financial Planning: Staff have applied for BC Hydro grant funding to support this conversion program and await formal decision. The requirement for utility connection-fees must also be confirmed with BC Hydro to understand the financial implications of any additional costs. Staff will continue to work with the utility provider and report back with any implications and associated recommendations.

e. Develop and implement a communication strategy for the City regarding LED replacement project and progress, and provide opportunities for feedback and information using the City's webpage and other appropriate media (recommended).

NEXT STEPS

1. Receive funding decision from BC Hydro and finalize BC Hydro's connection fee requirements - summer 2016
2. Report back to Council on any financial impacts regarding BC Hydro funding and connection fees – as soon as information is received from BC Hydro
3. Commence conversion project in fall of 2016
4. Develop and implement LED replacement communication strategy.

Respectfully submitted

Ed Robertson, Assistant Director, Engineering and Public Works

FrasrWoiik/birector
Engineering and Public Works

Report accepted and recommended by the City Manager: __________________________

Date: __________________________

List of Attachments
Attachment - 2014 Project Business Case - Energy Efficient Street Lighting Program
Attachment A - 2014 Business Case - Energy Efficient Street Light Program

Overview:
To implement a city-wide conversion of approximately 6500 High Pressure Sodium (HPS) streetlight fixtures to Light Emitting Diode (LED) fixtures phased over 3 years.

Energy consumption from streetlights has remained relatively constant at 4.5 million kWh; representing a 1.2% increase since 2010, while the electricity costs associated with streetlights have increased about 28% due to BC Hydro rate increases. BC Hydro rate increases are expected to continue into the future to fund BC Hydro’s capital investments. Electricity costs represent a significant portion of the Streetlight budget at approximately 60%.

The transition from HPS to LED technology is estimated to realize significant energy consumption savings, thereby directly reducing electricity expenses. Additionally, the lifecycle of an HPS streetlight is about 4 years and the lifecycle of the LED streetlight is 15 years. Reducing the frequency of lamp replacement, the City will save on maintenance costs. Currently, BC Hydro provides a rebate program that contributes to offset the cost of the capital outlay.

Aside from the projected operating savings, LED technology is superior to standard HPS lights in many ways such as:
- Reduced energy consumption advances the City’s commitment towards carbon neutral municipal operations and greenhouse gas reduction objectives; though modestly since BC has low-carbon hydro-electricity
- Potential improvements in lighting levels and quality, improving the ability for citizens to see and be seen
- Reduction of glare and light wastage through trespass, reducing light pollution

The analysis below shows the capital cost for the phased LED streetlight replacement project over the three year period and the operating savings over the 15 year lifecycle. The initial capital costs would be repaid in savings over a 9 year period.

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