Saving Energy and Improving Light Quality in Street Lighting

Applications of the SEAD Street Lighting Tool

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CLASP
Agenda

• About the SEAD Initiative and why we’re working in street lighting
• Street Lighting Tool features & benefits
• Case study example
• Cooperation with LightSavers Canada
• Future directions for the tool
Super-efficient Equipment and Appliance Deployment (SEAD) Initiative

• Engage governments and the private sector to accelerate market transformation for energy-efficient equipment and appliances

• 16 Participating Governments:
  - Australia
  - Brazil
  - Canada
  - European Commission
  - France
  - Germany
  - India
  - Japan
  - Korea
  - Mexico
  - Russia
  - South Africa
  - Sweden
  - United Arab Emirates
  - United States
  - China (observer)

• Partners:

- CLASP
- 4E: Efficient Electrical End-Use Equipment International Energy Agency
- en.lighten
SEAD Street Lighting Tool
Features & Benefits
Why Make a Tool for Street Lighting?

• Problem:
  – With LED fixtures, wattage and light distribution classifications have less correlation with fixture performance on a specific road.
  – Improved light distribution means increased fixture choices.
  – Performance and energy savings depend on proper fixture selection.
Why Make a Tool for Street Lighting?

Solution:
- Simplified photometric analysis
- Integrated energy and life cycle cost analysis
- Faster pre-screening process

This allows lighting managers to optimize fixture selection.
SEAD Street Lighting Tool Overview

• Free software for analyzing
  – energy use;
  – light quality;
  – and lifecycle costs
  for roadway lighting fixtures.

• The tool can be used for:
  – Batch analysis of fixtures for retrofits
  – early stage design evaluation
  – Introduction to photometric analysis
    for novice users
SEAD Street Lighting Tool Overview

- Compatible with Microsoft Excel 2003 and later versions
- Available in English, French and Spanish
  - Can support additional languages if partners can help with translation
- Download the latest version directly from: [www.superefficient.org/sltool](http://www.superefficient.org/sltool)
### Tool Approach

<table>
<thead>
<tr>
<th></th>
<th>Simplified Road Configuration</th>
<th>Target Light Levels</th>
<th>Multiple fixtures</th>
<th>Life cycle cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Only straight roads, no intersections or sloped roads, and even pole spacing. Simplifying the road calculations speeds up the analysis process.</em></td>
<td><em>Identifying minimum light level targets allows the tool to filter fixtures by those that pass or fail the criteria. Illuminance and luminance both available.</em></td>
<td><em>Users can upload IES files, and then select as many as hundreds of fixtures for simultaneous analysis.</em></td>
<td><em>Optionally, users can enter high-level cost estimates for fixture installation, maintenance, etc. The tool returns simple payback compared to a baseline and life cycle net present value estimates.</em></td>
</tr>
</tbody>
</table>
How this helps with prescreening:

- **Simplified roads**: Fast input of geometry
- **Multiple fixtures**: Allows the initial calculations to do screening for you, rather than vetting each fixture individually first.
- **Integrated cost and energy analysis**: allows you to evaluate trade-off with increased energy for improved light output. Simple payback and Net Present Value calculations both provided.
### Comparison to Conventional Software

<table>
<thead>
<tr>
<th>If you are trying to:</th>
<th>SEAD Tool</th>
<th>Conventional Software (AGi32, Dialux, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform early analysis of simple or generic road segments</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Analyze complex road geometries</td>
<td>✗</td>
<td>✔</td>
</tr>
<tr>
<td>Verify compliance with RP-8 for specific road segments</td>
<td>✗</td>
<td>✔</td>
</tr>
<tr>
<td>Analysis of a large number of simultaneous fixtures</td>
<td>✔</td>
<td>✗</td>
</tr>
<tr>
<td>Combine financial analysis with light performance</td>
<td>✔</td>
<td>✗</td>
</tr>
</tbody>
</table>
Sample Analysis of an Ontario municipality
## The Road Layout

Typical 4-lane arterial road  
(undisclosed location due to ongoing RFPQ process)

<table>
<thead>
<tr>
<th>Description:</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road Geometry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>4</td>
<td>lanes</td>
</tr>
<tr>
<td>Lane Width</td>
<td>2.7</td>
<td>meters</td>
</tr>
<tr>
<td>Shoulder Width</td>
<td>0</td>
<td>meters</td>
</tr>
<tr>
<td>Median Width</td>
<td>0</td>
<td>meters</td>
</tr>
<tr>
<td><strong>Light Geometry:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pole Placement</td>
<td>Single-side</td>
<td></td>
</tr>
<tr>
<td>Pole Height</td>
<td>10</td>
<td>meters</td>
</tr>
<tr>
<td>Pole Spacing</td>
<td>28</td>
<td>meters</td>
</tr>
<tr>
<td>Pole Setback</td>
<td>0.2</td>
<td>meters</td>
</tr>
<tr>
<td>Arm length</td>
<td>3</td>
<td>meters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description:</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminance Target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Surface Type</td>
<td>R3</td>
<td></td>
</tr>
<tr>
<td>Average Luminance Target (Lav)</td>
<td>1.2</td>
<td>cd/m²</td>
</tr>
<tr>
<td>Overall Uniformity (U0 - avg/min)</td>
<td>3</td>
<td>unitless</td>
</tr>
<tr>
<td><strong>Fixture Data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamp Lumen Depreciation</td>
<td>0.73</td>
<td>unitless</td>
</tr>
<tr>
<td>Luminaire Dirt Depreciation</td>
<td>0.88</td>
<td>unitless</td>
</tr>
<tr>
<td>Operating hours</td>
<td>4380</td>
<td>hours</td>
</tr>
</tbody>
</table>
Results

Analyzed performance for 300+ fixtures from 3 manufacturers

![Luminance vs. Wattage graph]

- Baseline
- Fails
- Passes
Results

Analyzed performance for 300+ fixtures from 3 manufacturers
Results

Luminance Range
(Lowest energy fixtures meeting luminance criteria)

Grid Points Below Average
Grid Points Above Average
Sample Cost Analysis

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost/Fixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Fixture Cost*</td>
<td>$2.8/watt + $115</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$100</td>
</tr>
<tr>
<td>LED Maintenance Cost</td>
<td>$25</td>
</tr>
<tr>
<td>Baseline Maintenance Cost</td>
<td>$50</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$0.10 / kWh</td>
</tr>
</tbody>
</table>

Values are illustrative and approximate

*LED fixture cost equation calculated from a limited set of sample fixture costs and should not be used for actual analysis.
Partnership with LightSavers

- Test the tool with lighting managers.
- Provide training on tool functionality.
- Obtain feedback on tool features and usability.
- Validate the tool as part of LightSavers assistance to Canadian municipalities in designing scalable strategies for street lighting retrofits.
Tool Implementation Plan

Pilot Partnerships
- Feedback on tool utility and features
- Assurance to future users of tool capabilities

Tool Upgrades
- Improved usability
- Improved financial analysis
- CIE calculations

Tool Dissemination
- Informing potential users of the tool
- Improved training and documentation

Additional Projects
- Identification of other key barriers to SL installations
- Considering additional projects to address barriers
Contact

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