

SMALL DIAMETER DIRECTIONAL LAMPS

REGULATORY PROPOSAL

PREPARED BY:

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SEPTEMBER 2016

COMMENTS MUST BE RECEIVED BY NOVEMBER 4, 2016

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SCOPE AND REQUIREMENTS – REGULATORY PROPOSAL

TYPE OF DEVICE	<p>Small diameter directional lamp (SDDL) - a commercially available lighting product for the purposes of aesthetic illumination or certain specialty applications. For the purposes of this document, ‘small diameter’ is defined as less than or equal to 2 ¼” (57mm).</p> <table border="1" data-bbox="516 447 1383 781"> <thead> <tr> <th data-bbox="516 447 943 520">Included bulb types (diameter ≤ 2 ¼”)</th> <th data-bbox="943 447 1383 520">Excluded bulb types (diameter > 2 ¼”)</th> </tr> </thead> <tbody> <tr> <td data-bbox="516 520 943 781"> <ul style="list-style-type: none"> • MR11 • PAR11 • MR16 (80% of the B.C. SDDL market sector) • PAR16 • R14 </td> <td data-bbox="943 520 1383 781"> <ul style="list-style-type: none"> • R20 • R30 • R40 • BR30 • PAR20 • PAR30 • PAR38 </td> </tr> </tbody> </table>	Included bulb types (diameter ≤ 2 ¼”)	Excluded bulb types (diameter > 2 ¼”)	<ul style="list-style-type: none"> • MR11 • PAR11 • MR16 (80% of the B.C. SDDL market sector) • PAR16 • R14 	<ul style="list-style-type: none"> • R20 • R30 • R40 • BR30 • PAR20 • PAR30 • PAR38
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<ul style="list-style-type: none"> • MR11 • PAR11 • MR16 (80% of the B.C. SDDL market sector) • PAR16 • R14 	<ul style="list-style-type: none"> • R20 • R30 • R40 • BR30 • PAR20 • PAR30 • PAR38 				
TEST STANDARD	<p>Efficacy of light-emitting diode (LED) lamps¹:</p> <ul style="list-style-type: none"> • IES LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products <p>Lumen maintenance:</p> <ul style="list-style-type: none"> • IES LM-84-14 Approved Method for Measuring Luminous Flux and Color maintenance of LED Lamps, Light Engines, and Luminaires <p>Time to failure:</p> <ul style="list-style-type: none"> • IES TM-28-14 Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires <p><i>Additional guidance for the test methodologies listed above is provided by the U.S. Department of Energy: 80 Fed. Reg. 39665-39666 (July 9, 2015), §430.23 (dd) and Appendix BB to Subpart B of Part 430.</i></p>				
PROPOSED ENERGY PERFORMANCE STANDARD	<p>The following items outline the mandatory criteria of this proposal:</p> <p>(1) SDDLs shall meet one of the following compliance pathways:</p> <ul style="list-style-type: none"> • Minimum efficacy ≥ 80 lumens per watt (LPW), OR • [Colour rendering index (CRI) + efficacy] ≥ 165; efficacy ≥ 70 LPW <p>(2) SDDLs shall have a minimum rated life of 25,000 hours.</p> <p>At current levels of technology, it will effectively eliminate lower-efficiency halogen SDDLs from the marketplace.</p>				
EFFECTIVE DATE	<p>Products manufactured and sold after January 1, 2018</p>				

¹ In the event that SDDLs with an incandescent filament are able to meet the proposed standards, manufacturers can apply the following test procedure: [U.S. Code of Federal Regulations, Title 10, Section 430.23\(r\) \(Appendix R to Subpart B of part 430\)](#).

<p>CERTIFICATION</p>	<p>Compliance with the proposed regulation will be based on testing and verification by Standards Council of Canada accredited Certification Organizations on adherence of manufactured products with the “Proposed Energy Performance Standard” using the proposed "test standard".</p> <p>No unique British Columbia label will be required for products where the following is listed on the packaging:</p> <ul style="list-style-type: none"> (a) Wattage (b) Lumens (c) CRI (d) Rated life
<p>NEED FOR REGULATION</p>	<p>The proposed standard reduces energy costs for consumers, improving the affordability of houses and buildings. The standard supports the Province’s energy objectives under the <i>Clean Energy Act</i>, including the target for BC Hydro to meet 66% of electricity demand growth through demand-side measures by 2020.</p>
<p>HARMONIZATION</p>	<p>This regulatory proposal harmonizes with the California Energy Commission standard for small diameter directional lighting adopted on January 27, 2016 and effective January 1, 2018, thereby advancing <i>the 2016 Pacific Coast Collaborative Climate Leadership Action Plan</i> commitment to harmonize product energy efficiency standards across the region.</p> <p>Harmonization with California will preclude B.C. from becoming a ‘dumping ground’ for less efficient products, eroding potential energy savings for the Province and costing consumers by way of increased utility bills.</p>
<p>TRANSPARENT REGULATION DEVELOPMENT</p>	<p>Development of the regulation proceeded as follows:</p> <ul style="list-style-type: none"> • Initial market analysis including installed capacity and annual sales in B.C. • Economic assessment • Regulatory assessment <p>A stakeholder consultation will be held during a 5-week public review period.</p>
<p>MARKET TRANSFORMATION ACTIVITY & INDICATORS</p>	<p>Overview: Data from a provincial market study commissioned in 2015 concluded that in 2014, 16% of MR16 sales in the commercial sector and 21% of sales in the residential sector were light-emitting diode (LED) technology.</p> <p>Availability: LED replacement products for common SDDL bulbs have been widely available since 2010.</p> <p>Awareness: B.C. utilities and retailers continue to promote the benefits of LED lighting via advertisement campaigns and retail store displays. ENERGY STAR designated lighting products (primarily LEDs) have built public awareness of high performance lighting options.</p> <p>Accessibility: SDDLs of various bulb types are now offered as LEDs in a variety of wattages at all major retailers, including:</p> <ul style="list-style-type: none"> • Home Depot • Rona • Canadian Tire • Costco

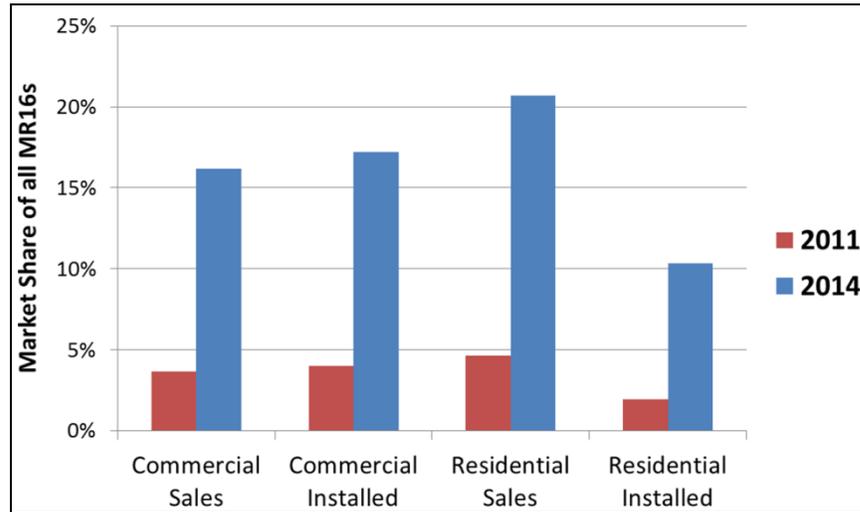
MARKET TRANSFORMATION ACTIVITIES & INDICATORS	<ul style="list-style-type: none"> • Walmart • London Drugs • Superstore • Safeway • Save-On • Lowe's <p>Affordability: A Ministry of Energy and Mines survey of 7 major retailers in 2015 found that average costs of MR16 LEDs have dropped by approximately 50% compared to prices documented in 2012. Information on costing is detailed on page 6.</p> <p>Acceptability: LED bulbs are now generally accepted as comparable alternatives to incandescent bulbs. Early LED technology suffered from concerns surrounding poor colour rendering index (CRI), harsh “white” light, and incompatibility with dimmers. Over the last five years there have been a multitude of bulbs introduced with higher CRIs, alleviating these concerns. Additionally, LEDs are now largely dimmable. Likewise, correlated colour temperature (CCT) is commonly reported on product packaging to allow users to select the hue of the bulb’s emanated light.</p> <p>Demand Side Management (DSM) programs to increase market share: Since 2010, BC Hydro has offered incentives for LED MR16s as part of their Business Energy Savings Incentives package (formerly PowerSmart Express program) that replaces MR16s greater than or equal to 5W. Since 2014, FortisBC’s Commercial Product Rebate Program has featured incentives in the same category.</p> <p>This proposed regulation can be promoted by energy utilities through their Demand-Side Management (DSM) programs, leading to increased market share of compliant products prior to the effective date. In turn, part of the energy savings from the proposed regulation can be attributed back to those DSM programs as per Section 4 (Subsection 1.4) of the Demand-Side Measures Regulation under the <i>Utilities Commission Act</i>:</p> <p>http://www.bclaws.ca/Recon/document/ID/freeside/10_326_2008</p>
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ASSESSMENT FROM AN INDUSTRY PERSPECTIVE

RANGE OF PRODUCTS AFFECTED	The proposed regulation affects the manufacture and sale of SDDLs (less than 2¼” in diameter) in B.C. The proposed regulation would only apply to products manufactured after the proposed effective date. Retailers that are selling inventory that is manufactured before the proposed effective date can continue to do so.
COST IMPACT	Retailers can expect to be selling more expensive ‘premium’ products in the short term. Since LEDs have a lifetime of greater than 20 years, unit sales for retrofit scenarios are expected to decrease over time.
COMPETITIVE ANALYSIS	The proposed regulation is identical to the SDDL regulation adopted by the California Energy Commission on January 27, 2016 that becomes effective on January 1, 2018. Harmonization with California will simplify compliance for manufacturers (all of whom are located out of province).

MARKET SHARE

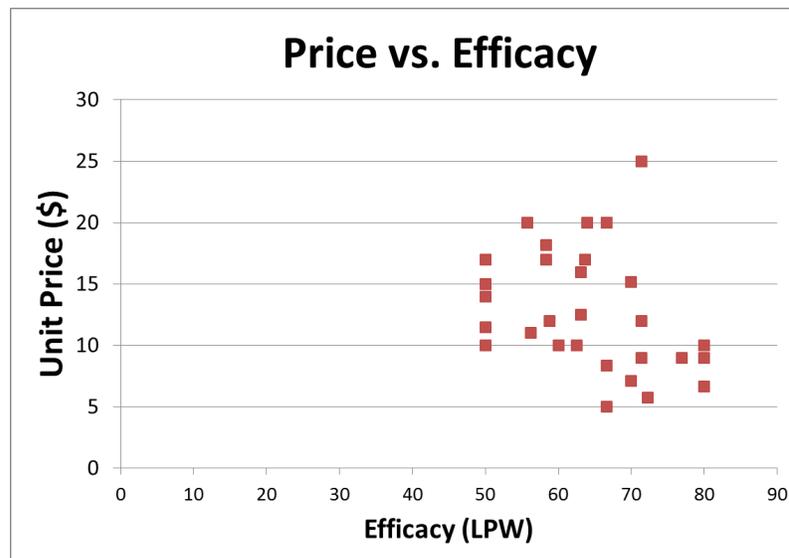
The MR16-type bulb makes up 80% of the SDDL sector. A 2015 BC Hydro Product Survey Report concluded that market share of LED MR16s is increasing rapidly as depicted in the following chart:



These trends, coupled with the recent adoption of the same standard in California, are expected to propel the market toward LEDs over the next 10 years. By 2018, nearly 100% of installed commercial-sector bulbs in B.C. and 32% of residential-sector bulbs are expected to be LED. The transition to LEDs in the residential sector is slower because of a longer replacement cycle relative to the commercial sector (due to fewer hours of use in the residential sector).

ASSESSMENT FROM A CONSUMER PERSPECTIVE
INCREMENTAL PURCHASE COSTS

A 2015 Ministry of Energy and Mines retail survey yielded the following results:



The average price of LED MR16s has dropped to an average of approximately \$13 in 2015. This figure is expected to continue to decrease with incentives and increased market adoption. In contrast, the typical unit price for a halogen MR16 is approximately

	<p>\$4-5. Therefore, incremental costs in 2015 are approximately \$9 for LED SDDLs. Other bulb types in the SDDL category such as MR11 and PAR16 have similar relative pricing characteristics when comparing halogens and LEDs. These other types of bulbs make up a relatively small portion (<20%) of the total market and therefore do not significantly affect the incremental cost assumptions for the model.</p>																				
<p>DATA AND ASSUMPTIONS</p>	<ul style="list-style-type: none"> • Average energy consumption of a < 80 L/W lamp: 36 kWh/yr for residential and 197 kWh/yr for commercial <ul style="list-style-type: none"> ○ includes 35W/50W common bulb type blend ○ includes current market share of halogen and LED blended into baselines • Average cost of a < 80 L/W lamp: \$4.84 • Average expected life of a < 80 L/W lamp: 4.3 years for residential and 1 year for commercial • Average energy consumption of a 80 L/W lamp: 5.8 kWh/yr for residential and 21 kWh/yr for commercial • Average cost of an 80 L/W lamp in 2015: \$12.44 and decreases by 5% per year. • Average expected life of a 80 L/W lamp: 26.8 years for residential and 7 for commercial • Average consumption for the MR16 baseline is 36.56 kWh/yr for residential and 197 kWh/yr for commercial • Economic analysis included BC Hydro Residential Inclining Block (RIB) rates, with 60% tier 1 rates and 40% tier 2 rates <ul style="list-style-type: none"> ○ Tier 1 rate in 2018: \$0.0902/kWh ○ Tier 2 rate in 2018: \$0.1306/kWh • Commercial rate in 2018: \$0.1269/kWh • Consumer and provincial discount rates are 6% 																				
<p>COST-BENEFIT ANALYSIS</p> <p>ENERGY SAVINGS FOR EACH CONSUMER</p>	<p>An economic model using the above data and assumptions yielded the following results:</p> <table border="1" data-bbox="431 1209 1479 1612"> <thead> <tr> <th></th> <th>Residential</th> <th>Commercial</th> </tr> </thead> <tbody> <tr> <td>Energy savings per unit</td> <td>30.7 kWh/yr</td> <td>175 kWh/yr</td> </tr> <tr> <td>Cost savings per unit</td> <td>\$3.13</td> <td>\$20.93</td> </tr> <tr> <td>Simple payback per unit</td> <td>1.7 years</td> <td>0.3 years</td> </tr> <tr> <td>NPV of consumer cost savings per unit, full equipment life, including PST/GST</td> <td>\$55.62</td> <td>\$138.79</td> </tr> <tr> <td>Consumer NPV per unit, including PST/GST</td> <td>\$48.47</td> <td>\$131.64</td> </tr> </tbody> </table>				Residential	Commercial	Energy savings per unit	30.7 kWh/yr	175 kWh/yr	Cost savings per unit	\$3.13	\$20.93	Simple payback per unit	1.7 years	0.3 years	NPV of consumer cost savings per unit, full equipment life, including PST/GST	\$55.62	\$138.79	Consumer NPV per unit, including PST/GST	\$48.47	\$131.64
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<p>NON-ENERGY BENEFITS</p>	<p>LEDs generally emit less heat than halogens. In certain applications it can be advantageous to minimize heat gains in buildings and homes to ensure thermal comfort, maximize energy efficiency of an existing heating system, and minimize air conditioning load on hot days and/or in warmer climates.</p> <p>LEDs require less frequent replacement than halogens as they typically have an average life of 20 years, compared to approximately two year for halogen SDDLs.</p>																				

ASSESSMENT FROM A PROVINCIAL GOVERNMENT PERSPECTIVE

<p>ECONOMIC ASSESSMENT FROM A PROVINCIAL PERSPECTIVE</p> <p><i>(Aggregate energy, emission and net cost savings)</i></p>	<p>A province wide impact assessment considers the following additional assumptions and trends:</p> <ul style="list-style-type: none"> • In the reference case, 32% of residential and 94% of commercial SDDL lighting is ≥ 80 lumens per watt by 2018 • In 2014, there were 2.6M and 0.5M SDDLs installed in B.C. homes and businesses, respectively • MR16s represent 80% of sales and energy savings in the SDDL category • long run marginal cost (LRMC) of electricity: \$0.1034/kWh • provincial and consumer discount rates: 6% • utility discount rate: 5% <p>The following three metrics illustrate the benefit of the regulation from an energy, cost, and provincial Net Present Value (NPV) perspective:</p> <table border="1" data-bbox="431 751 1438 1081"> <tr> <td>Cumulative Energy Savings 2018-2025</td> <td>76 GWh/yr</td> </tr> <tr> <td>Cumulative Energy Bill Savings 2018-2025</td> <td>\$8M</td> </tr> <tr> <td>Provincial NPV (\$) over the lifetime of products installed between 2018-2025, with energy benefits</td> <td>\$118M</td> </tr> </table> <p>In summary, British Columbians as a whole will see 76 GWh/yr of savings in 2025, resulting in \$8 million of annual energy savings. The province will benefit from a \$118 million NPV over the lifetime of products installed between 2018 and 2025.</p>	Cumulative Energy Savings 2018-2025	76 GWh/yr	Cumulative Energy Bill Savings 2018-2025	\$8M	Provincial NPV (\$) over the lifetime of products installed between 2018-2025, with energy benefits	\$118M
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<p>ADMINISTRATIVE FEASIBILITY FOR COMPLIANCE AND ENFORCEMENT</p>	<p>Compliance and enforcement under the <i>Energy Efficiency Act</i> is based on inspections and response to compliance complaints. Enforcement will rely upon comparisons of product packaging with certification reports.</p>						

NOTES

<p>REGULATORY ASSESSMENT COMPLETED BY</p>	<p>Voytek Gretka, M.Eng, CEM, EIT Tel: (250) 952-0626 E-mail: Voytek.Gretka@gov.bc.ca</p>
<p>DATE</p>	<p>September, 2016</p>