CIE CNC – IES BC Seminar
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Adaptive Street Lighting

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BC hydro POWER SMART

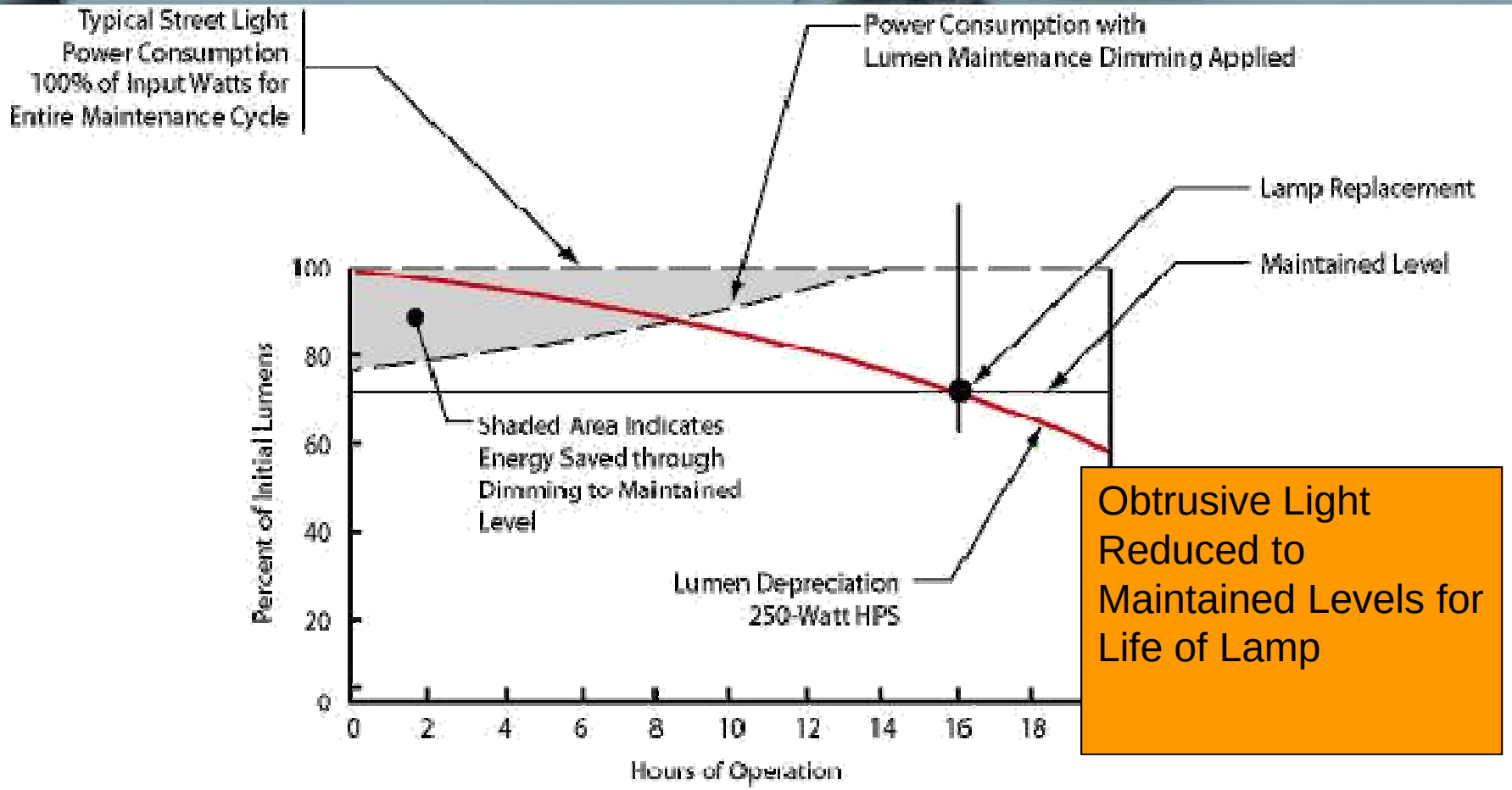
Adaptive Lighting – Street Lighting Opportunities

- What is Adaptive Street Lighting?
- Benefits
- Drivers to adopt ASL
- ASL technologies
- Field Studies and Pilot Projects
- BC Hydro's ASL Incentive Program

Adaptive What is Adaptive Street Lighting?

"the ability to vary
lighting levels based on
pedestrian activity levels"

Opportunity:
- Dim to Maintain Design Level

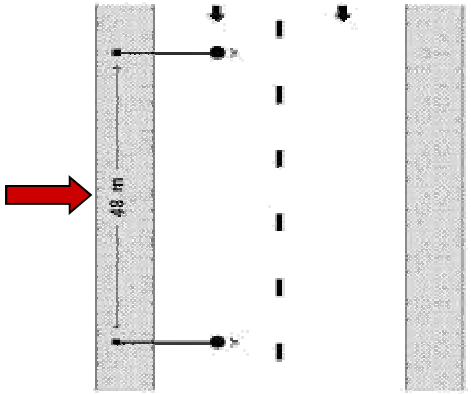


Obtrusive Light Reduced to Maintained Levels for Life of Lamp

Opportunity
- Reduce Lighting in Over-Lighted Areas

Roadway Information

Number Left Lanes	2
Left Lane Width	4 m
Median Width	0 m
Number Right Lanes	0
Right Lane Width	0 m
Calculation Method	IES RP8-2000
Pavement Reflectance	Asphalt - R3
Roadway Classification	Local
Pedestrian Conflict	Low



Luminaire Information

Left Side

Label	A
Catalog Number	(not specific to a single catalog number)
Photometric File	GET286.IES
Lamp Lumens	9500
Light Loss Factor	0.80
Input Power	100 W
Tilt	0°
Arm Length	3 m
Mounting Height	7.5 m
Setback	1.2 m
Quantity	21

Set spacing results in over-lighted roadway

RP-8 – 4lux

Calculation Results - Left Side

Luminance		
Average	0.5	cd/m²
Max	1.1	cd/m²
Min	0.1	cd/m²
Max/Min	8.8	
Avg/Min	4.0	

Illuminance		
Average	7.4	lux
Max	26.9	lux
Min	1.3	lux
Max/Min	22.0	
Avg/Min	5.7	

Lv Ratio	0.3	
STV	4.4	
Spacing	48	m
Length	1000	m
Quantity	21	

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Opportunity:
- Match Lumen Output to Variable IESNA Pedestrian Conflict Levels

Road and Pedestrian Conflict Area		Pavement Classification (Minimum Maintained Average Values)			Uniformity Ratio	Veiling Luminance Ratio
Road	Pedestrian Conflict Area	R1 lux/fc	R2 & R3 lux/fc	R4 lux/fc	E_{avg}/E_{min}	L_{vmax}/L_{avg}
Freeway Class A		6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Freeway Class B		4.0/0.4	6.0/0.6	5.0/0.5	3.0	0.3
Expressway	High	10.0/1.0	14.0/1.4	13.0/1.3	3.0	0.3
	Medium	8.0/0.8	12.0/1.2	10.0/1.0	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Major	High	12.0/1.2	17.0/1.7	15.0/1.5		
	Medium	9.0/0.9	13.0/1.3	11.0/1.1		
	Low	6.0/0.6	9.0/0.9	8.0/0.8		
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0		
	Medium	6.0/0.6	9.0/0.9	8.0/0.8		
	Low	4.0/0.4	6.0/0.6	5.0/0.5		
Local	High	6.0/0.6	9.0/0.9	8.0/0.8		
	Medium	5.0/0.5	7.0/0.7	6.0/0.6	6.0	0.4
	Low	3.0/0.3	4.0/0.4	4.0/0.4	6.0	0.4

Potential for Dimming of 1/3 to 1/2 Based on Pedestrian Conflict Level – 40% Energy Savings

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IESNA RP-8-00

Roadways Table 2	High	Medium	Low	Low/High	Allowed Reduction
Expressway	1.4	1.2	0.9	64%	36%
Major Roads	1.7	1.3	0.9	53%	47%
Collector Roads	1.2	0.9	0.6	50%	50%
Local Roads	0.9	0.7	0.4	44%	56%
Urban Intersections Table 9					
Major/Major	3.4	2.6	1.8	53%	47%
Major/Collector	2.9	2.2	1.5	52%	48%
Major/Local	2.6	2.0	1.3	50%	50%
Collector/Collector	2.4	1.8	1.2	50%	50%
Collector/Local	2.1	1.6	1.0	48%	52%
Local/Local	1.8	1.4	0.8	44%	56%

Impact of Varying Light Levels

"reductions in light level to about 70% of initial value are likely the minimum change that would not be detected reliably by observers"

"a majority of subjects found a 30% reduction acceptable, even if they could detect it"

"government agencies are exempt from the usual duties of care if their decisions regarding matters such as lighting are bona fide policy decisions"

"a municipality or property owner should understand whether there is a legal duty to provide lighting and if so, how to demonstrate that the duty is being properly carried out. Local ordinances requiring lighting may call for specific light levels or may be written in more general language

- There are approximately 300,000 street lights in British Columbia:

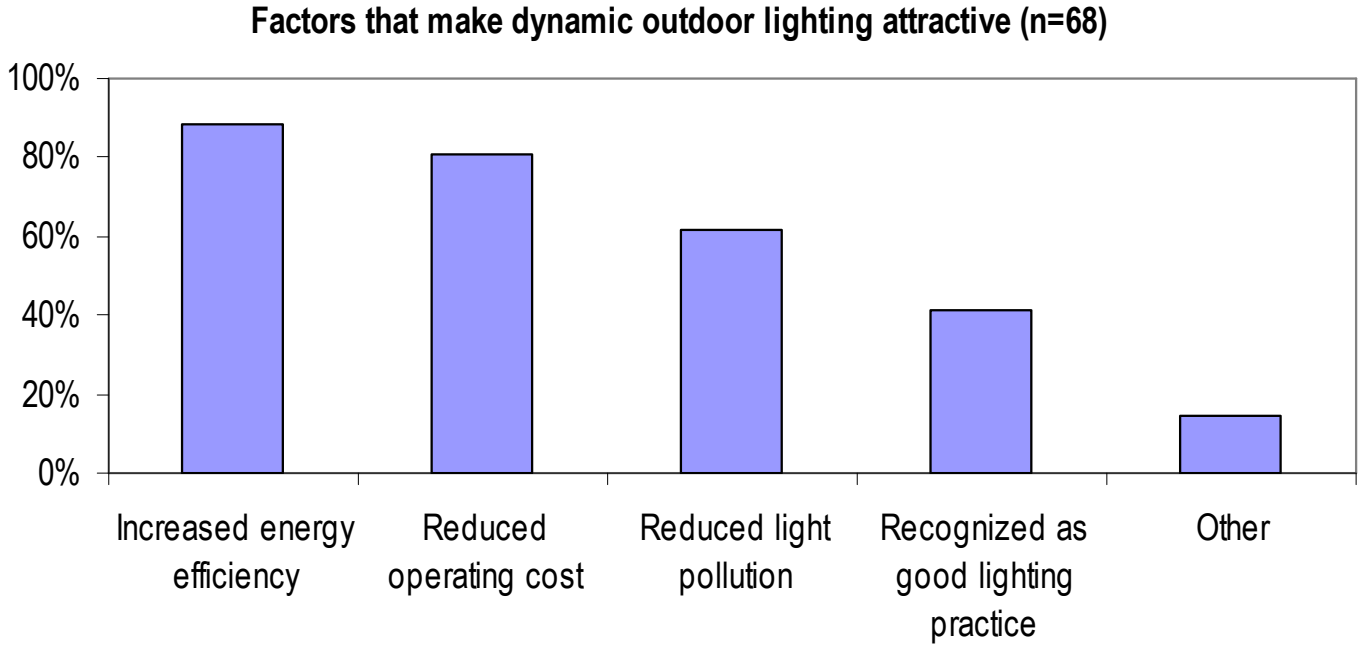
	Annual Savings	Savings over 20 Years
kWhr Saved	**103,500,000**	**207,000,000**
Value	**$6,479,100**	**$129,582,000**
CO_2 Reduction *(tonnes)*	**33,741**	**674,820**
Value of CO_2	**$1,012,230**	**$20,244,600**

- There are approximately 4.5 mil street lights in Canada
- There are approximately 220 mil street lights Worldwide

ASL Benefits

- “Greening” the municipalities and utilities
- Improve efficiency of asset management:
  - Maintenance savings to manage outages
  - Mitigates risks as outages can be addressed quickly
  - Better control over inventory
- Energy cost savings
  - Modified BC Hydro rate has been developed and approved by BCUC

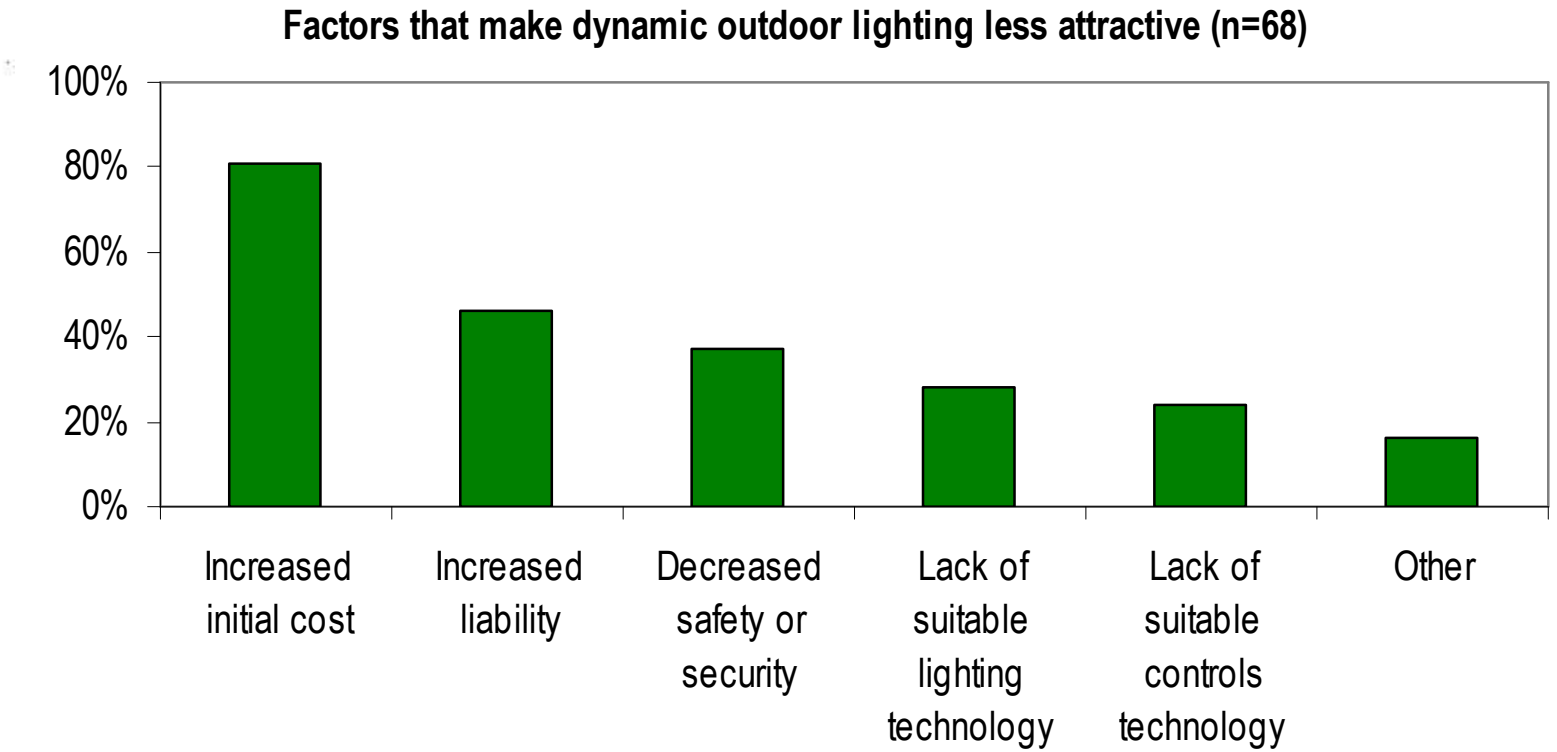
Drivers for Adopting ASL



NLPIP Industry Survey of LRC– Jan/ Feb 2010

98% respondents confirmed that dynamic outdoor lighting is a feasible technologically

Drivers for Adopting ASL



A total of 16% of respondents identified other factors, including a lack of:

- standards regarding visual requirements from dynamic outdoor lighting
- tariff structures to accommodate dynamic outdoor lighting

Courtesy of LRC

Adaptive Lighting Controls – Static

Static

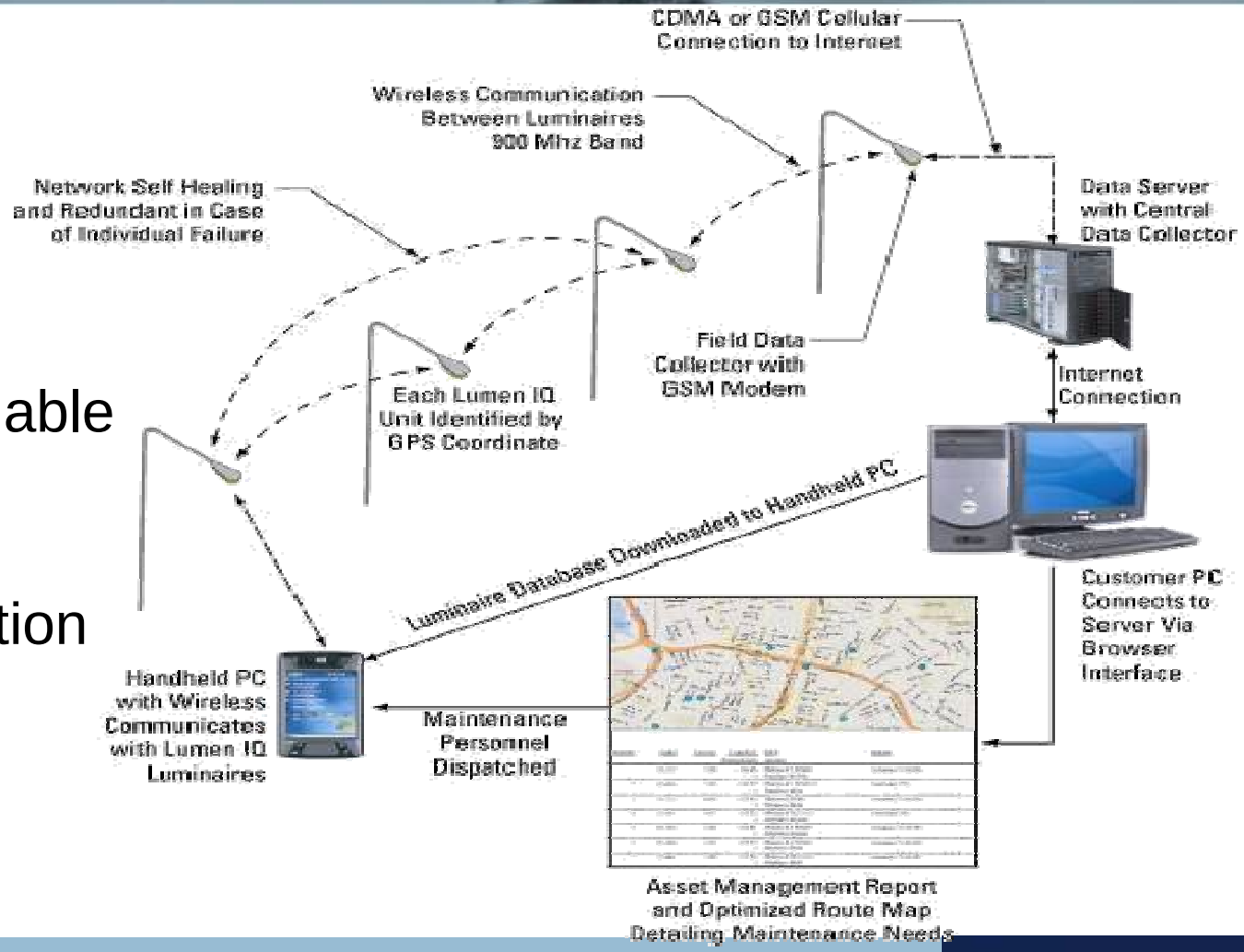
- Preset schedule or time
- Operates independently
- Not adjustable

Courtesy of Night Saver

Adaptive Lighting Controls – Dynamic

Dynamic

- Programmable
- Adjustable
- Two-way communication



Courtesy of STI

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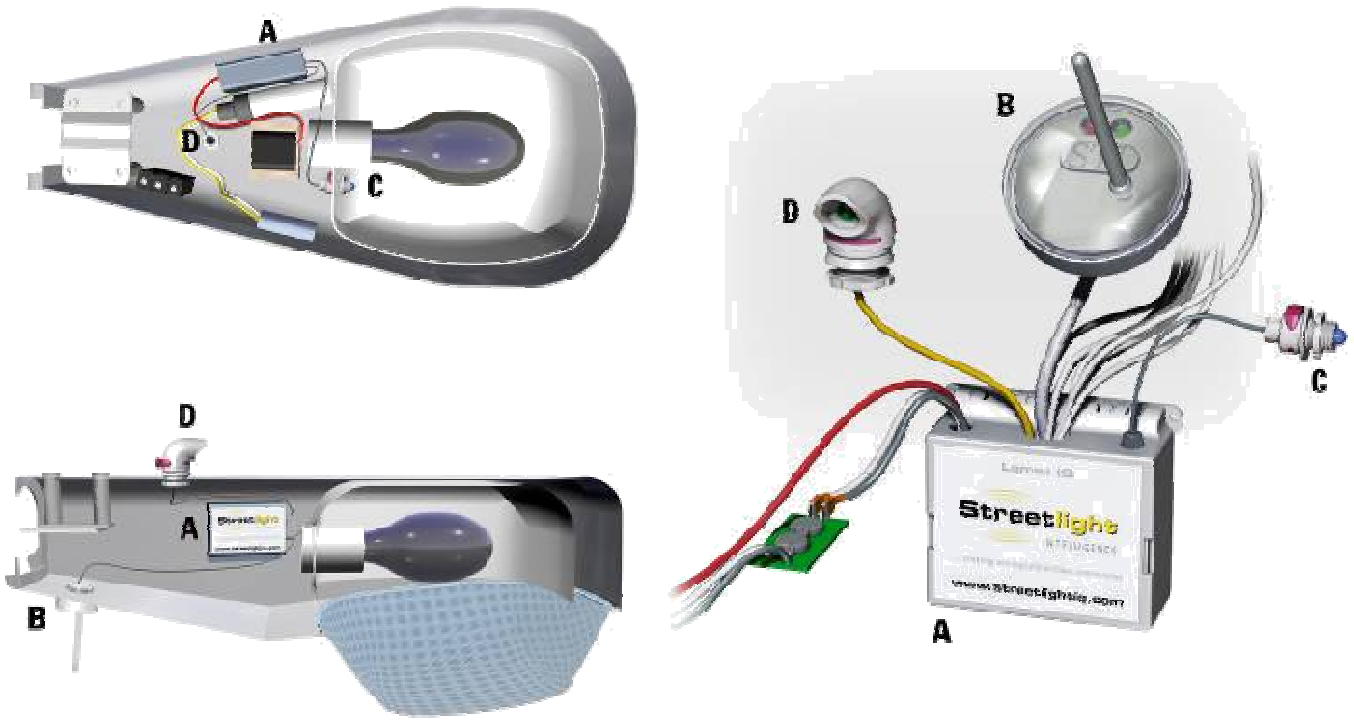
Adaptive Lighting Controls – Dynamic



A) Microprocessor B) WiFi Interface C) Lamp Lumen Sensor D) Day/Night Sensor

Courtesy of STI

ASL Pilot Project: HID

Prince George, BC

Project Plan:

- To retrofit **67, 250W HPS** luminaires with Dynamic ASL Control (50%-70%-100%)
- 2.5 km main arterial with commercial and residential roadway.
- Annual Savings : 36,000 kWh
- Percent Savings: 26.5%

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ASL Pilot Project: LED

Vancouver, BC

Project Plan:

- **30 LED** luminaires with Dynamic ASL Controls at 2010 Olympic corridor site - Downtown
- **106W** LED, dimmed to **54W all hours**
- Percent Savings: 51% energy savings to date

Dimming LED Benefits:

- Extended life, reduced maintenance

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The PS Adaptive Street Lighting Program

What is involved

- Energy Study/ ASL Guidelines
- Implementation design and execution
- Incentive payment
- On-going billing communication with BCH
- Eventual annual billing reconciliation

The PS Adaptive Street Lighting Program

To date:

- 28 largest municipalities in BC are interested
- 23 GWh potential savings
- 100,000 streetlights
- Energy Studies completed for 14 Municipalities
- Potential for BC Hydro owned streetlights

Street Light Energy Saving Calculator

BCHydro powersmart

Version 1.3 - Aug 2009

Account Information

Municipality:	Anytown
Daylight Zone:	Vancouver
BCH Account #:	12345
Customer Contact:	John Smith

Results

Total Savings [kWh]	563,981
Total Savings [%]	15.4%

Insert 5 New Lines | Delete Line | Update for Billing

Data Entry: Enter Data Pole-by-Pole?

Measurement System: Metric / Imperial

Street Light Data

Location Information							Existing Street Light Data								Dimming Specifi		
Street Lighting System Location	Land Use	Road Classification	Average Pole Spacing [m]	Required Illumination (IESNA RP-8) LUX			Existing Illumination Level [LUX]	Existing Technology	Lamp/Ballast Wattage	Input Watts	Number of Street Lights	Total kW	Use Dimming?	Proposed Min Level [LUX]	Dimming Profile	Average Load Dimming
				High	Med.	Low					2571	914				
Vancouver Rd - North of Victoria	Residential	Local	15			9	20	High Pressure Sodium	150W lamp (190W input)	190	25	4.75	No	10	Profile #1	0.0%
Vancouver Rd - South of Victoria	Commercial	Local	15		13	9	22	High Pressure Sodium	150W lamp (190W input)	190	41	7.79	No	13	Profile #2	0.0%
Lakeview Road	Residential	Local	15			9	16	High Pressure Sodium	400W lamp (475W input)	475	60	28.50	Yes	9	Profile #3	36.5%
Kamloops Boulevard - Res	Residential	Local	15			9	18	Low Pressure Sodium	180W lamp (235W input)	235	275	64.63	Yes	9	Profile #1	63.3%
Kamloops Boulevard - Com	Commercial	Local	15		13		18	Low Pressure Sodium	180W lamp (235W input)	235	50	11.75	Yes	12	Profile #2	29.6%
United Way South	Commercial / Industrial	Major	15		13	9	20	Low Pressure Sodium	180W lamp (235W input)	235	17	4.00	Yes	13	Profile #3	36.5%
United Way North	Commercial / Industrial	Major	15			9	12	Low Pressure Sodium	180W lamp (235W input)	235	19	4.47	Yes	9	Profile #3	36.5%
3 Ave	Residential	Sidewalk	15			9	15	Mercury Vapour	400W lamp (450W input)	450	30	13.50	Yes	9	Profile #3	36.5%
13 St	Commercial	Major	15	17		9	23	Mercury Vapour	700W lamp (780W input)	780	56	43.68	Yes	17	Profile #3	36.5%
14 St	Commercial	Major	15		5		12	Metal Halide	400W lamp (450W input)	450	146	65.70	Yes	5	Profile #3	36.5%
15 St	Commercial / Residential	Major	15	17		9	16	Metal Halide	400W lamp (450W input)	450	83	37.35	Yes	17	Profile #3	36.5%
North Rd	Commercial / Residential	Pedestrian Walkway	10	17	13		28	Metal Halide	400W lamp (450W input)	450	121	54.45	Yes	17	Profile #3	36.5%
South Rd	Residential	Expressway	25			10	20	Metal Halide	400W lamp (450W input)	450	100	45.00	Yes	10	Profile #3	36.5%
12th Ave	Residential	Expressway	25			9	20	Metal Halide	400W lamp (450W input)	450	500	225.00	No	10	Profile #3	0.0%
13th Ave	Residential	Expressway	25			9	20	Metal Halide	400W lamp (450W input)	450	50	22.50	Yes	10	Profile #1	63.3%
Meadows St	Industrial	Collector	25			9	12	Metal Halide	400W lamp (450W input)	450	20	9.00	Yes	13	Profile #3	36.5%
12th Street to 2nd Ave	Industrial	Collector	25		13	9	14	Metal Halide	400W lamp (450W input)	450	14	6.30	Yes	13	Profile #3	36.5%
12th Street to 2nd Ave	Industrial	Collector	25		13	9	14	Metal Halide	400W lamp (450W input)	450	44	19.80	Yes	13	Profile #3	36.5%
19th Ave	Residential	Sidewalk	10		12	10	15	Metal Halide	400W lamp (450W input)	450	400	180.00	Yes	10	Profile #3	36.5%
20th Ave	Residential	Sidewalk	10			10	20	Metal Halide	75W lamp (95W input)	95	250	23.75	No	10	Profile #3	0.0%
25th Ave	Commercial	Collector	20			10	12	Metal Halide	150W lamp (185W input)	185	200	37.00	No	10	Profile #2	0.0%
		Sidewalk						High Pressure Sodium	50W lamp (70W input)	70	20	1.40	Yes		Profile #2	29.6%
								Mercury Vapour	100W lamp (125W input)	125	10	1.25	Yes		Profile #1	63.3%
								Compact Fluorescent	13W lamp (17W input)	17	20	0.34	Yes		Profile #3	36.5%
								Other	150	150	10	1.50	Yes		Profile #2	29.6%
								Incandescent	100W input	100	10	1.00	Yes		Profile #3	36.5%

Table Field	Explanation
Street Lighting System Location	The system name for a set of street lights of the same type and wattage.
Proposed Min Level	The proposed minimum lumens output after dimming measures installed. NOTE: An error message will be displayed if this value is below the minimum value entered under Required Illuminations (IESNA RP-8) or if it corresponds to dimming greater than 50
Use Dimming?	Choose "Yes" if dimming technology will be applied to this street light system.
Dimming Profile	Choose a dimming profile. The settings for the dimming profile are determined by the user under the "Profiles" tab where a load dimming level for the streetlight is set for every hour of the week.
Average Load Dimming	The weighted average load dimming level applied to the street light according to the corresponding dimming profile set under the "Profiles" tab.
Average Light Dimming	The weighted average light dimming level applied to the street light according to the corresponding dimming profile set under the "Profiles" tab.
Total Dimming Hours/Year	The total hours in a year in which dimming is applied to the street light.
Use Add'l Energy Saving Hardware?	Choose "Yes" if an additional energy saving technology will be applied to the street light system (eg. Flat Lens) or if a lower power lamp is installed.

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Dimming Profiler For: Anytown

Create dimming profile in terms of percentage of power dimming or percentage of light output?

Power Dimming

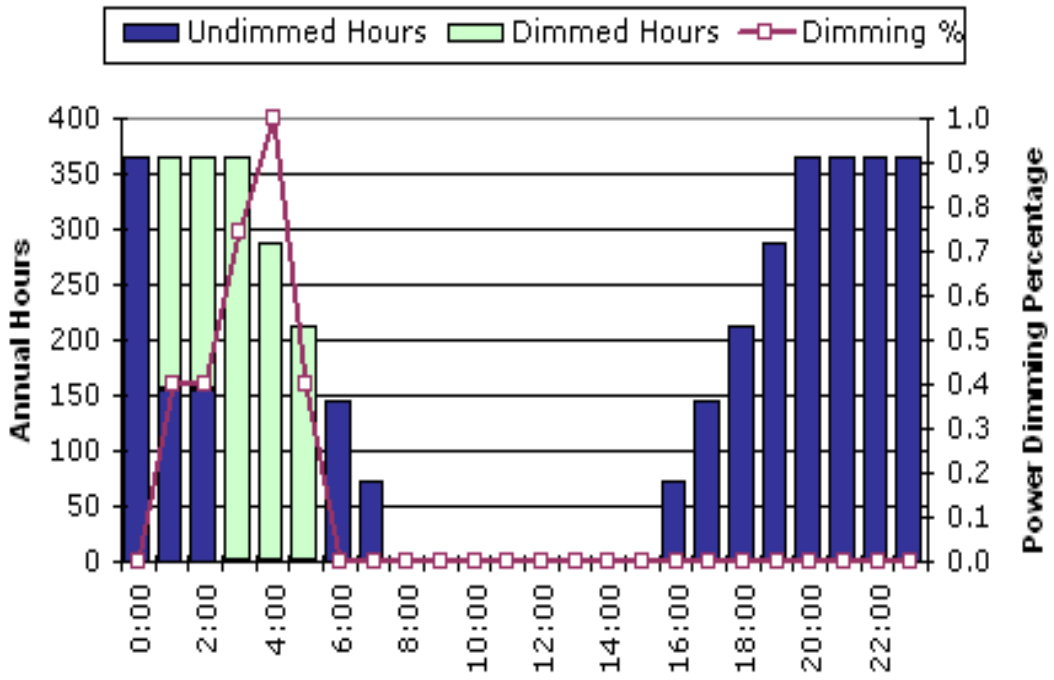
NOTE: If light output dimming is chosen, the maximum allowable dimming is 50%. If power dimming is used, the maximum allowable dimming is 40%.

Dimming Profile #1

You are now using power dimming.

Time	Mon - Thurs	Fri - Sun
0:00	0%	0%
1:00	40%	0%
2:00	40%	0%
3:00	100%	40%
4:00	100%	100%
5:00	40%	40%
6:00	0%	0%
7:00	0%	0%
8:00	0%	0%
9:00	0%	0%
10:00	0%	0%
11:00	0%	0%
12:00	0%	0%
13:00	0%	0%
14:00	0%	0%
15:00	0%	0%
16:00	0%	0%
17:00	0%	0%
18:00	0%	0%
19:00	0%	0%
20:00	0%	0%
21:00	0%	0%
22:00	0%	0%
23:00	0%	0%

Total Annual Dimming Hours:	1284
Average Power Dimming %:	63.3%
Average Light Output Dimming %:	84.3%
Blended Average Power %:	81.4%



Street Light Billing Information

BC hydro powersmart

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Account Information

Municipality:	Anytown
BCH Account #:	12345

Summary

Total Street Lights [Q-ty] :	2571
Total Street Lights With Adaptive Measures [Q-ty]:	1555
Total Dimming Account at 100% Power [kW]:	616
Total Dimming Account at Blended Power [kW]:	475
Billing Rate [$/kW]	$0.02
Dimming Blended Ratio [%]	77.1%
Total Billing for Dimming Account at 100% Power [$]:	$12.32
Total Billing for Dimming Account at Blended Power	$9.50

No. Street Lights	Type	Old Watts	New Watts
10	Mercury Vapour	125	102
30	Mercury Vapour	450	343
56	Mercury Vapour	780	594
50	Metal Halide	450	366
928	Metal Halide	450	343
20	High Pressure Sodium	70	58
60	High Pressure Sodium	475	362
275	Low Pressure Sodium	235	191
50	Low Pressure Sodium	235	196
36	Low Pressure Sodium	235	179
20	Compact Fluorescent	17	13
10	Incandescent	100	76
10	Other	150	125

The PS Adaptive Street Lighting Program

BC Hydro Adjusted Rate Schedule 1702 (customer owned ornamental lighting)

- The present RS 1702 is a flat rate wattage charge that assumes a fixed hourly consumption of 4,000 hours of use per year and a fixed input wattage for the lamp fixture and the ballast.

- The amendment to introduce an RS 1702 energy rate allows for the information provided by the dimming technology to provide an "Equal Billing" (Blended Average Wattage)

- The design of the RS 1702 energy charge is consistent with the RS 1702 wattage charge and is revenue neutral between the two rates.