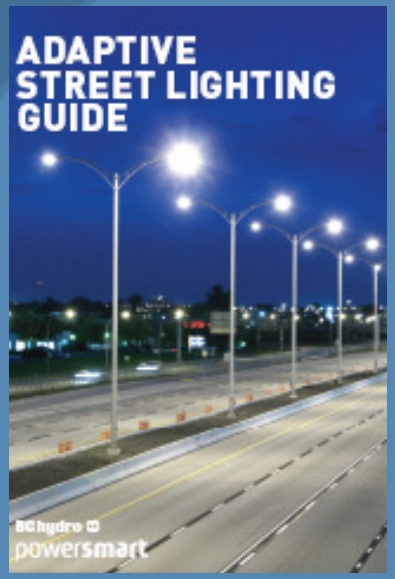
Adaptive Lighting Deployment – An Engineered Approach



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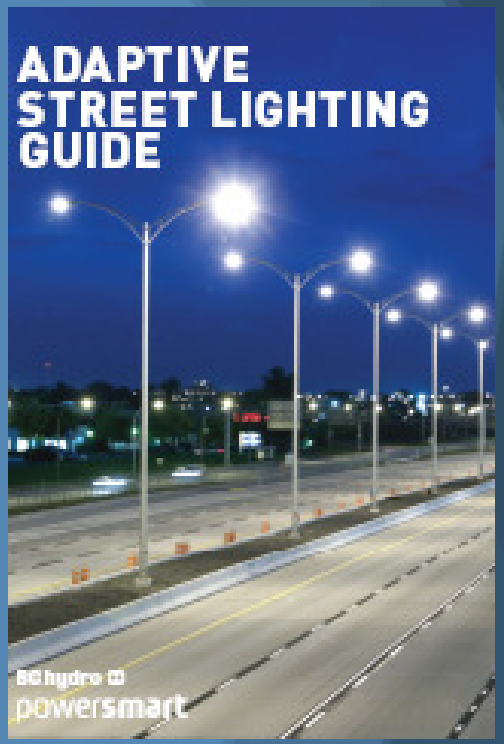
Today's Presentation

- Review Adaptive lighting
- How it can be deployed in a typical City
- What are the typical energy saving benefits.
- Challenges and concerns



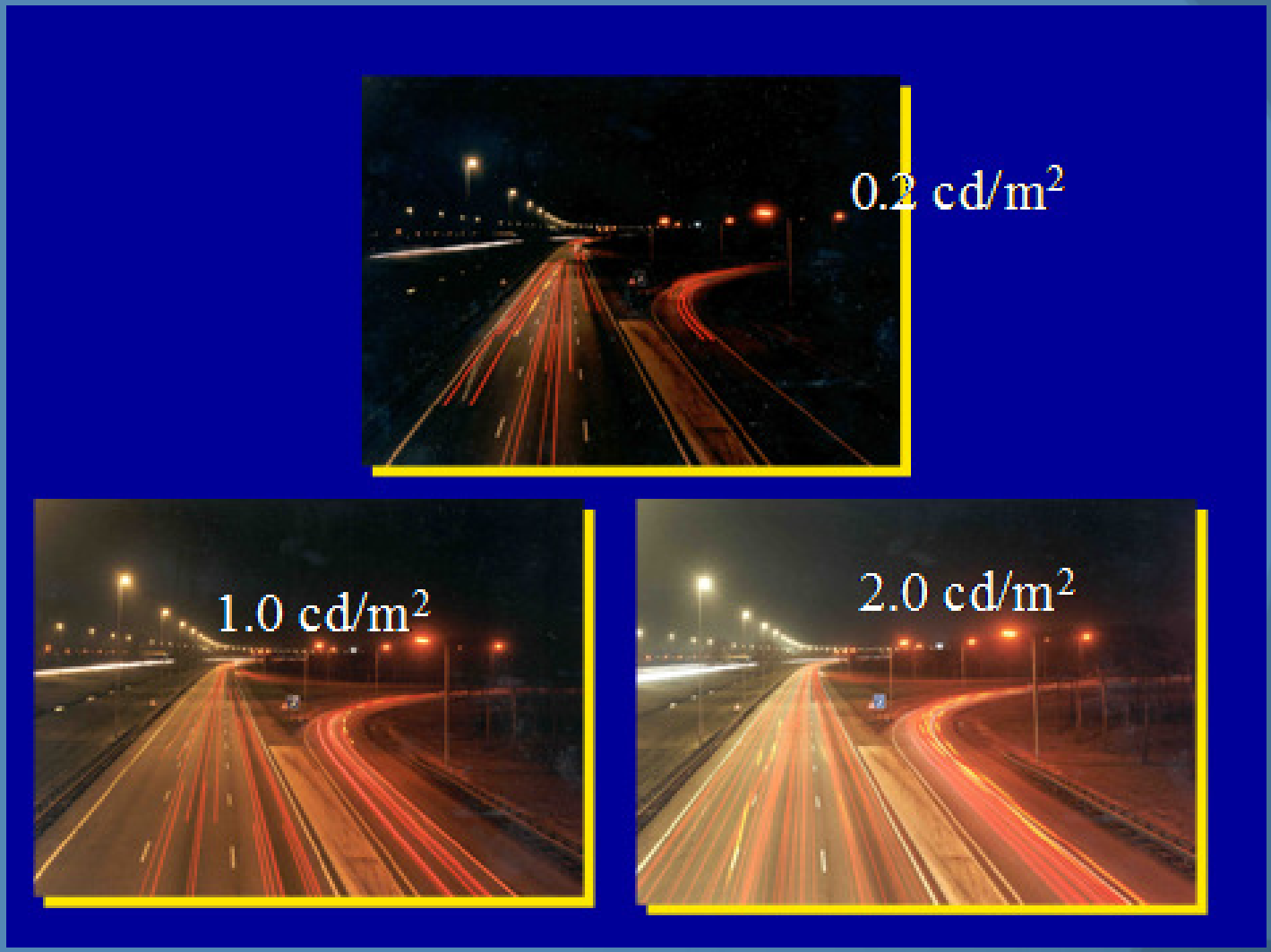
Adaptive Lighting (new term):

"The ability to vary lighting levels to suit activity levels." – Activity levels will typically decline during the evening.

Becoming accepted practice as it is in many published documents (ie; TAC, CIE, IMSA, IESNA)

Why now? – Lighting controls have developed to the point where they are easy to install and can be cost effective.

Adaptive Lighting - Example



Rationale – Current Practice

Current design practice - Light streets to meet or exceed required minimum levels and define by IESNA RP8 or TAC.

No maximum levels exist.

Lighting levels are often well exceeded. Some think ***"more light is better".***

Rationale – Roadway Levels

Road and Pedestrian Conflict Area		Pavement Classification (Minimum Manintained 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	3.0	0.3
	Medium	9.0/0.9	13.0/1.3	11.0/1.1	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0	4.0	0.4
	Medium	6.0/0.6	9.0/0.9	8.0/0.8	4.0	0.4
	Low	4.0/0.4	6.0/0.6	5.0/0.5	4.0	0.4
Local	High	6.0/0.6	9.0/0.9	8.0/0.8	6.0	0.4
	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

Rationale – Sidewalk Levels

Pedestrian Activity	Maintained Average Horizontal Illuminance (lux)	Average-to - Minimum Horizontal Uniformity Ratio	Minimum Maintained Vertical Illuminance (lux)
High	≧ 20.0	≦ 4.0	≧ 10.0
Medium	≧ 5.0	≦ 4.0	≧ 2.0
Low	≧ 3.0	≦ 6.0	≧ 0.8

Rationale - Why

Why vary lighting levels in off peak periods?

It has been estimate 64 million street lights exist in North America. Estimated power consumed in a year would be approximately 51billion kWh. Just imagine 20% reduction in off peak hours.

- ***That's 5 billion kWh hours per year***

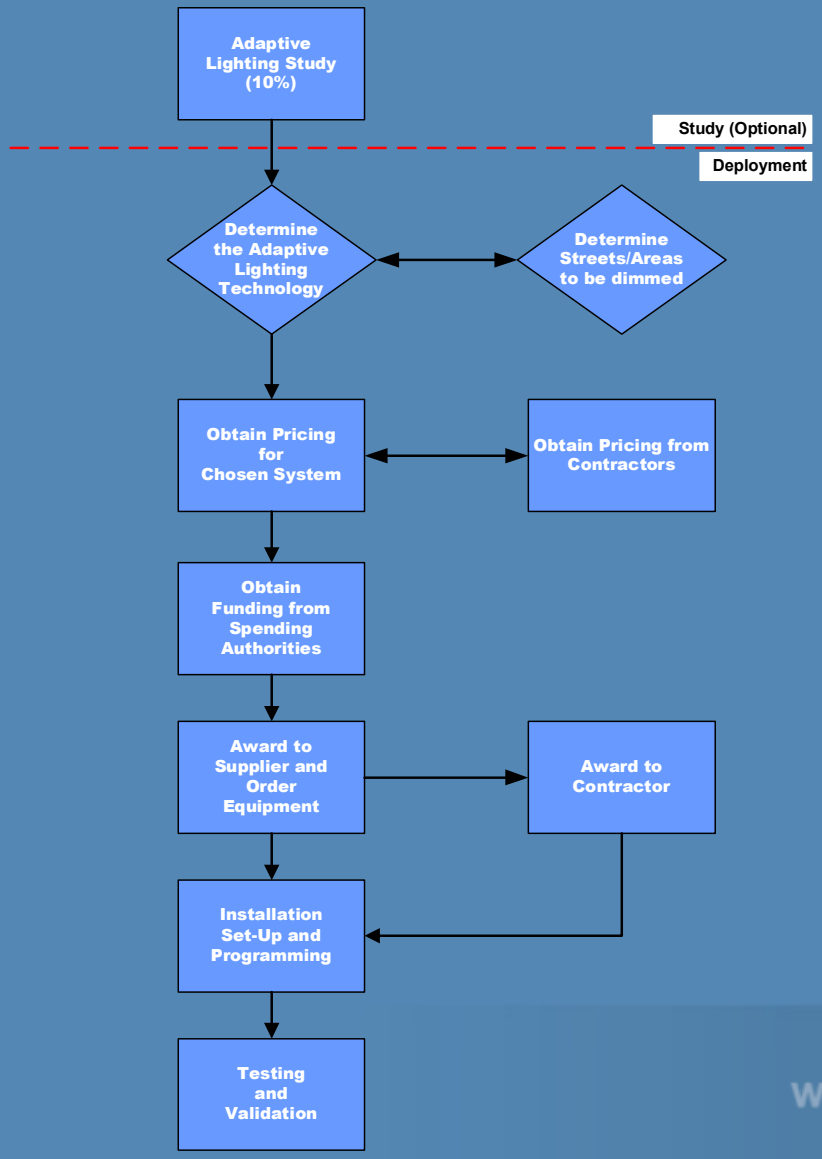
Rationale - Potential Benefits

- Reduced Energy Consumption
- Reduced Operating Costs
- Light Pollution Reduction
- *Power Consumption Monitoring*
- *Streamlined Asset Management*
- *Alerts of wire theft*

Rationale – Potential Energy Savings

Application		Advantages
1	Reduce Lumen Output of Lamps to Maintained Levels	• Energy Savings (5-10%) • Reduce Environmental Impacts
2	Reduce lighting on over lighted roads	• Energy Savings (5%-50%) • Reduce Environmental Impacts
3	Reduce levels to suit Pedestrian Activity / Conflict	• Energy Savings (20-40%) • Reduce Environmental Impacts

Deployment Process



Deployment – Feasibility Study

To determine the viability and benefits of adaptive lighting a feasibility study should be undertaken. Key items to consider are:

- Select typical roads (suggest a 10% sampling of local collector and arterial roads) in high, medium and low activity areas (ie; commercial, residential, industrial)
- Define typical pole spacing, mounting heights, wattages, voltages, road widths, wattages, fixture types and photometrics, etc and undertake computer calculations.
- Define dimming schedule (when to go from high to medium to low activity levels) – Consultant required with City planners, transit authority, review of commercial business hours, site review, etc.
- Request City GIS asset management data base, if such is available.
- Determine power savings, costs and payback
- Review rate options with local electrical utility (power supplier)

Deployment – Determine Technology

There are several types of adaptive street lighting technologies available on the market today. The two main types are ***fixed dimming systems*** and ***adjustable dimming systems***.

Adjustable dimming is where the levels can be changed remotely via a computer terminal.

Fixed dimming is set to one level at the factory and must be removed and replaced if the levels need to be reset.

Deployment – Determine Technology

Features to considering when selecting an adaptive lighting system:

1. Fixed versus adjustable?
2. Will the system calculate energy usage?
3. Is there control wiring?
4. What are the installation costs?
5. What sort of monthly or annual costs are involved to manage the system?
6. Will the system aid in managing the asset (maintenance)?
7. Payback versus energy savings?

Deployment – Determine Technology

Three systems worth consideration include:

1. Street Light Intelligence in Victoria, BC - Produces an adjustable dimming product called “Lumen IQ”.
2. MJB Technologies in Ontario, Canada - Produces a fixed dimming product called the “Night-Saver”.
3. Echelon Corporation in San Jose, California - Echelon produces an adjustable dimming product called “LonWorks”.

Deployment – Determine Streets

Determine Streets – What work best for the City. Higher wattage luminaires typically have better payback than lower wattage. Post tops can be a problem.

Approach - Three choices:

- Area
- Per Street
- Optimized per light

Lighting calculations will be required however the amount required will depend on the approach.

Deployment – Determine Streets

Listed below are scenarios where reducing lighting levels in off peak periods is not recommended:

- *Signalized Intersections*
- *Mid-Block Crosswalks*
- *Roundabouts*
- *Rail Crossings*

Deployment - Publicity

The publicizing of and adaptive lighting program is a City decision.

A well developed and thought-out media campaign defining benefits such as reductions in GHG and overall cost savings may help dismiss any issues and show a City as being environmentally responsible.

Benefits – Energy Savings

Results from about 15 recent feasibilities studies in various Cities

Road Classification	Average Dimming Ranges
Local	30%
Collector	25%
Arterial	20%

Issues – Cost Benefit

Cost to retrofit can be high with 10 + year payback

Better for new installations or with LED's

Issues – Utility Provider

Most street lighting is paid by flat rate and is not metered

A special flat rate will have to be developed. BC Hydro has developed such a rate to suit adaptive lighting.

Utilities (power providers) must adjust rate schedule in order to realize cost savings.

Issues – Liability

Risk can be mitigated by applying sound engineering judgment.

Are you following a published practice? – CIE, TAC, IMSA and IES documents are support adaptive lighting.

What are the risks?

Why an Engineered Approach?

If properly thought out and engineered an adaptive will reduce energy and operational costs while posing minimal risk.

Dimming or turning off lighting with no engineering may pose a high risk.