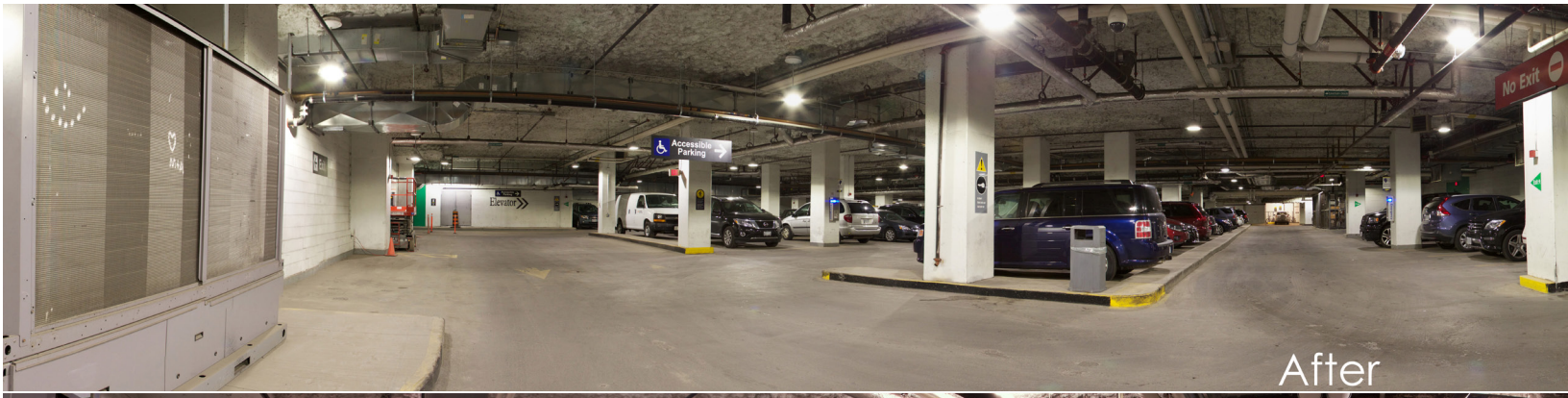
The Canadian Coalition for Green Health Care
Coalition canadienne pour un système de santé écologique

**Green Best Practice Case Study #8**

# Lighting the Way...
## *One Parkade at a Time*

Upgraded lighting in University Health Network's Peter Munk Building parkade is saving the hospital energy, time, money... and has improved the patient experience. The parkade is now illuminated with LED lamps resulting in greatly increased visibility and safety for users, lower operating costs and reduced energy consumption.



After

Before

*The Canadian Coalition for Green Health Care is Canada's premier integrated green health care resource network; a national voice and catalyst for environmental change.*

**www.greenhealthcare.ca**

## PROJECT HIGHLIGHTS

University Health Network (UHN), one of Canada's largest teaching hospitals, is made up of Princess Margaret Cancer Centre, Toronto General Hospital, Toronto Rehabilitation Institute and Toronto Western Hospital. With the aide of their team of energy managers, UHN has been making tremendous strides forward in reducing energy consumption at all four sites. One of the recent projects at Toronto General focused on the replacement of energy-intensive metal halide lamps with new efficient LED technology in the parkade.

| | |
|---|---|
| Space Type: | Indoor Parkade |
| Total Area: | 3500 $m^2$ |
| Parking Stalls: | 74 |
| Light Fixture Count: | 68 |

The new lighting system uses LED fixtures while the original lights were metal halide (MH) technology that suffered from a number of undesirable characteristics:

1. Energy intensive
2. Frequent failures and rapid lumen degradation
3. Poor light quality and distribution

The replacement LEDs have proven to be superior in every way. Read on to learn more. The table (right) provides the project data and highlights. Light quality improvement shown in the photographs throughout this case study is confirmed here by the lux measurements.

Energy use and overall costs were reduced by ~50% and note the parkade now exceeds ASHRAE 90.1-2010. Based on the space-by-space method for calculating lighting power density, the ASHRAE target is 2.0W/m2 or below. Looking to the graph below provides the life-cycle cost breakdown. Note that the initial cost includes installation done by TGH electricians. LED maintenance should be virtually nothing, just some time for cleaning and potential unexpected failures for warranty replacement.

| | Existing: Metal Halides | New: LEDs |
|---|---|---|
| Demand | 10.6 kW | 4.6 kW |
| Consumption | 93,000 kWh | 40,700 kWh |
| Light Power Density | 3 $W/m^2$ | 1.3$W/m^2$ |
| Average Lux - Lane | 67 | 127 |
| - Stall | 49 | 92 |
| Lamp Life* | 1 year | 11+ years |
| Total Lifecycle Cost *(10 year baseline)* | $166,178 | $86,980 |
| Energy Savings | - | 56% |
| Lifecycle Savings | - | 48% |
| Overall Payback | - | 2.7 years |

*MH lamp life is based on actual results in the TGH indoor parkade. MH lamps are typically rated ~12,000 to 20,000 hours.

## Reduced Energy!

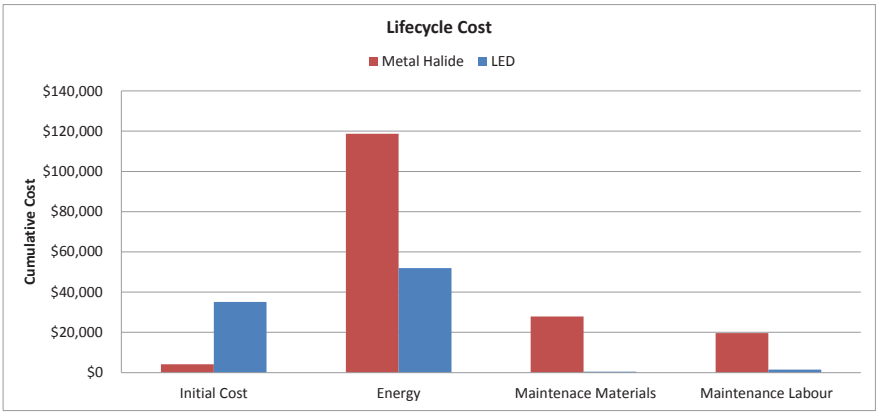
As you may know, electricity is measured in "*watts"* and light output in "*lumens"*. We use the term *"efficacy"* to measure the ability of a lamp to produce light efficiently; the units are therefore *lumens per watt.*

Both light-emitting diode lamps (LED) and metal halides (MH) have similar efficacies when new, so naturally you may ask why there are energy savings associated with LEDs since both take the same amount of energy to produce the same amount of light. But there are energy savings and here's why:

- LEDs use the light they produce much more effectively. It's directional, so the illumination is put where you need it (on the ground). It doesn't radiate out in all directions, and bounce around in a fixture until the reflectors direct it where you really want it; downward. There are significant illumination losses in all that bouncing.
- LEDs maintain the amount of light output much better than MHs. At 5,000 hours, MHs will have lost ~40% of their lumen output. In a garage that requires lighting 24/7, that means the lamps have degraded to almost half in only six months. The LEDs, by comparison, lose only 20% after 100,000 hours. In a 24/7 garage application, that translates to eleven years.

Replacing the old 180 and 125 watt MH fixtures with 79 and 53 watt LEDs resulted in not only energy savings of 56% but greatly increased light quality as seen in the images throughout this case study.

***Energy use and overall costs were reduced by ~50% and the parkade now exceeds ASHRAE 90.1-2010.***

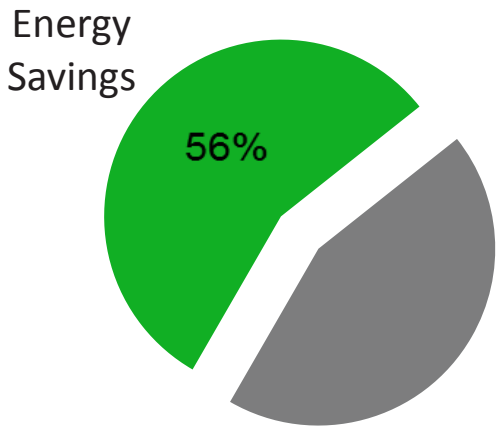


## Freeing up resources

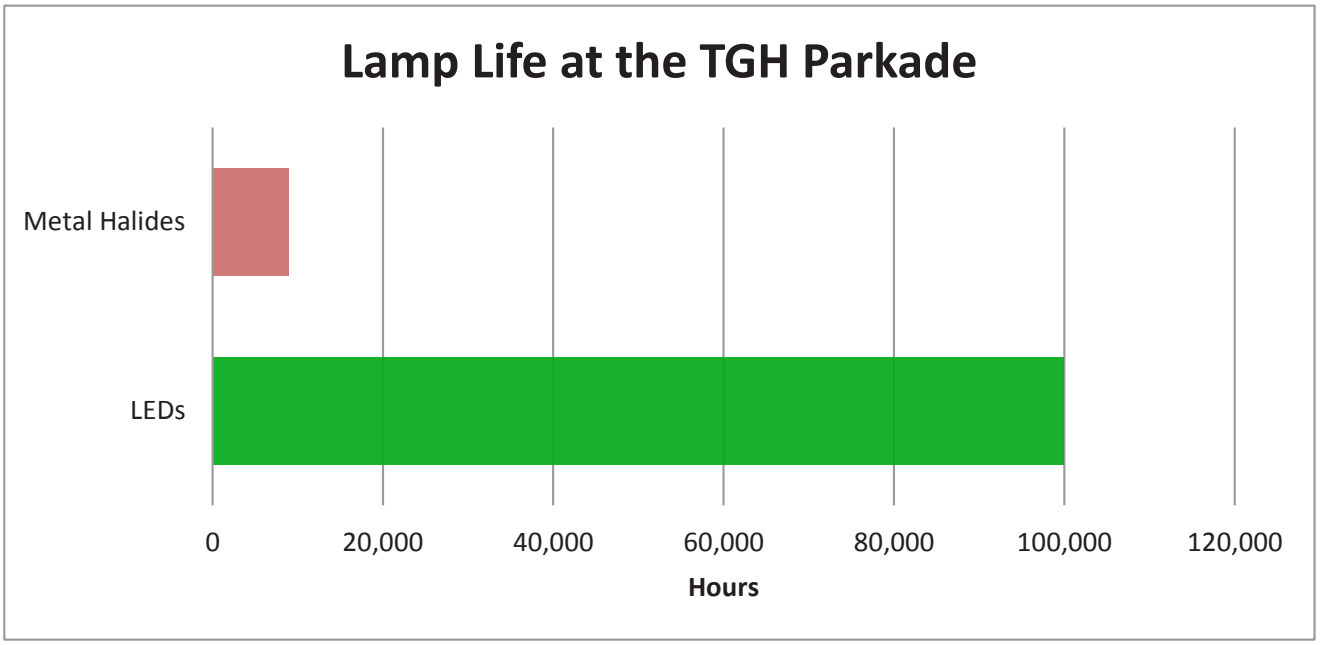
Previously, the MH lamps would last up to one year before needing to be replaced with some lasting only a few months. This meant UHN staff had to constantly monitor which ones had burnt out and be ready to replace them. Replacement, however, was not a straightforward task; timing it so there wasn't a car below the fixture, getting a lift jack in place, wrestling off the heavy class covering, and swapping out the failed bulb, whenever one of the 68 fixtures failed.

Less frequently they'd also have to replace the ballasts. With so many other items to attend do on a day-to-day basis, having to spend all this time on garage lighting was an unwelcome time sink. There was also the cost of bulbs to be factored in at $35 each and the cost of ballasts at $60.

The new LEDs come with a ten year warranty and a L80 life of 100,000 hours. That means they should still be shining brightly eleven years from now, with virtually zero maintenance cost. It's quite a difference.




*Switching to LED lamps also means 56% less heat is going into the already hot parkade.*




*LED lifespan is rated by L80, which means the output will have dropped only 20% after 100,000 hours. The metal halides are rated based on 'mean failure', which means that half will have failed by the rated life. For metal halides, rated life is typically ~12,000 to 20,000 hours. In the UHN parkade case, the metal halides lasted only ~9,000 hours on average.*

### *How it works*

*Metal halide technology was developed in the late 1950s; it introduces an arc of electricity through a contained gas/metal salt mixture, creating a superheated plasma. The plasma produces a lot of infrared, ultraviolet, and conducted heat, while emitting some visible light. LEDs produce light using a different method entirely; there is no burning, no ignition, no plasma. The light emitting diodes are made of semiconductor materials, which emit light through the process of electroluminescence. Significant heat is still generated, but not through the light itself.*

*SOURCE: americanhistory.si.edu/lighting/20thcent/invent20.htm*

## Better Light!

This is perhaps the most important benefit of the new LED lights. When people first arrive at the hospital, staff want it to be a comfortable and safe experience. In the parking garage, this is assisted through proper lighting which the previous MH lighting failed to provide. Too many parking stalls were dark, lighting was uneven as lamps burnt out, poor light distribution resulted in bright spots under the lamps which quickly fell off to dark patches, displays and signs were difficult to read, side entrances were always in the shadows, and there were real concerns raised about tripping hazards.

A bleak picture you say? A bit sensationalized maybe? But this was the reality for some visitors and patients to the hospital. Primarily people who have difficulty with their mobility or vision, and older patients who need more light as they age. As people age, their eyes need better light to navigate through spaces, therefore improving the light quality was a must.


Near Bike Storage: *In the 'After' photo, you can see how the walls are well illuminated with far fewer shadows.*


Laneway: *Similarly, in the laneway, lighting is more evenly distributed; shadows have been greatly reduced.*


*Near Building Entrance:* *Notice in the 'Before' photo that the old MH lamps don't all look the same colour. As the lights burn out, they transition along the colour spectrum towards yellow/red.*

During the preliminary stage of the project, staff had established that the parkade suffered from poor lighting and that it needed to be improved but exactly how would they define 'improvement?' To do that, they needed to know what good lighting really was, and then use that information to establish some goals and targets.

First, they looked at standards for covered and enclosed parking areas as articulated by IESNA (Illumination Engineering Society of North America), the Ontario Building Code, and the Toronto Municipal Code; all of which it was learned have similar minimum requirement of 50 lux for general parking areas (IESNA lists 54).

IESNA clarifies that recent practice suggests a target between 85 and 110 lux is more suitable for a well-designed facility. They further provide targets for specific areas such as ramps, corners, entrance areas, and stairs. From this information, UHN created the following specific workable targets:

- Parking stalls – 85 to 110 lux
  *(absolute minimum 50+ lux)*
- Driving lanes and pathways - 100+ lux

Next the team looked at how light was distributed through the space with a goal to improve lighting uniformity. The existing fixtures produced quite the patchwork of light, with relatively well lit areas clashing with dimly lit areas, both on the floor and on the ceiling. Numerous dark walls and corners made the parkade seem even darker than it was.

Light distribution was the problem; that and of course fixtures that kept burning out. Lighting fixtures need to work in conjunction with the space, since they rely on surfaces in the space to reflect the light around and back into our eyes. In the case of the Peter Munk Building, they were faced with predominantly grey concrete walls and a ceiling of fibrous grey fireproofing; the light didn't stand a chance. What they needed were light fixtures that provided light directly where it was needed, in a wide angle of distribution with minimal light bouncing off walls and ceilings.

After numerous sample tests, the Philips QLP G3 LED fixture they have installed now, proved to be the preferred solution, providing a wide distribution, and a visually-pleasing light throughout the entire space. Enough light even bounces back up, so that the ceiling isn't too dark.

Post-installation measurements verified that the targeted lux values were all met and exceeded, the floor was well lit, the walls and corners illuminated, and the entrances were bright and inviting. The LED upgrade greatly improved light quantity and quality, freed up maintenance resources, saved energy and helped further reduce UHN's ecological footprint.

With assistance from Toronto Hydro, UHN also applied for and received a financial retrofit incentive through the Ontario Power Authority's **save**ON**energy** program. They pursued the Custom Lighting Retrofit incentive which proved to be a very straightforward application process that resulted in a total incentive of $2,615, or $0.05/kWh.





*For consistency, all photos were captured at f 9.0, 1/8s, ISO 1250. White balance was selected for the fixture type. Based on the photos, which lights do you prefer?*

## Resources

Ontario Building Code (2012 Online): www.e-laws.gov.on.ca/html/source/regs/english/2012/elaws_src_regs_r12332_e.htm

Toronto Municipal Code Chapter 629, Property Standards (p35): www.toronto.ca/legdocs/municode/1184_629.pdf

IESNA Lighting Handbook: www.ies.org/handbook/

Canadian Parking Association – Technical Bulletin No.8 – Parking Lighting: http://assets-production-webvanta-com.s3-us-west-2.amazonaws.com/000000/38/19/original/files/Bulletin_8%20Parking%20Lighting.pdf

Lighting for the project provided by: http://soneparcanada.com/

Philips QLP Gen3 Fixture Information: www.legacy.widelite.com/products/qlp-gen-3

**Thank you** to Chad Berndt, P.Eng, CEM, LEED AP, Energy Project Manager at University Health Network for providing the photographs and content for this case study. For further information, contact chad.berndt@uhn.ca

*NOTE: Due diligence and sound financial analysis is required on your part in selecting a lighting solution to suit your organisational needs. Information contained in this paper is provided as a public service. The Canadian Coalition for Green Health Care in no way endorses any of the mentioned vendors or their products/services.*

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