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## Relighting Chris Burden's *Urban Light* using LEDs



Figure 1 *Urban Light* (Chris Burden, 2008)

February 2018 marked the 10<sup>th</sup> anniversary of the installation of Chris Burden's iconic outdoor sculpture, *Urban Light*, at the Los Angeles County Museum of Art (LACMA). To celebrate the occasion and to contribute to the museum's commitment to energy efficiency and sustainability, LACMA replaced the existing incandescent bulbs with light emitting diodes (LEDs).

This retrofit project was the culmination of many years of research and development by LACMA's conservation science staff to identify suitable replacements for all 309 incandescent bulbs that were part of the sculpture. In this paper the authors review the selection criteria and design of the new LED bulbs with an emphasis on the quality of the light output and on energy savings.

### Introduction

Chris Burden's *Urban Light* (M. 2007.147.1-202, Figure 1) is a large-scale assemblage sculpture installed in 2008 at the Wilshire Boulevard entrance to LACMA (Urban Light | LACMA Collections, n.d.). The installation consists of 202 antique street lights dating to the 1920s collected from Los Angeles and surrounding cities.

Burden first began collecting street lights in December 2000 without a specific work in mind and continued gathering them for the next seven years. The street lamps were restored in his studio where they were repainted a neutral gray, rewired and missing parts were recast as needed (Freudenheim, 2008). In describing his sculpture Burden

said "My artwork, *Urban Light*, is ultimately a statement about what constitutes a civilized and sophisticated city, safe after dark and beautiful to behold" (Hoffman, 2007).

Burden was actually not the first to use Los Angeles' historic street lamps as part of an outdoor sculpture. Fifteen years earlier Sheila Klein created *Veronica*<sup>1</sup> (Figure 2), an installation composed of twenty-five street lamps (Darling, 2017). *Urban Light* is comprised of a mix of lampposts (Table 1) with one, two, or three luminaires of varying dimensions and styles (Mandelkern, 2018). The posts are positioned close together in long colonnades arranged in a grid on a

Figure 2 *Veronica* (Sheila Stein, 1993)



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raised concrete platform measuring 60 ft x 61.8 ft. The grid is composed of 12 rows of street lights with 16 to 18 posts in each row. The 202 lampposts support 309 incandescent street lamps with three different luminous outputs.

The overall effect of the street lights with their assorted frosted globes is an omnidirectional, diffuse, warm glow. The artist acknowledged the need for maintenance, permitting the changing of light bulbs when they burned

out. He also insisted the sculpture must be displayed with all luminaires working, and requested that it be turned on daily, 365 days a year, from dusk to dawn.

Three types of GE incandescent street lamp bulbs<sup>2</sup> lighted the sculpture initially (Table 2). However, soon after the 2008 installation of *Urban Light*, production of the highest-wattage (327W) bulbs was discontinued as California began its phaseout of high energy-consuming incandescent light

**Table 1** *Urban Light* lamppost design and layout (Burden, 2007 and Mandelkern, 2018)

Lamp Type	Style	Total	Height	Weight (lbs)	Base Width (in)
Doubles and Triples					
1	Broadway Rose Double with Globes	6	26 ft 8.5 in	8000	24
2	Large Downtown Double with Globes	9	26 ft 5 in	1275	26
3	Medium Downtown Double with Globes	5	22 ft	1250	26
4	Magnolia Double with Globes	16	20 ft 5.5 in	3000	24
5	Metropolitan Double with Lanterns	12	20 ft 2 in	700	24
6	Pacific Twin with Lanterns	6	20 ft 2 in	700	24
7	Portland Double with Lanterns	9	19 ft 8 in	700	24
8	Pacific Twin with Globes	26	19 ft 7 in	700	24
9	Glendale Double with Globes	6	19 ft 3 in	1225	24
10	Hobart/Llewellen Triple with Ball Globes	6	14 ft 2 in	1500	19
Singles					
11	Pacific Single with 2-Piece Globe	7	17 ft 6 in	550	24
12	Portland Single with Lantern	6	16 ft 1 in	550	24
13	Anaheim Single with 2-Piece Globe	6	15 ft 4 in	650	21
14	Large Flemish King Single with Globe	9	15 ft 3 in	550	18
15	Metropolitan Single with Lantern	8	14 ft 4 in	700	18
16	Medium Flemish King Single with Globe	22	13 ft 11 in	500	18
17	Lynwood Single with Globe	17	12 ft 10 in	400	18
18	Capitol 10 Single with Globe	6	12 ft 8 in	425	18.5
19	Small Flemish King Single with Globe	10	12 ft 1 in	400	18
20	Bellefontaine Single with Ball Globe	10	10 ft 10.5 in	625	16

**Table 2** Comparison of energy use by incandescent and LED bulbs

	Model	Wattage	Quantity	Annual usage (kWh)
Incandescent (GE)	GE42392 (1000 lumens)	105	78	35,872
	GE42663 (2500 lumens)	205	34	30,529
	GE21307 (4000 lumens)	327	197	282,155
<b>Total kWh:</b>				<b>348,556</b>
LED (Truly Green Solutions)	Universal Light 360	15	78	5,125
	Custom CCT – 80% frosted			
	Universal Light 360	19	34	2,829
	Custom CCT – 80% frosted			
	Universal Light 360	27	197	23,297
<b>Total kWh:</b>				<b>31,251</b>

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bulbs. Although additional bulbs were stockpiled at the time of installation to keep the sculpture operational, it was obvious that an alternative means of lighting the sculpture was needed.

Over time the incandescent bulbs changed color and dimmed, which significantly impacted the visual appearance of the sculpture as a whole. To make matters worse, many of the luminaires leaked and during periods of heavy rainfall some bulbs would fail when moisture got into the globes. In some cases, the bulb blew out and subsequently filled with rainwater (Figure 3).

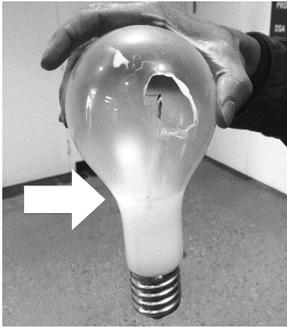


Figure 3 Damaged incandescent bulb partially filled with rainwater

Also, heat trapped inside the globes began to degrade the insulation on the electrical wiring, leading to voltage fluctuations and short circuits, which also blew out bulbs. The lamps were burning out at an alarming rate.

Replacing the burnt out incandescent bulbs was not only time-consuming and costly but also hazardous. Maneuvering a scissor lift<sup>3</sup> between the closely spaced posts - with less than an inch to

spare in some locations - placed both the sculpture and the electrician in jeopardy.

### Finding alternative lamps

By 2010 research began in earnest to identify replacements for the incandescent bulbs. The search for alternative means of lighting the sculpture was guided by the following selection criteria (Eng, et al., 2016):

The light sources must be energy efficient and meet the new California energy requirements;

They must be designated for use in enclosed outdoor luminaires;

They must be available in bulk and compatible with the existing bulb sockets to avoid expensive retrofitting;

The effective luminous output of the light sources should be as close to the incandescent lamps as feasible;

The emitting elements must have approximately the same height as the filaments in the incandescent bulbs;

The light sources should emit omnidirectionally with a "warm glow";

The light sources must have the same low color temperature as the original incandescent bulbs selected by the artist;

They must meet with the artist studio's approval.

Three contemporary lighting technologies that would satisfy California's evolving energy requirements were investigated: Induction Lamps, Compact Fluorescent Lights (CFLs), and Light Emitting Diodes (LEDs).

Electrodeless induction lamps were initially considered because of their long service life and low lumen depreciation over time. A custom-fit Philips QL induction lamp (PowerLux® Corporation, n.d.) was given to the museum for testing *in situ*, and it operated without failure for several years. However, the light it cast was noticeably greener than the incandescent bulbs in the installation. Also, to retrofit *Urban Light*, each socket would require its own induction circuit inside the globes on the lampposts. These modifications would have been prohibitively expensive. Also, the induction lamps contain mercury which would eventually present a significant disposal cost. For these reasons, they were not given further consideration.

Some CFLs were tested as replacements for incandescent bulbs in *Urban Light*. Unfortunately, the spiral tube structures within the bulbs were visible at street level. The color temperatures of the bulbs were significantly colder and did not provide the warm glow of the original incandescent lights, and CFLs also contain mercury. Given these shortcomings CFLs were also not considered a viable option.

Beginning in 2014, many different commercially available LEDs were evaluated; none of which proved satisfactory. At that time few manufacturers made LEDs with the shape, high luminous outputs, and low color temperature required for *Urban Light*. Because the installation required three different luminous outputs, possible replacements would have to come from different commercial sources.

Using LEDs from different manufacturers is problematic because even slight variations in the fabrication processes for the light-emitting components of LEDs meant the criterion for uniform appearance of the lighted sculpture would not be met. In addition, the large, finned heat sinks in these earlier LED bulbs interfered with the omnidirectionality of the light output.

LED lamps with high luminous outputs that are also suitable for use in enclosed outdoor luminaires have only recently become available. Beginning in 2016 we collaborated closely with a local company. Truly Green Solutions, which specializes in commercial and industrial lighting, was able to provide custom designed LEDs that possessed the desired specifications for *Urban Light*. The specifications for the new, custom designed LED lamps are given in Table 2.

The LEDs provided by the company successfully imitated the omnidirectionality of incandescent lights by incorporating a corn-cob design in which individual light emitting diodes are arranged in columns placed around a vertical cylinder (Figure 4).



Figure 4 LED bulbs provided by Truly Green Solutions

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To obscure the individual vertical bright dots or striation patterns produced by the diodes, custom-designed milky covers were placed over the LED columns to diffuse the light. Samples were tested in the laboratory inside globes from the lampposts. They were assessed visually, both in the laboratory and in selected locations in the sculpture. In almost all cases the individual LED diodes were not visible through the globes despite the variability in the transparency of the latter. The appearance of a 27W LED inside its globe is compared with a 327W incandescent bulb in Figure 5.

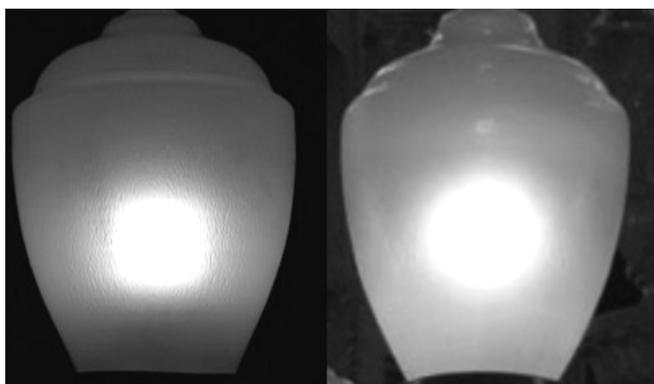


Figure 5 Glow and directionality of 27W LED (left) compared to 327W incandescent bulb (right)

### Changeover to LED bulbs in *Urban Light*

After the years of research and development, all the incandescent bulbs were replaced with the energy efficient LEDs from Truly Green Solutions. The retrofit project, generously

Figure 6 Electricians maneuvering scissor lift through sculpture



supported by the Leonardo DiCaprio Foundation (Eng, 2018), also provided an opportunity to inspect the globes for condition issues and to improve the wiring inside the luminaires.

Given the nature of the work required, an outside electrical contractor was hired to undertake the bulb replacement and electrical upgrades (Figure 6).

The tasks were performed in stages over a period of a week so that the sculpture could remain fully illuminated at night.

Maneuvering a scissor lift in between the closely spaced rows of lamp posts proved to be very tedious and time-consuming, requiring much patience and great skill to avoid damaging the sculpture. A boom lift had to be used to access some of posts in the center; this equipment provided barely enough room to position the operator's basket in the midst of the lamp posts.

Most of the globes were in good condition and required only a thorough cleaning, although some had to be replaced due

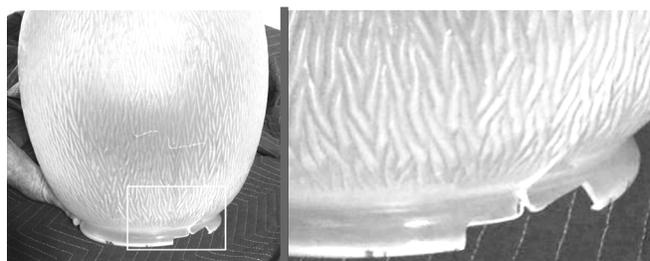
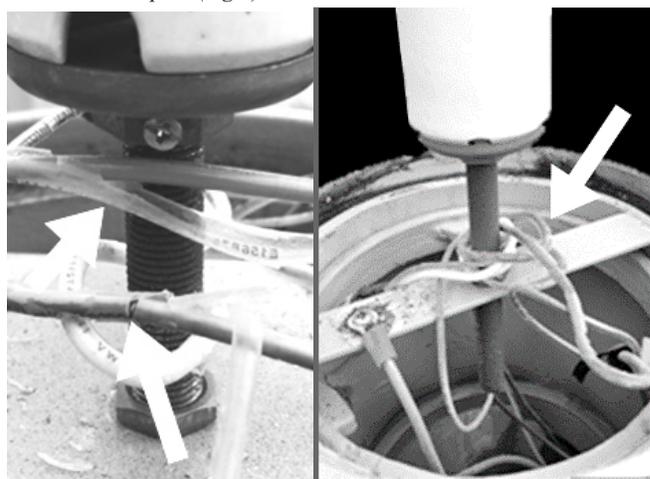


Figure 7 Cracked globe

to cracks that formed at the base (Figure 7). The acorn and round globes had been secured with set screws, some of which may have been over-tightened. Crack propagation and breakage of the globes are exacerbated by windy conditions which can occur, for example, during Santa Ana winds. To mitigate damage, all globes are now fitted with neoprene gaskets around their base, which will also keep dust and dirt from collecting inside the luminaires.

Inside some of the globes, it was found that the plastic insulation on the electrical wires was badly degraded (Figure 8, left) and needed replacement. Also, some of the wiring had been wrapped around the metal socket support, a situation which could result in a short circuit (Figure 8, right). The damaged wires were replaced, and all wiring was appropriately rerouted inside the globes.

Figure 8 Degraded insulation (left) and electrical wiring wrapped around socket post (right)



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Upon completion of the changeover to the custom LEDs, a significant improvement in the visual effect of *Urban Light* was noticeable. The iconic sculpture now has a more uniform light appearance and seems brighter and more welcoming than previously, while still providing a very warm glow. To date, no lamps have burned out despite several weeks of heavy rain.

### Energy savings

Calculations using data on energy expenditure provided by the company suggest that the total annual energy use will be approximately 91% less than it was prior to the retrofit (Table 2). These cost savings are significant for the Museum; at LACMA's current rate for electricity, it will only cost about \$13 to keep the sculpture lit for an entire night. The additional cost of staff time that was needed to replace broken bulbs has also been essentially eliminated.

As part of LACMA's 2008 *Transformation* project (BP Grand Entrance Press Release, 2008), solar panels were installed on the roof of the BP Grand Entrance adjacent to *Urban Light*. Although these panels were never intended to supply power directly to *Urban Light*, they do feed directly into the Museum's electrical grid.

At the time of installation, it was thought that the electricity produced by the panels could offset a significant portion of the energy required by *Urban Light*. Initial estimates had suggested that the energy saving offset would be about a quarter of the annual energy used by the sculpture.

This proved not to be the case, because the amount of electricity that the panels can generate fluctuates widely, depending upon the time of year, the sky conditions (cloudy vs. sunny), and how clean the panels are.

With the retrofitted bulbs, it will now take only about an hour of sun each day of the year to meet the annual electrical energy needs of the new LEDs.

### Summary

The research conducted by the LACMA Conservation Science staff highlighted the challenges in retrofitting traditional, incandescent light-based artworks such as Burden's *Urban Light* with new, energy efficient light sources.

As lighting technologies evolve, museums will need to keep pace and replace obsolete lamps in their lighted artworks with new light sources that have similar appearances to the original ones. Planning ahead, allowing adequate time to test sample bulbs with the appropriate equipment (e.g. spectral light meters), and establishing connections with a lighting manufacturer amenable to working with us were essential to the success of the LACMA retrofit project.

The research associated with replacement of lamp bulbs will need to be undertaken periodically in the future as technology inevitably advances and today's newest lamps become obsolete. The knowledge gained from this initial retrofit project has provided a very useful framework for undertaking future relampings of Burden's *Urban Light*.

### Acknowledgments

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### Notes

1. In 1993 local artist Sheila Klein installed *Vermonica* in a parking lot at the corner of Vermont Avenue and Santa Monica Boulevards; it has recently been removed and relocated across the street at the offices of Los Angeles Department of Public Works resulting in Klein stating the piece "is no longer *Vermonica*." Retrieved from [sheilaklein.com/etc/vermonica.html](http://sheilaklein.com/etc/vermonica.html) last accessed April 7, 2018.
2. 105W bulb: [consumer.gelighting.com/catalog/p/42392](http://consumer.gelighting.com/catalog/p/42392);  
250W bulb: [consumer.gelighting.com/catalog/p/42663](http://consumer.gelighting.com/catalog/p/42663);  
327W bulb: [consumer.gelighting.com/catalog/p/21307](http://consumer.gelighting.com/catalog/p/21307)  
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