

# **ANN ARBOR'S LED STREETLIGHT PROGRAM**

## **SUMMARY**

The City of Ann Arbor is installing LED streetlights in order to reduce lighting costs and greenhouse gas emissions. After successfully piloting an LED replacement for our downtown "globe" lights, the City received a \$630,000 grant from the Ann Arbor Downtown Development Authority to fund retrofits for over 1,000 downtown lights. This initial installation will save the City over \$100,000 per year, reducing annual greenhouse gas emissions by 267 tonnes CO<sub>2e</sub>. In addition, testing will continue on LED replacements for neighborhood streetlights, with the eventual goal of replacing all of our public lighting with LEDs. Full implementation of LEDs would cut Ann Arbor's public lighting energy use in half and reduce greenhouse gas emissions by 2,200 tonnes CO<sub>2e</sub> annually.

## **PROJECT HISTORY**

Funding for public lighting is increasingly difficult as electric costs rise and available municipal funds get tighter. In its 2005-2006 budget, the City of Ann Arbor established a moratorium on new street lighting to help keep costs under control. City staff were tasked with finding ways to reduce public lighting costs. Like other cities, Ann Arbor had already replaced all its incandescent traffic signals with LEDs (light-emitting diodes). As with the traffic signals, LED streetlights, if the technology was sufficiently developed, could create significant energy and maintenance savings since LEDs reduce lighting energy requirements by one-half or more and last five times longer than conventional outdoor lighting technologies. In 2005, Ann Arbor committed to investigate LEDs for outdoor public lighting purposes as part of the ICLEI Great Lakes Climate Policy Project.

Initial research into past efforts with LED outdoor lighting in other municipalities like Honolulu and San Diego revealed failed efforts. These tests found that LED products had high costs and poor light output. To assess the current LED technologies, the city invited numerous LED manufacturers to provide test lights, which the City then installed at its own expense to evaluate the performance. Early lighting tests in 2006 were performed in the City Hall parking lot and showed improvement over the older LED technologies. Over the next two years, more successful technologies were demonstrated on city streets in the downtown area and in neighborhoods. Over the last two years of testing, city staff has seen a tremendous improvement in light output and color rendition from LED lighting manufacturers. While lighting distribution and uniformity remain a problem for the highly directional LEDs, we have found applications where the LED technology is ready to replace existing public lighting today.

Tests on LED replacements for our downtown pedestrian "globe" lights have been very successful. This retrofit globe from Lumecon houses LEDs on four panels that face down and out, directing the light toward the street and away from the sky. Each fixture draws 56 watts and is expected to last ten years, replacing fixtures that use 120 watts and only last two years. These globe lights are mounted on ten-foot poles. As a test, 25 of these LED globes, purchased

with help from our Downtown Development Authority (DDA), were installed to light one complete block in the Ann Arbor downtown.

With five times the lifetime and less than half the energy use, the lights have a 4.4 year payback. We are now planning to retrofit all of these downtown lights over the next two years. Funding for the downtown light conversions is being provided by a \$630,000 grant from the DDA. The downtown LED project will reduce annual greenhouse gas emissions by 267 tonnes CO<sub>2</sub>e and save the city over \$100,000 annually. The DDA grant will be administered through the Ann Arbor Municipal Energy Fund, which ensures that a portion of the savings from the retrofits is paid back to the fund to pay for future retrofits.

Meanwhile, Ann Arbor will continue to test possible LED replacements for the remainder of our streetlights. If the project succeeds in retrofitting all of the streetlights in Ann Arbor, the annual greenhouse gas emissions reduction is expected to be around 2,200 tonnes CO<sub>2</sub>e annually. All of the test installations have signs requesting public input, and the response from the community has been overwhelmingly positive. There seems to be agreement that Ann Arbor's LED streetlight future will indeed be bright.

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## **MORE INFORMATION: BENEFITS OF LEDS**

The primary benefits of LEDs are their reduced energy consumption, longer lifetime, directionality and controllability. The energy savings are 50% or more and the lifetime is estimated at 5 times longer which yields the excellent payback time of 4.4 years. The "instant-on" and dimming ability of LEDs will offer additional energy savings through control strategies that can brighten and dim based on time of day, ambient light, or any other control parameters desired. Motion sensors can turn LEDs on or off instantly, allowing lighting to be used only when needed. Typical outdoor lighting (MH or HPS) has a re-strike time of a few minutes before they can turn on and therefore cannot be used with motion sensors. The City of Ann Arbor is partnering with lighting control companies to explore these new possibilities with LED lights. Finally, because LEDs emit directional light, we have more control over what we light (streets and sidewalks) and what we don't (the night sky). This makes for easier compliance with the Dark Skies Initiative, which aims to reduce light pollution and its associated wildlife impacts.

Our test globe LED fixtures use half the energy of the bulbs they replace and cobrahead fixtures use 50 to 80 percent less energy than our current cobraheads. This reduces emissions of mercury from coal power plants which leads directly to reduced CO<sub>2</sub> emissions. Full implementation of LED streetlights could cut Ann Arbor's greenhouse gas emissions by over 2,200 tonnes CO<sub>2</sub>-equivalent emissions.

One of the greatest advantages of LED fixtures is their lifetime, which reduces maintenance costs. At a ten-year lifetime (compared to two years for a metal halide bulb), city staff will need

to change far fewer bulbs, ballasts, and igniters. In fact, maintenance savings alone are sufficient to make LED fixtures cheaper on a lifecycle basis than conventional fixtures.

## MORE INFORMATION: LIFE-CYCLE COST ANALYSIS

### Continue with existing bulbs (2 year life)

	<u>Number</u>	<u>Cost</u>	
Bulb replacements	5	\$37	\$186
Bulb labor & equip	5	\$211	\$1,056
Ballast (10 yr life)	1	\$59	\$59
Igniter (10 yr life)	1	\$35	\$35
Energy cost (4,380 kWh)			\$325
			<b>\$1,661</b>

### Change to LED bulb (10 year life)

	<u>Number</u>	<u>Cost</u>	
Bulb replacements	1	\$460	\$460
Bulb labor & equip	1	\$56	\$56
Energy cost (2,100 kWh)			\$182
			<b>\$698</b>

<b>10-year Maintenance saving</b>	<b>\$819</b>
<b>10-year Energy saving</b>	<b>\$143</b>
<b>Total</b>	<b>\$962</b>

Each LED replacement bulb saves \$962 in energy and maintenance costs over its ten-year lifetime. At this savings rate, the new bulb pays for itself in 4.4 years (\$423 / \$96). This analysis is based on our downtown globe lights, but initial inquiries into cobrahead fixtures suggest that the results will be even better.

## MORE INFORMATION: TEST INSTALLATIONS

The first test fixtures that the City received and installed in our City Hall parking lot in the summer of 2005 were unimpressive. We got the sense that LED lighting manufacturers were not quite ready to meet our public lighting needs. Over the following year, however, the test fixtures we received from manufacturers increased markedly in quality and today Ann Arbor is seriously considering moving to LEDs for public lighting.



The second test installation consists of a series of overhead streetlights (called "cobraheads" because of their shape) in a residential neighborhood. These fixtures have not been purchased yet as the block of downtown globes have,



*Holophane cobrahead*

but are instead on loan from the manufacturers. Wattages vary from 50 to 80 watts for fixtures that replace 250-watt fixtures. Manufacturers of cobrahead replacements currently installed for testing include **Holophane, IntenCity, Leotek, Lumecon, and Millenia Technologies.**



*Lumecon globes*

To evaluate these fixtures, Ann Arbor is employing a four-part test process, with lights being assessed on light output, heat management (which affects lifetime), and general public input.

**Light Output:** The cobrahead replacements are installed on a residential street where the spacing allows for each fixture's light output to be judged independent of adjacent fixtures but where different fixtures can be easily compared. City staff is measuring light output and plans are in the works for a more involved public input process to evaluate the fixtures' aesthetics.

**Heat Management:** One of the most attractive characteristics of LEDs is their long lifetime, but this lifetime depends directly on the fixture's operating temperature. As a result, heat management testing is vital to identifying fixtures that achieve our goal of a ten-year life. City staff is measuring the operating temperature of fixtures to project the useful life of different test fixtures.

**Energy Consumption:** Each light is tested for electricity use in watts to verify energy savings.

**Public Input:** All the test installations have signs requesting public input, and the response from the community has been overwhelmingly positive (81 of 83 responses). The 81 positive responses emphasized the lack of light spilling out onto yards and house faces ("light trespass"). One negative response commented that the light was too harsh. The other negative comment reflects a minority opinion about the purpose of public lighting, objecting that the LED cobrahead no longer lit up their garage and yard and that the globe LEDs were creating a "dark cavern" through the downtown.



*Test light public input sign*

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