Green Light

Sustainable Street Lighting for NYC

NEW YORK CITY DOT

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As our city grows, and as clean air and safe streets become more important to residents and businesses, pioneering innovative transportation policies will be more critical than ever. Investments in LED stoplights and retrofits to City-owned buildings have already saved the City money and reduced the City's energy consumption. The opportunity exists to go much further.

- Mayor Michael R. Bloomberg

New York has always shaped the future by introducing and popularizing the next big thing. Today we play that role with the technology of sustainability. The scale of New York is great enough to build a strong market for innovations such as LED street lighting, which will speed its adoption around the world.

- Commissioner Janette Sadik-Khan

Michael R. Bloomberg
Mayor

Janette Sadik-Khan
Commissioner

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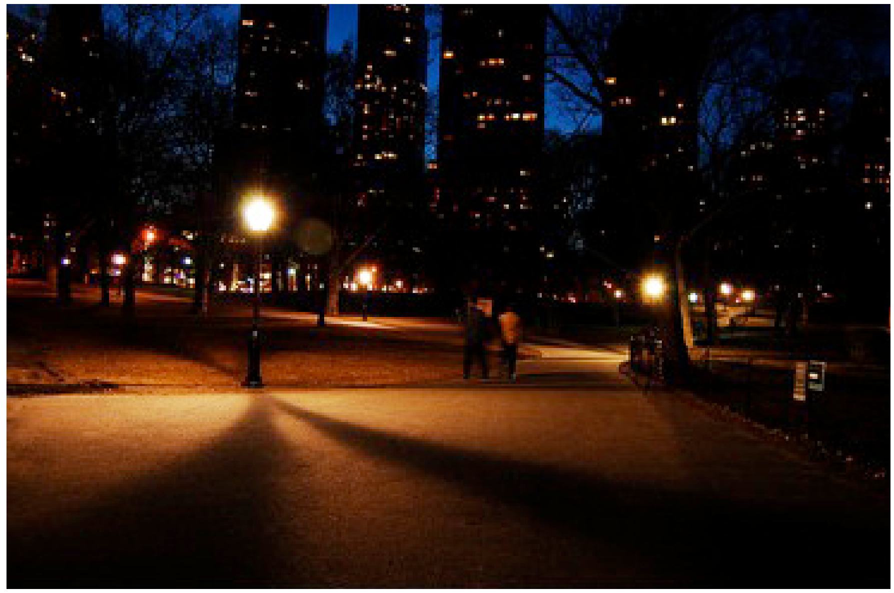
EXECUTIVE SUMMARY



Well lit streets are vital to pedestrian and vehicle safety

Well lit streets are vital to pedestrian and vehicle safety. Street lighting also facilitates evening use of parks, plazas and other areas for outdoor activities. For both environmental and economic reasons many municipalities are investigating ways to improve lighting efficiency for the public realm. The following report documents current and proposed street light projects that the New York City Department of Transportation (NYCDOT) has initiated to realize energy and cost savings while reducing the City's carbon footprint.

For the last half-century, New York City was illuminated by both high pressure sodium (HPS) and metal halide fixtures that by today's standards are very inefficient. In 1999, NYCDOT began installing an updated HPS luminaire that operated at a lower wattage than the older models, resulting in significant energy savings.

To reduce energy use even further, NYCDOT has been exploring Light Emitting Diode (LED) and other new street lighting technology. Ten years ago LED technology was not capable of providing sufficient illumination for streets and sidewalks. The only practical application for LED lighting that was both energy-efficient and economical was for use in signals and warning markers.

NYCDOT conducted a successful pilot program during the 1990s to test the use of LED's in traffic signals. In May 2001 conversion of all incandescent traffic signals to LED began, making New York City the first large city in the United States to do so. As of August 2009, nearly all traffic

NYCDOT is partnering with the US Department of Energy and The Climate Group to make energy efficiency improvements and test new technologies that will further reduce the City's greenhouse gas emissions

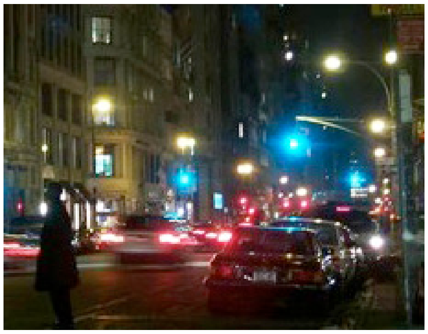
signals throughout the five boroughs have been converted to LED, producing an annual energy savings of 81%. Now, for the first time, LED street lighting is available to potentially replace existing HPS luminaires providing comparable illumination at a far more affordable cost. In 2009, NYCDOT will be testing LED lighting on both streets and sidewalks in locations in Central Park and along the FDR Drive.

NYCDOT is partnering with the US Department of Energy (DOE) and the Climate Group (TCG) to develop an LED pilot program for new technologies that will further reduce the City's greenhouse gas emissions and improve energy efficiency. DOT is participating in the DOE Gateway Program, which promotes the early adoption of commercial LED technology and helps cities to test and evaluate LED luminaires. It provides independent third party evaluations of LED products installed in real-world applications. Data collected from New York City's LED installations will quantify the performance of LED's and assist other cities interested in the conversion to LED fixtures.

On the international level, New York City is a founding member of the Light Savers program organized by The Climate Group (TCG), a non-profit organization dedicated to addressing climate change. Through the Light Savers program, TCG is coordinating the testing and implementation of LED lighting in New York City and several other international cities to further demonstrate the commercial viability of the technology to reduce energy consumption and greenhouse gas emissions. Other cities that will be participating in TCG's LED lighting initiative include Toronto, London, Mumbai, Calcutta, Bangalore, Hong Kong, Beijing, and Shanghai.

With the installation of these and future energy-efficient lighting solutions, the New York City Department of Transportation is poised to become an international leader in green lighting.

STREET LIGHTING IN NYC TODAY



The New York City Department of Transportation (NYCDOT) operates the largest municipal street lighting system in the country. The agency maintains approximately 300,000 lights throughout the City, including lighting for streets (262,000, including bridges and underpasses), parks (12,000) and highways (26,000) and installs new street lights and decorative fixtures. Appropriate lighting can reduce the number of accidents; increase security for pedestrians; facilitate vehicular and pedestrian traffic; and increase evening economic and community activity.

The NYCDOT operates the largest municipal street lighting system in the country

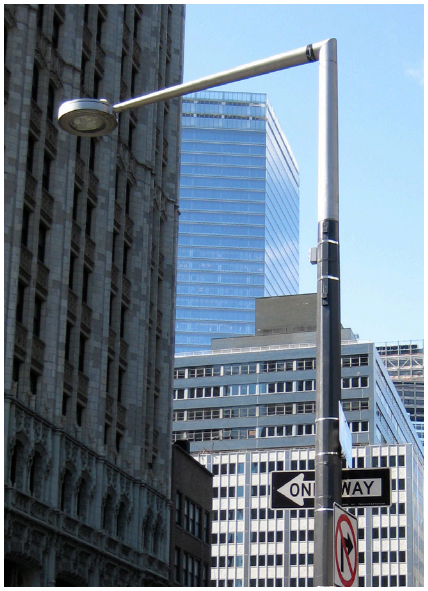
Power consumption and costs

The City purchases 4.32 billion kWh annually and street lighting accounts for approximately 6% of total municipal energy use.[1] Energy efficiency improvements made over the last few years are expected to reflect an additional 25% reduction in energy consumption.[2]

Between 2006 and 2009, the energy rates for production charged to New York City by utilities increased approximately 22% and delivery rates have gone up nearly 27%.The rising costs for production and delivery of energy further justify the improvements that NYCDOT has implemented and continue to pursue.

1 Mayor's Management Report 2008. Total electricity in kilowatt hours purchased by New York City in 2008 (http://www.nyc.gov/html/ops/downloads/pdf/2008_mmr/0908_mmr.pdf)

2 New York City's comprehensive and complex street lighting system uses approximately 295.5 million kWh at a cost of $50 million annually. NYCDOT is billed by Con Edison for estimated electricity use. There is a lag between billing and actual energy consumed.



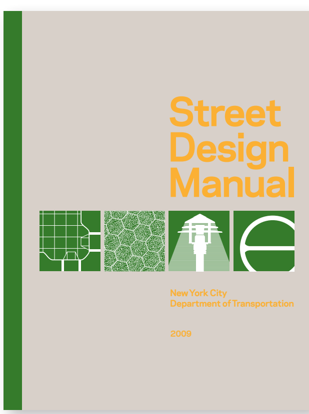
The Downtown Alliance's signature light fixture for use in Lower Manhattan

Current lighting fixtures

NYC began utilizing electric street lights in the early 1900s. Although many of the historical fixture designs for street and pedestrian lighting are no longer available, several designs remain in use today. The standard luminaires used by NYCDOT currently are the 100W and 150W high pressure sodium (HPS) cobra head for street lighting and 100W and 70W HPS for pedestrian lighting including park lights.

Decorative fixtures are for example typically found in historic or special districts; within Central Park there are 1,400 historic poles. Some Business Improvement Districts (BIDs) have selected or developed a decorative luminaire and pole to designate and characterize their commercial district. For example, the Downtown Alliance created a signature light fixture for use in Lower Manhattan; other BIDs have selected decorative options from the DOT's lighting catalogue included in DOT's recently released *Street Design Manual*.

Standard cobrahead



Street Design Manual, 2009

Street Design Manual

The *Street Design Manual* provides detailed information on lighting applications, lamping/optics, materials, colors, cost and spacing requirements in addition to design guidelines and references to specifications. The *Manual* establishes standard lighting options that the agency will install and maintain as well as other options that may be included in capital construction projects or funded by local organizations.

A sample entry from the *Street Design Manual* is included on the following page illustrating the Helm fixture. This particular fixture, currently located on Queens Boulevard, uses energy-efficient 100W HPS or 150W HPS lamps, as well as an option for full-cutoff illumination to control glare and upward light.

Helm

USAGE: OPTIONAL

The Helm luminaire was piloted by NYC DOT on Queens Boulevard in 2008. The design of the luminaire provides a contemporary option in place of the standard Cobra Head at an additional cost.

Applications

Commercial districts

Lamping/Optics

100W HPS or 150W HPS

Flat glass and curved sag glass optics

Cutoff, or semi–cutoff, IES Type II or III

Material/Color

Aluminum/silver, black, brown and green

Cost Compared to SLP

$$$

Spacing/Typical

⅔: 1

Helm luminaire and WM pole: 39th Street, Queens

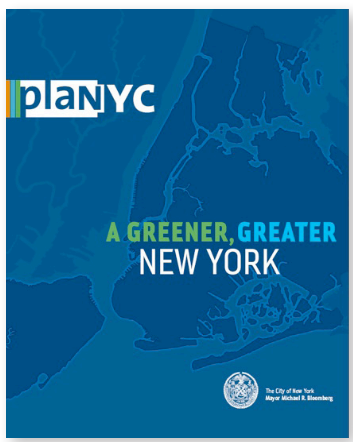
ENERGY EFFICIENCY IMPROVEMENTS TO DATE

PlaNYC 2030 calls for a 30% reduction in the City's greenhouse gas emissions by 2030

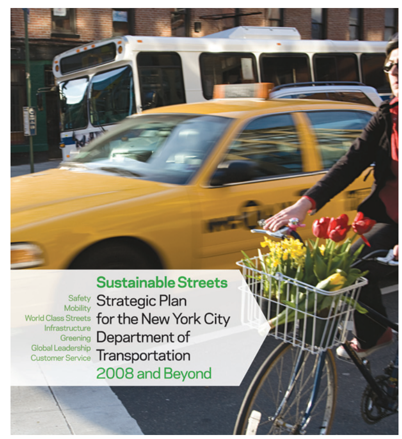
Policy

The energy efficiency goals NYCDOT established over the last ten years were formalized in PlaNYC 2030. Released by Mayor Bloomberg in 2007, PlaNYC 2030 calls for a 30% reduction in the City's greenhouse gas emissions by 2030. In 2007, Executive Order 109 and Local Law 55 set additional goals for municipal energy consumption to be reduced 30% from 2006 levels by 2017.

Sustainable Streets, NYCDOT's first strategic plan released in 2008, further describes energy reduction goals which support those outlined in PlaNYC. In 2008, DOT began requiring the private sector to pay energy cost increases above current minimum illumination standards.



PlaNYC Report



Sustainable Streets, DOT's Strategic Plan

Conversion to lower wattage cobra heads has reduced upward lighting, minimized glare and reduced greenhouse gas emissions

Wattage Reduction Program

Ten years ago, NYCDOT began replacing 60,000 of the 400 watt HPS cobra heads with 250 watt heads to conserve energy. In June 2007, NYCDOT began further improving energy efficiency by converting 160,000 250 and 150 watt HPS luminaires (cobra head street lights) to more efficient 150 and 100 watt cobra head street lights respectively. As of May 2009, 82,000 cobra heads have been replaced in Brooklyn and Queens. The replacement of these fixtures provided both financial and environmental benefits. Converting 250 watt heads to 150 watt heads yields a 45% energy savings while switching from 150 watt to 100 watt heads results in a 35% energy savings. Conversion to lower wattage cobra heads has also reduced upward lighting, minimized glare and reduced greenhouse gas emissions.

Typical NYCDOT LED traffic signal

New York was the first large American city to use LED traffic signals

Traffic Signals

NYCDOT tested LED fixtures for traffic signals in the 1990s. After successful testing in May, 2001, the agency began converting incandescent traffic and pedestrian signals at 12,000 intersections to LED fixtures. The LED signals use significantly less energy and last longer (100,000 burning hours compared to 8,000 hours for incandescent); however, they have higher initial capital costs.

New York was the first large American city to use LED traffic signals, and has offered guidance to other municipalities as they consider converting to LED signals.[4] The capital cost of the project was recovered in less than five years. with energy and maintenance savings of approximately $6.3 million a year. The energy savings from LED traffic signals is 81% annually. [5]

Table 2: Incandescent vs LED Traffic Signals

Signal Type	Wattage	Infrastructure Costs	Maintenance Costs	Annual Energy Use	Annual Energy Costs
Incandescent traffic*	67	$.65	$13	587kwh	$70.44
Incandescent pedestrian*	67	$.65	$13	570kwh	$68.40
LED 8 inch traffic	9	$75	$10.50	79kwh	$9.48
LED 12 inch traffic	14	$165	$10.50	123kwh	$14.76
LED pedestrian	12	$200	$35	96kwh	$11.52

*The difference in annual energy use for incandescent traffic and pedestrian signals is due to the flashing time of the pedestrian signal.

4 The program was funded with grants from the New York State Consolidated Highway Improvement Program for a total of $28.2 million.

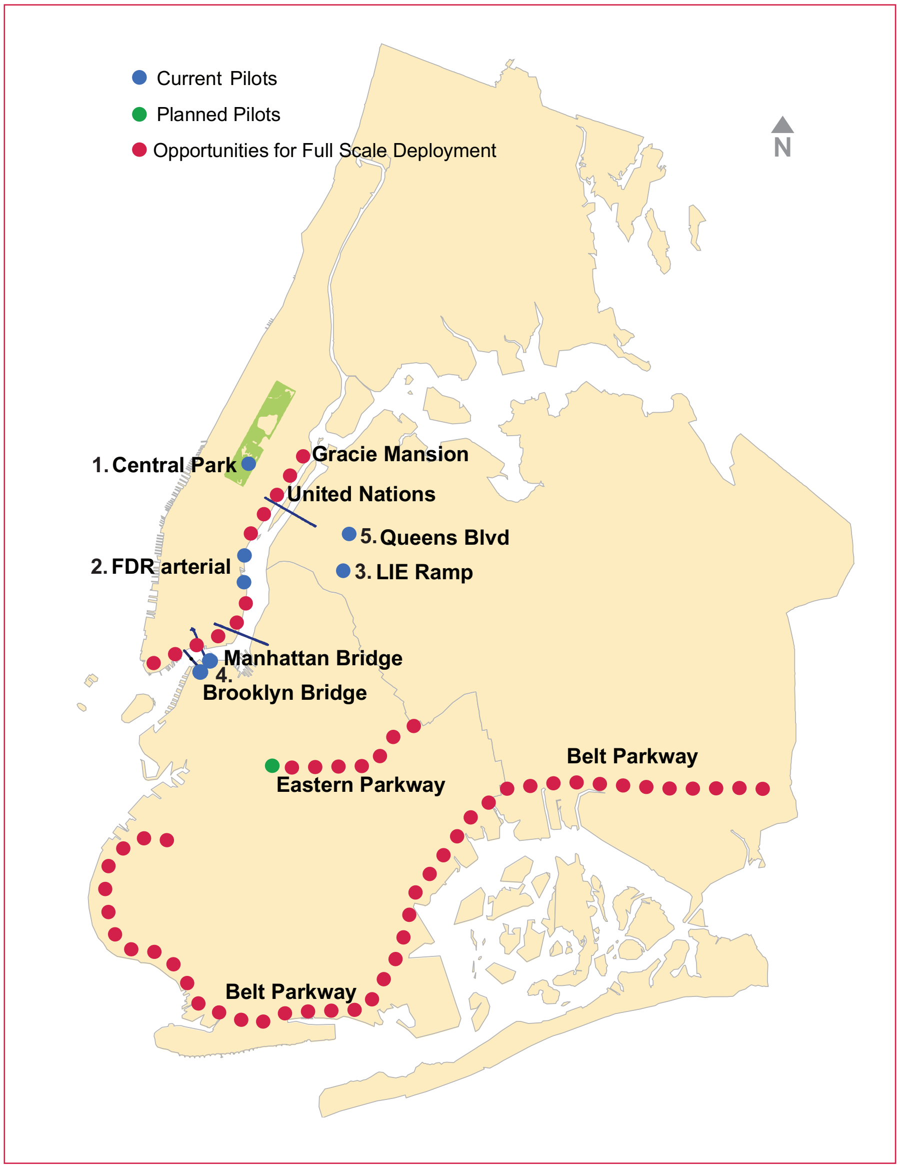
5 86 gigawatt hours per year with incandescent signals compared to 16 gigawatt hours annually with LED signals. Conversion of red and green traffic light and pedestrian signals to LED fixtures was completed in February 2004. Because they are illuminated for fewer hours than red or green signals, amber signals were converted last and are being replaced with LED as the agency converts to new ASTC controllers. Approximately 1,500 intersections in the City have been upgraded with amber LED lights as of April 2009.

LED LIGHTING IN NYC

LEDs provide a crisp white light that enables people to see more clearly at night under lower light intensity than that provided by HPS luminaires

LED lighting is increasingly emerging as a way to capture energy efficiency savings around the world. LEDs provide a crisp white light that enables people to see more clearly at night under lower light intensity than that provided by HPS luminaires. Additionally, the quality of light from LED luminaires depreciates more slowly than light from HPS luminaires. LEDs have a lifespan of 50,000-70,000 hours, which is 2 to 3 times longer than HPS.

In addition to the conversion to LED traffic signals, New York City is currently testing LED lighting at five locations in New York City. (see map below and project details, pages 9 and 10).



LED luminaire in Central Park

NYCDOT is testing LEDs for the necklace lights on the Brooklyn and Manhattan bridges

Current LED Pilot Projects

1. Central Park:

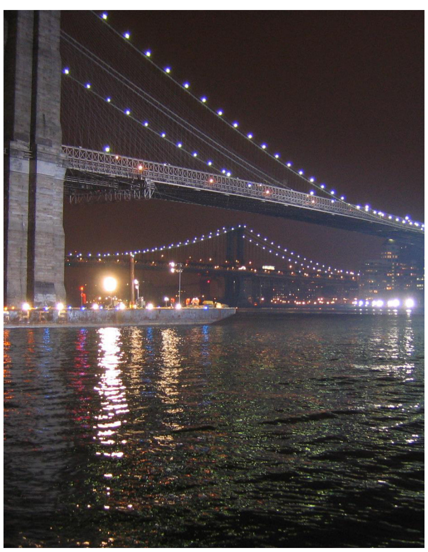
In Central Park, NYCDOT replaced a total of thirteen 175W metal halide fixtures with a mix of 90W LED fixtures and 40W LED fixtures from five different manufacturers. Pending the outcome of the test, a full conversion of the 1,400 175W metal halide lights to 90W or 40W LED luminaires in Central Park would provide significant energy and costs savings as well as greenhouse gas reductions.

2. The FDR Drive:

The FDR Drive on Manhattan's East Side, includes both arterial and under deck lighting. In the FDR arterial pilot, the agency has replaced twenty four 150W HPS luminaires with 108W LED luminaires. The pilot is located along the center median of the drive near the Williamsburg Bridge where lighting from other sources is less likely to interfere with performance testing and monitoring. If the pilot proves successful, all 1,200 of the arterial lights on the FDR could be converted to LED.

3. Long Island Expressway Ramp, Queens:

The first installation of a streetlight application is on the Long Island Expressway (LIE) entrance ramp at Borden and Greenpoint Avenues in Queens. The initial results of this test indicate the 78W LED fixtures do not produce enough light output to replace 150W HPS for this type of roadway. Higher wattage LED lights will be tested along other roadways with the same output requirements (see section below on Opportunities for Full Scale Deployment).



The Brooklyn and Manhattan bridges at night

4. East River Bridges Necklace Lights:

NYCDOT is testing ten LED and ten induction luminaires on its necklace lights for the Brooklyn and Manhattan Bridges. During the test period both types performed well however the LED fixtures used less electricity. Based on these results, the agency is preparing to replace approximately four hundred 125W mercury vapor necklace lights on the Williamsburg and Queensboro Bridges with 37W LED lighting beginning in 2009.

These conversions will be completed in early summer 2010, saving approximately $35,000 annually in maintenance costs. The initial capital cost will be nearly $400,000 and is expected to be recovered in approximately 11 years primarily from reduced maintenance costs. Conversion of the necklace lights on the Manhattan and Brooklyn bridges will be coordinated with planned capital contracts for each bridge.

Central Park LED

LED lighting has a life expectancy 2 to 3 times that of HPS; deployment of LED lighting on highways may provide maintenance savings because of anticipated reduction in the frequency of service

5. Queens Boulevard:

In February 2009, NYCDOT replaced two 250W HPS luminaires with two 108W LED luminaires in the parking fields beneath the elevated 7 train. The success of the small pilot has lead to the expansion of the test to include an additional 63 fixtures spanning approximately 14 blocks along Queens Boulevard. The LED fixtures in use in the parking fields are wall/ceiling mounted fixtures that have other potential applications in the City

Planned LED Pilot Projects

Eastern Parkway, Brooklyn:

At Eastern Parkway in Brooklyn, NYCDOT is planning to replace 142 (out of 625 total) 175W metal halide pedestrian lights with 90W LED luminaires. These lights are currently scheduled for replacement, which facilitates their inclusion in the LED pilot program. The cost of the Eastern Parkway pilot is expected to be approximately $270,000.

Opportunities for Full Scale Deployment

Central Park, the FDR Drive and Eastern Parkway:

Should the above outlined LED pilots prove successful and provide lighting levels to meet NYCDOT standards, the agency is prepared with several options for full scale deployment of LED lighting at three locations: Central Park, the FDR and Eastern Parkway.

FDR Drive underpass at Gracie Mansion and the United Nations:

Two other possible locations where the FDR passes under Gracie Mansion and the United Nations have been identified as appropriate for LED implementation. Under full scale deployment, all 500 of these 150W HPS luminaires would be replaced with 108W LED fixtures similar to those being tested in the Queens #7 train parking fields.

Belt Parkway:

An additional site includes the Belt Parkway, a limited access arterial roadway that runs through Brooklyn and Queens. There are approximately 2,300 150W HPS lights along the roadway that can be converted to 108W LED lights. The total cost of converting all of the lights along the Belt Parkway would be approximately $2.8 million, including removal of the old lights and installation of the new LED fixtures.

With the installation of these and future energy-efficient lighting solutions, the New York City Department of Transportation is becoming an international leader in green lighting

Looking Ahead

Over the next year, the New York City Department of Transportation will be participating in the United States Department of Energy Gateway Program, installing, and evaluating LED luminaires. Upon successful completion of the program, data collected from New York City's LED installations will be used to help other cities looking to convert to LED fixtures.

With the installation of these and future energy-efficient lighting solutions, the NYCDOT is becoming an international leader in green lighting. In this decade alone, NYCDOT has cut its carbon footprint by thousands of tons and saved millions of dollars through its energy-saving initiatives. These numbers will increase as the LED program expands and more lights are converted to energy-efficient luminaires. NYCDOT will continue its research to identify the latest in energy-efficient technology to ensure New York City is lit by the greenest, most cost-effective lighting possible.

APPENDIX

Maintenance Costs for Street Lighting

The annual maintenance budget for street lighting in New York City is approximately $40M for the light fixtures currently in use. The average maintenance costs per fixture for standard light components per year are $35 for lamps, $35 for luminaires, and $30 for photo electrical controls (PEC).

A typical cobra head fixture requires replacement after 24,000 hours, or approximately 5.85 years. Other costs include replacing lampposts, foundations and underground cable and control panels. The maintenance costs also account for more difficult access for highways and other limited access roads, which require lane closures whenever maintenance is required.

Table 1: Cost Comparison of Various Street Light Options (costs per fixture)

Luminaire	Lamping	Wattage	Fixture Costs	Maintenance Costs	Annual Energy Use	Annual Energy Costs
Cobra head/standard with electonic ballasts	HPS	150W/ 100W	$160	$100 per year	672.4kWh/ 475.6kWh	$102.52/ $72.51
Historic (i.e. shielded teardrop)	HPS	250W	$950	$100 per year	1,230kWh	$187.53
Optional (i.e. Helm contemporary, see page 5	HPS	150W/ 100W	$950	$100 per year	1,230kWh	$187.53
LED/standard pole or under deck	LED	108W/ 90W	$1,050	$0 per year*	442.80kWh/ 369 kWh	$67.51/ $56.26
Central Park LED/"Type B" pole	LED	90W	$1,650	$0 per year*	369 kWh	$56.26

*The LED components are covered under a 7 year manufacturer's warranty. General maintenance required for the lights related to the non-LED components are covered by the street lighting general contract which is not included as maintenance costs.

Anticipated Energy and Cost Savings for LED

LED technology is relatively new and has a high initial capital cost relative to other technologies currently in use. The reduced energy costs that result from lower energy consuming fixtures are not always sufficient to justify the initial capital costs. At the current time, much of the anticipated cost savings for converting from HPS to LED lighting will be justified by reduced maintenance costs. LED lighting has a life expectancy 2 to 3 times that of HPS; deployment of LED lighting on highways will provide maintenance savings.

As illustrated in Table 3 (below), the initial cost of achieving significant energy savings through lowering HPS wattage is substantially less than those costs for achieving additional incremental energy savings through the employment of LEDs. This is primarily due to the fact that older technology used to achieve the initial savings although relatively inexpensive is limited in the amount of additional efficiency improvements possible. It is typical for new advances in energy efficient technology to have higher initial implementation costs than older technologies that have been refined over time.

In order to continue to achieve greater energy efficiency, it is necessary to deploy newer technology that has been on the market for a shorter period of time and is therefore more expensive. The energy savings remain significant, but the cost per ton of emissions reduced is higher. The potential for significant cost savings may be found in longer term maintenance/ life cycle costs. To provide additional perspective regarding cost per ton of emissions reduced, two non-lighting emissions reduction projects are shown in Table 3. These cases illustrate that LED lighting is within the same range as other technology solutions (car sharing) compared to low/no technology options (bike lanes). In order to help cover the higher technology costs associated with LED lighting, NYCDOT has applied for federal funds to assist with the implementation cost of full scale deployment of LED lights in the identified locations.

Table 3: Comparison of Wattage Reduction Effort with LED Deployment

Cobra Head Wattage Reduction					
Location	**Net GHG Savings (tons CO2)**	**Net kWh Savings**	**Net Energy Cost Savings**	**Net Maintenance Cost Savings**	**Contruction Cost per ton of GHG Reduction**
Phase 1 – BK & QN	18,558.45	35,723,681	$4,644,078.57	$0	$983.39
Phase 2 – MN, BX, SI	19,337.72	37,223,720	$4,839,083.55	$0	$1,204.95
Phase 3 – Misc Other	17,148.06	33,008,772	$4,291,140.36	$0	$1,398.96
Phase 4 – Highways	869.02	1,672,800	$217,464.00	$0	$1,299.39
TOTAL	**55,913.25**	**107,628,973**	**$13,991,766.48**	**$0**	**$1,192.38 (avg)**
LED Lighting Projects					
Belt Parkway (BK and QN)	350.34	675,024	$101,254.00	$149,352	$7,997.36
Central Park	327.70	631,400	$94,710.00	$88,900	$8,031.82
Eastern Parkway	146.29	281,875	$42,281.25	$39,687	$8,031.82
FDR (arterial and under deck)	238.32	459,200	$68,880.00	$101,600	$7,007.24
TOTAL	**1,062.65**	**2,047,499**	**$307,125.25**	**$379,539**	**$7,790.67 (avg)**
Non-Lighting Energy Efficiency Projects					
Bicycle Lanes	15,664.13	-	-	-	$2,234
Car Sharing	85.00	-	-	-	$8,552

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Project Team:
Steve Galgano, Director of Engineering, Traffic Operations
Ghanshyam Patel, Director, Streetlighting
Margaret Newman, Chief of Staff
Heather Richardson, Senior Project Manager, Planning and Sustainability
Anthony Femminello, College Intern

Special Contributors:
Wendy Feuer, Assistant Commissioner, Planning and Sustainability
Jon Orcutt, Senior Policy Advisor
Bruce Schaller, Deputy Commissioner, Planning and Sustainability

Design:
David Moidel, Director of Creative Services
Diane Murphy, Graphic Designer, Creative Services

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