MUNICIPAL LED STREETLIGHT PROGRAM

Summer 2021 Program Newsletter

This newsletter by the Maryland Energy Administration describes the latest developments of a technical support program that assists municipalities seeking to adopt LED streetlighting technologies that reduce operating costs while minimizing the environmental impacts of energy waste. For more information about the program's purpose, organization, funding, scope of services, eligibility for participation, and more, see the program webpage:

https://energy.maryland.gov/govt/Pages/municipal-streetlight-grant.aspx

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Howard County, MD LED Streetlight Conversions

Howard County, a largely suburban community located between Baltimore and Washington, D.C., is a leader among Maryland jurisdictions seeking to convert inefficient streetlighting to LED technology. This effort is one item among many commitments to sustainability and climate action announced by County Executive Calvin Ball in 2019, which have already earned the county recognition as a "Maryland Smart Energy Community" by the Maryland Energy Administration.[1] As part of the commitments, Howard County aims to reduce greenhouse gas emissions 45% from 2010 levels by 2030 and reach zero emissions by 2050. The County will also strive to reduce electricity use in government facilities by 25% by 2024, making it the first jurisdiction to exceed the state goal of 15%. Conversion of all county-owned streetlights to LED technology by 2025 is one of the largest and most visible initiatives facilitating the county's energy goals.

Howard County owns just over 9,000 streetlights in total, with approximately 1,500 already converted to LED before the project began.[2] Approximately 1,400 streetlights in the county are owned by the local utility, Baltimore Gas & Electric (BGE), of which just over 1,000 have already been converted to LED. While the streetlight project was announced in 2019, most of the conversions began in January 2021 and will cost an estimated $3.5 million to complete. The project is financed through a multi-year, tax-exempt capital equipment lease that will be paid off by the project savings over 12 years. The County anticipates saving $332,000 and 225,000 kWh of electricity per year once the conversion is complete, which equates to 3,045 metric tons in reduced carbon emissions over 20 years (or roughly the same benefit as planting 50,000 trees). Conversion is expected to be completed by the end of 2022, well ahead of the initial goal of 2025.

Howard County is installing Hadco LED fixtures. The installation is being completed by BGE and their contractors. The per fixture conversion costs range from $150 to $1,200 depending on the fixture type, but most fixtures cost approximately $315. Installation costs are approximately $175 per fixture.

Streetlight Construction Items	Cost
Labor	$157/fixture
Post-top fixture	$270-292
Cobra fixture	$153-169
Teardrop fixture plus new arm	$1,625
Retrofit Kit cost	$417

Of the approximately 7,200 streetlights that will be converted in this project, 95% have a color temperature of 3,000 degrees Kelvin and are rated for zero uplight. The remaining 5% have a color

[1] https://www.howardcountymd.gov/environment-community-sustainability/county-executive-ball-announces-major-commitments-climate

[2] https://dash.howardcountymd.gov/MetricDetail.aspx?MetricID=819

temperature of 4,000 degrees Kelvin with some uplight. These are existing fixtures where an LED retrofit kit will be installed at a lower cost with fewer materials. Howard County opted not to purchase LEDs with dimming capabilities due to cost, but if desired in the future, photocells being installed by BGE will have the ability to dim on a case-by-case basis.

The bulk of the work to ensure success of the LED streetlight project was completed by Howard County's Bureau of Highways staff within the Department of Public Works, along with support from the Office of Community Sustainability and Department of Finance. These departments worked together to conduct exhaustive research, negotiate with BGE, and conduct several procurement processes to find a way to lower its carbon footprint and save money over the long term, with zero net change to the operating budget. Through its tireless efforts, the County successfully overcame hurdles imposed by costs and installation work restrictions.

To date, resident response has been generally positive. From the start, stakeholders were invited to provide public testimony during the legislative process to approve the project funding. Concerns surrounded dark-sky compliance[3] and the health of people and wildlife. To address these concerns, Howard County's procurement specifications included criteria for dark-sky performance. Now, 95% of the lights purchased and installed will meet all dark-sky standards. As the project progresses, stakeholders are informed prior to installation work starting on specific streets and can reach out directly to the Office of Community Sustainability and Department of Public Works with any concerns and questions.

Leah Miller, Howard County's Energy Manager, has found support from the top levels of government incredibly valuable in moving projects such as the LED streetlight conversion project forward. The project is a fantastic example of government at its best, with multiple departments collaborating to find a creative, cost-effective solution to convert all streetlights to LED.[4]

[3] "Dark-sky compliant" means that the fixtures' output is optimized to reduce unwanted backlight, uplight, and glare.

[4] Photos from Scott Kramer at the Public Information Office, Howard County, MD

Cape Light Compact LED Streetlight Conversions

Massachusetts is a leader in converting conventional streetlights to LED fixtures. As of 2017, 71% of streetlights in the state were already converted to LED or were in the process of conversion.[5] Supportive policies, regulations and incentives in the state underpin this success – for example, Massachusetts law allows municipalities to purchase streetlights from their utilities.[6] The same legislation also requires utilities to base the purchase price of streetlights on their depreciated value minus any salvage value,[7] making a purchase more affordable for municipalities. Additionally, Massachusetts allows use of energy savings performance contracts to retrofit existing luminaires to high efficiency LED.[8]

One successful example of LED streetlight conversion is the Cape Light Compact Conversion Program. The Cape Light Compact is a municipal aggregator for communities across Cape Cod and Martha's Vineyard. It is also an energy efficiency program administrator and a participant in the U.S. Department of Energy's Solid State Street Lighting Consortium. The Cape Light Compact successfully converted 15,700 municipally owned streetlights to LED fixtures across its member communities between 2012 and 2014,[9] which represents all eligible municipal-owned streetlights among the 23 participating municipalities.

The Cape Light Compact undertook the conversion for several reasons: to reduce greenhouse gas emissions, to lessen energy usage including peak energy demand, to decrease the costs for operation and maintenance (O&M) for the municipalities, and to be responsive to Massachusetts' requirements established through passage of the Green Communities Act (2008) that efficiency and demand reduction measures are undertaken first before additional grid infrastructure is planned and built.

As required by state law, every three years the Cape Light Compact develops an energy efficiency plan, which is approved by the Massachusetts Department of Public Utilities (DPU) and as part of the overall state plan also reviewed by the Massachusetts Department of Energy Resources. The LED conversion project was included in the 2013-2015 Three-Year DPU Approved Energy Efficiency Plan. Based on the prescribed cost-benefit analysis, which considers energy savings and O&M savings (and more recently, carbon savings are also calculated), the project benefits outweighed the costs. This determination has allowed the project costs of $5.9 million to be completely covered through the energy efficiency program incentives, with no costs to the participating communities except for any special requests demanded by the municipalities (e.g., special work hours due to summer tourist season, etc.). By engaging adjacent communities, the project was able to leverage economies of scale and thus reduce overall costs. The Compact entered into a 10-year energy savings performance contract. Each municipality signed a separate contract with the O&M provider, with contract language being provided as a template. Also included in the project costs (and required by statute[10]) was a GIS GPS-audit, which provided a database map of

[5] https://ma-eeac.org/wp-content/uploads/LED-Streetlights-12-15-17.pdf
[6] https://malegislature.gov/laws/generallaws/parti/titlexxii/chapter164/section34a
[7] http://www.mapc.org/wp-content/uploads/2017/11/Notes_Streetlight-Buyback-Roundtable_092012.pdf
[8] https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter25a/Section11c
[9] https://www.capelightcompact.org/municipal/
[10] Ch. 25A

streetlights including their location, type and their conditions. This data has proven to be vital to the success of the project as it allows utilities to prepare accurate billing information and is updated frequently.

The Cape Cod region encompasses mostly rural areas with residential neighborhoods, both of which require comparatively low light output. Most municipal streetlighting prior to the conversion consisted of high-pressure sodium cobrahead lights. Martha's Vineyard's inventory even included a few mercury-vapor lights. The streetlights were converted to CREE XPS LED lighting that are dark-sky compliant, which means that the fixtures' output is optimized to reduce unwanted backlight, uplight, and glare. The lights are also adaptive and can be dimmed, however no municipalities installed dimming controls to date. In a second round of upgrades, and depending on interest by the participating municipalities, the Cape Light Compact could provide dimming and motion sensor controls. This could result in further cost reduction and energy savings.

The project achieved a 70% reduction in energy use. The annual energy reduction is over 3,310,000 kWh, with annual utility bill savings over $675,000 and annual maintenance savings over $212,000 which is a combined annual billing and maintenance savings of over $869,000.

Early community engagement paved the way to broad acceptance of the program from the start. Pilot installation projects provided the public with first-hand observation opportunities, which facilitated potential adjustments prior to full installation. Establishing a call-in number and ensuring the staff's responsiveness to requests by the public further bolstered the public's acceptance. The Cape Light Compact conversion program successfully achieved its conversion goals to LED streetlighting and achieved the envisioned energy and cost savings.

LEDs: Light Pollution and Potential Impacts on People and Wildlife

LED technology provides a wide range of economic, environmental and technological benefits to municipalities and their residents. Rapid technological advancements continue to make LEDs increasingly more effective and efficient than they were in their infancy, over 10 years ago. However, one of the persistent perceptions of LEDs is that they produce a blue-white color that is detrimental to human health and that of surrounding wildlife. Advances in LED technology have successfully addressed harmful effects while retaining significant energy and cost savings. Many medical and conservation organizations have developed thorough guidelines that prescribe bulbs and fixtures compatible with animals and humans.

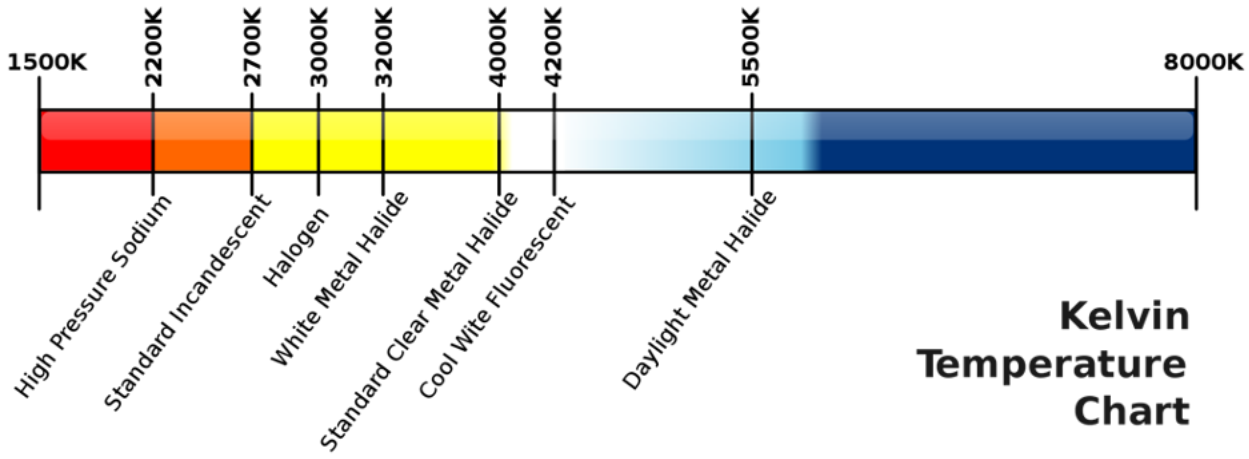
Light Pollution and Wildlife

Nighttime illumination cast by homes, businesses and streetlights can be disruptive to the biological patterns of wildlife. Scientists understand some of these effects, but new discoveries continue to be made. Maryland's State Wildlife Action Plan, published by the Department of Natural Resources, lists light

pollution as a threat to wildlife in the State.[11] The most affected types of animals are insects, birds, turtles and reptiles. Insects are distracted from feeding patterns by bright lights. Birds rely on stars to navigate migratory paths and become disoriented and confused by bright city lights below. Turtles and reptiles use moonlight to find nesting grounds and desirable habitat, which can be confounded by similar-looking streetlights near waterways.

Color Temperature

All the effects of artificial lights on animals are dependent upon where their color falls in the light spectrum. The term "color temperature" describes the appearance of the light given off by a source. This has nothing to do with heat emitted by light fixtures (which for LED lighting is negligible).[12] Therefore, the relation between color and temperature is opposite our assumptions: cooler color temperatures give off a warmer, redder glow while higher color temperatures are bright blue-white. Below is a chart depicting the color temperatures of various artificial light sources. While any other light source only glows at one color temperature, LEDs are difficult to show on the chart because they can be found in a range of color temperatures from 2700K - 7000K ("K" for the Kelvin scale).



Source: *https://commons.wikimedia.org/wiki/File:Kelvin_Temperature_Chart.svg*

Daylight falls somewhere between 5500K and 6500K. The chart above shows the color temperature of various light sources. Artificial lights with hotter color temperatures mimic the effects of daylight and disrupt the natural day/night cycles. High-temperature bulbs are also much more efficient to operate at a higher brightness, which led early adopters of LED streetlights to over-light their streets with hot temperature bulbs in order to save additional costs. Traditional High-Pressure Sodium and Incandescent bulbs are some of the least disruptive light sources to wildlife, but they are very energy intensive. The American Medical Association concluded in 2016 that bulbs with a color temperature of 4000K, which was commonly installed by early adopters of LEDs, can significantly harm the health of humans and wildlife.[13]

[11] https://dnr.maryland.gov/wildlife/Documents/SWAP/SWAP_Chapter5.pdf

[12] https://www.westinghouselighting.com/color-temperature.aspx

[13] https://www.ama-assn.org/sites/ama-assn.org/files/corp/media-browser/public/about-ama/councils/Council%20Reports/council-on-science-public-health/a16-csaph2.pdf

They recommended installing bulbs with a temperature of 3000K or less, which has a significantly reduced effect on wildlife while only being 3% less efficient than 4000K bulbs.

LED light recommendations to mitigate negative effects on people and wildlife

Modern LEDs can mitigate the problems above while offering potential cost-efficiency, visual clarity and urban safety benefits. Many companies also offer streetlight fixtures that point the light directly downward, focus the light on what is important and greatly reduce the amount that leaks into the night sky. Smart LED technology and dimming capability is a more significant upfront investment but offers the ability to remotely control the fine settings of lights across an entire city, which can further increase labor and energy savings. The International Dark-Sky Association's frequently-cited recommendations for municipal lighting systems should be referenced when selecting fixtures.[14] A breakdown is below.

- **Choose fully-shielded fixtures** that emit no light upward.
- **Use "warm white" or filtered LEDs** with a color temperature of ≤ 3000 degrees Kelvin to minimize blue light emission.
- **Look for products that accept 7-pin controls** that enable use of dimmers, timers, motion sensors, and networking.
- **Consider dimming or turning off lights during overnight hours.**
- **Avoid over-lighting** because of the higher luminous efficiency of LEDs. Consider adding a lighting designer to the project team to ensure desired light levels are met.
- **Light no more than the exact space and in the amount required** for particular tasks.
- **Select fixtures that have aftermarket shields available** if light trespass is an issue in some lighting situations.
- **Install sample light fixtures** to allow residents and business owners an opportunity to observe and comment on various options.

For additional information on the potential health impacts of LEDs for both people and wildlife, access the following resources:

Cree Lighting white paper on LEDs and wildlife
https://www.creelink.com/exLink.asp?64612420OA52W48I103920454
International Dark-Sky Association Homepage
https://www.darksky.org/
IDSA LED lighting guide for citizens and municipalities
https://www.darksky.org/our-work/lighting/lighting-for-citizens/led-guide/
Department of Energy Solid-State Lighting Consortium, with links to other federal resources
https://www.energy.gov/eere/ssl/street-lighting-blue-light-and-light-night

[14] https://www.darksky.org/our-work/lighting/lighting-for-citizens/led-guide/

Smart LED Streetlighting: Status Update for Pepco-Served Maryland Communities

In 2020, the Potomac Edison Power Company (Pepco) drafted its "Smart LED Streetlighting" (SLED) initiative to serve Maryland customers in both Pepco and Delmarva service territories with the promise that implementation would be at "zero cost to the customer". This ambitious, $67 million, multi-year rate plan (Maryland Public Service Commission Case No. 9655) included, amongst other proposed items, a tariff that would convert about 66,300 utility-owner streetlights to LED fixtures "coupled with smart node technology" to be installed in in tandem with streetlighting fixtures. In addition, the proposed tariff would capitalize the costs of a Smart Sensor Pilot Program to field-test digital technologies for monitoring traffic, air quality, gunshot detection, and possibly other activities not related to electric power distribution.

While Pepco's proposal would ensure electricity reduction and greenhouse gas emissions reduction through the adoption of LED streetlighting technology, the proposal provided no mechanism for conferring the benefits of cost reduction to its customers. Rather, the proposal offered a greater array of digital information services associated with streetlighting infrastructure while keeping rates constant for most customers, but in some cases jurisdictions would see increased costs. As noted above, a central premise in Pepco's proposal was that implementation of the SLED initiative would be at "zero cost to the customer," but this only rings true because funds collected from Maryland ratepayers as part of the "EmPOWER" program were to be employed to offset any rate increases caused by the SLED initiative.

The Maryland Public Service Commission (PSC) invited public testimony from numerous municipal stakeholders in anticipation of approving the SLED initiative. The PSC's proceedings, which included an array of issues in addition to streetlighting, culminated in Order No. 89868, dated June 28, 2021 as presented here:

https://www.psc.state.md.us/pepco-9655-myp-order/order-no-89868-case-no-9655-pepco-myp-order/

The Commission found that "not all affected municipal customers are friendly towards this initiative." Opponents of the proposed SLED offering voiced objections, including (1) no opportunity for customer approval (i.e., customers had no ability to opt out of participation); (2) insufficient customer choice of LED fixture selections; (3) lack of customer engagement in development and deployment of the SLED initiative; and (4) uncertainty as to which parties the benefits of smart node technologies will accrue.

Finally, the PSC's decision states that "Pepco's costs for the Initiative are not insignificant, and the 'zero cost to customer' impact is necessarily tied to securing EmPOWER Maryland funding for those customers who will experience cost increases... The fact that these customers cannot opt-out of the streetlight conversion to avoid the rate increase, which could be up to 117% for some customers, goes against the stated purpose of EmPOWER Maryland funds, which should be used to incentivize customers to take

action and engage in energy efficiency improvements when they otherwise would not have done so. The voluntary aspect of EmPOWER is key because the cost of an approved EmPOWER program is shared by all customers within the class… As discussed, the proposal, as filed, runs counter to the spirit and intent of the EmPOWER program."

For these reasons, the Commission decided that it "cannot approve the Smart Streetlight Initiative" as proposed in Rate Case 9655. This means that Pepco's current Maryland streetlighting tariffs remain in effect for now.

Also in its decision, the Commission suggested that Pepco could, in the future, develop a stand-alone proposal that makes appropriate use of EmPOWER funds to enable utility-owned streetlight conversions to LED. "Should Pepco choose to do so," the Commission stated, "the Company should take the following into consideration: (1) make the program voluntary to incentivize customer action; (2) apply the [EmPOWER] incentive in a way that helps remove barriers to participation (e.g., rebates that reduce [upfront investment costs] or price differentials in lamp styles); (3) proactively engage interested customers as part of program design; and (4) include smart nodes as an optional technology." Finally, "…the Commission therefore directs Pepco to continue discussions with the municipalities regarding customer choice, purchase of the LED streetlights, and tariff changes if it pursues an EmPOWER filing."

For MEA's Municipal LED Streetlight Program participants located in the PEPCO service territory, this means that the realization of cost-effective LED streetlight conversion awaits PEPCO's follow-up to the Public Service Commission's Order No. 89868.