MUNICIPAL LED STREETLIGHT PROGRAM

Fall 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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Municipal jurisdictions across Maryland and Virginia are employing a variety of methods to achieve streetlight conversions to LED technology. Their experiences, summarized here, provide valuable guidance for public authorities that wish to pursue similar accomplishments.

Going Beyond LED Conversions: The New Smart Streetlights

Local jurisdictions across the U.S. are steadily upgrading their streetlights with light-emitting diode (LED) technologies. These conversions are opportunities not only to improve lighting quality but also to install a variety of compatible monitoring and control technologies in the same streetlighting infrastructure, thus creating "smart lights." Smart LED streetlights are connected to a central management system, which can remotely control and monitor multiple functions at once.

Smart LED streetlights increase potential energy savings. Digital controls adjust light outputs by dimming and brightening the streetlight as needed. Motion sensors can trigger lights to turn on only as movement is detected. Other digital options include the capacity to instantaneously monitor and report power outages to the municipality, allowing for faster restoration times. By reducing energy waste and increasing maintenance efficiency, smart LED streetlights generate cost savings for municipalities.

The German city of Bottrop is already more than half-way to meeting the goal of converting its 12,000 streetlights to LED technology by 2025. To date, Bottrop's conversion has achieved CO2 savings between 50% - 85%. Since the end of 2020, Bottrop has also outfitted 462 LED streetlights with controls that allow city managers to achieve weekend dimming profiles distinct from weekday settings.[1]

Smart LED streetlight infrastructure can host additional digital technologies. Options include sound

sensors, seismic sensors, digital signs, cameras, and speakers. Sensors can monitor air quality and pollution, parking conditions, and traffic patterns. They can also be used to direct traffic to open parking spots or less congested areas, broadcast warnings in case of imminent danger, and aid police investigations through security camera footage or gunshot triangulation.

A number of U.S. cities have started to install or are piloting smart LED streetlights – Atlanta, Portland, Philadelphia, and San Diego are among these. The city of Philadelphia issued a procurement request in March 2021[2] to convert all of the city's conventional high pressure sodium light fixtures to smart LED streetlights. The new smart LED streetlights will be monitored by remote control. This system enables dimming of the streetlights, detecting outages, tracking energy use data, and adjusting lighting levels as needed in response to traffic conditions and other city events. With the conversion, Philadelphia aims to reduce C02 emissions, decrease overall costs of the city's streetlight infrastructure, improve public safety, and leverage streetlighting infrastructure for future technological innovations.[3] The city anticipates the conversion to be completed within 2 to 3 years. Financing for the project is to be achieved with a bond issue, while the city will also benefit from a new streetlighting tariff, which was approved the Pennsylvania Public Utility Commission last year.[4]

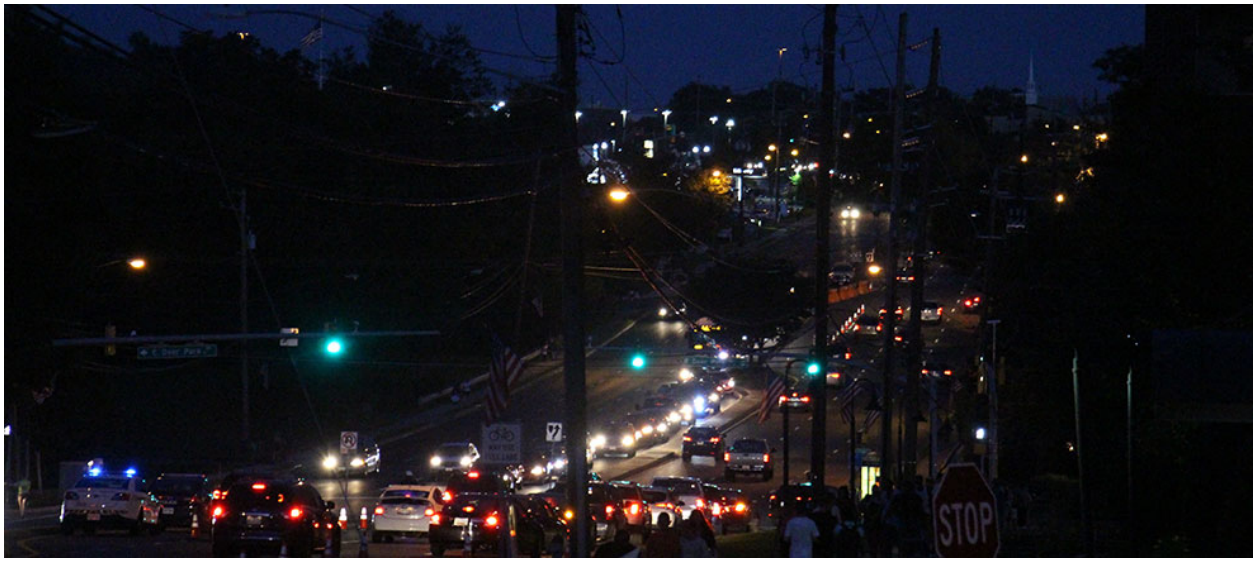
Through its *Smart Streetlight Program*, San Diego collects anonymous, near real-time data on parking, vehicle, bicycle and pedestrian counts. The sensors also collect highly localized environmental data, such as temperature, humidity, and barometric pressure. San Diego is unique in that this data is openly accessible to data developers in an aggregate format.[5] However, the San Diego program has also highlighted the challenges surrounding privacy and data collection via smart streetlighting. Other jurisdictions may encounter similar considerations when the digital data management infrastructure for LED streetlighting is also used for other purposes that may compromise privacy.

Challenges for smart streetlights not only include privacy concerns, but also additional costs and cybersecurity considerations. Costs can often be defrayed by energy savings, which can be enhanced by dimming capabilities and reduced maintenance costs. Cities and municipalities interested in installing smart LED streetlights will need to establish terms and conditions for data access and oversight, while communicating clearly to the public how collected data and information are used.

The energy savings potential provided by smart LED streetlights are compounded. At one level are the reduced costs of illumination. But in addition, thanks to the same digital streetlighting infrastructure, cities can generate data to facilitate city planning in ways that reduce traffic congestion, thus leading to greater overall CO2 emissions and cost savings. When cities and municipalities consider conversion of conventional streetlights to LED lights, additional smart functionalities could be included in the scope.

Gaithersburg, Maryland's LED Streetlight Conversion

Gaithersburg, Maryland is currently in the middle of a plan to convert all 3,950 of its city-owned streetlights to LED by 2024. The Mayor and City Council, which together manage the city of 70,000 residents, have been considering LED streetlight conversion since 2005. Until recently, conversion was impeded by outdated utility tariff structures that underestimated operating cost savings while also relying on higher LED fixture procurement costs from years past. Deborah Moran[7], hired as Sustainability Coordinator in 2019, championed the project and developed an equitable and fiscally responsible five-year plan.



Only seven percent of city-owned streetlights had already been converted to LED before the start of the current project. The local power utility, Pepco, owns 592 streetlights which aren't being converted under this project due to the prohibitive expense of converting those lights per the current tariff structure. Conversion of city-owned fixtures began in August 2020 and will be completed in December 2024, costing an estimated $2,372,000. The project will be funded largely by the city's Capital Improvement Plan, as well as $411,000 in pre-approved rebates spread out over the project's timeline, drawn from the utility administered EmPower Maryland Program. EmPower Maryland was created in 2008 by the Maryland General Assembly and is overseen by the Maryland Public Service Commission. This initiative continues to evolve to meet the needs of projects like that executed by Gaithersburg. The City also has been approved for a grant of $55,000 from Maryland Energy Administration's Maryland Smart Energy Communities Program for the second year of conversion.

An analysis based on the current Pepco LED tariff structure estimated that Gaithersburg could expect $275,500 in annual cost savings with full costs recovered in 8.6-years[8]. Once the first phase of 938 fixtures was completed, the City saw an annual savings of approximately $48,000 on their energy bill. By comparing the wattages of their existing lights with those of their LED replacements, the City estimates a potential annual energy savings of 850,260 kWh, or a 40% reduction. The total savings are equivalent to the power consumption of approximately 80 homes.

The first phase of conversion was completed by riding an existing Montgomery County procurement contract that converted approximately 25,000 county-owned streetlights to LED in 2020. The first phase included the less expensive cobra head and colonial lights which cost approximately $280 and $415 per fixture, respectively. Work for the remaining phases will be contracted out on a yearly basis, with Phase II set to begin in October 2021. The estimated per-fixture costs for the remaining phases range from $517 to $1,400, depending on type, with most fixtures costing an average of $600 each. Data for a few of the fixture types can be found in Table 1 below, based on a summary of contractors' bid proposals submitted to the City. Note that each type has multiple varieties with different wattages and design styles. Only one wattage and style for each fixture type is represented below for simplicity.

Table 1: Gaithersburg LED conversion fixture type and cost per fixture

FixtureType	**Wattage**	**Proposed LED Wattage**	**Cost per Fixture**
Cobra head	100W	39W	$275.90
Rectilinear	150W	70W	$ 590.75
Colonial	100W	33W	$531.76
Decorative	250W	116W	$1,439.97
Washington Globe	150W	56W	$1,318.65

All LED streetlights will conform with International Dark Sky Association standards. Dimming capabilities were not explored for this project, and smart streetlights were avoided due to cost and associated difficulties with implementing data into existing systems.

One of the biggest lessons Ms. Moran and the City learned is that street lighting can be an equity issue. Neighborhoods that are underlit are much more prone to vandalism and other safety issues, and studies show that people in low-income areas are less likely to report outages and complain about visibility[9]. Moran believes prioritizing LED conversions in these areas is an important component to community building. Since the City completed work on the least expensive lights during Phase I, efforts are now focused on underserved and vulnerable communities. Increased safety and equity were one of the primary reasons for converting to LED, along with greenhouse gas reduction. Cost savings were not a primary driver for the project, although lack of sufficient savings can slow or prohibit conversion, as with the utility-owned lights.

A few other benefits of converting became apparent through the process. Previously, the City operated 17 different varieties of light fixtures, with different maintenance procedures for each unique fixture. Conversion has greatly improved maintenance efficiency by reducing the number of different makes and

models of fixtures to maintain without changing the style of lights found in different neighborhoods.

The conversion was also an opportunity to validate the City's streetlight inventory and mapping for better asset management. Gaithersburg now requires contractors to report real-time fixture conversions via a GIS mapping tool. The tool also allows the contractor to note issues with the conversion, such as pole damage, missing handhole covers or if the light has been removed. These real-time assessments are crucial for updated billing and addressing damaged streetlights in a timely manner.

Gaithersburg's streetlight conversion program has been a success to date, with immense support from the public. Still, there are lingering difficulties imposed by outdated utility tariffs that fail to reflect the true magnitude of cost savings, especially for utility-owned fixtures. Most of the comments received by the City are from citizens wondering when their neighborhood will receive LED streetlights. The only concern voiced to the City to date regards the potential glare and negative effects of LEDs with high color temperature. The City assured residents the temperature would not exceed 3000K, producing warmer light, and has successfully mitigated current concerns. To maximize public support, the project was reviewed and approved by the Environmental Affairs Committee, a volunteer citizen committee that advises the Mayor and City Council on environmental issues. Letters are sent to any HOAs prior to planned conversion to provide another opportunity for citizen engagement and increased awareness. A page on the City website is regularly updated with information on the project and provides a means for the public to express concern and praise.[10] "Finally" is a citizen comment that sums it all up, with sighs of relief that this work is getting done.

South Hill, VA LED Streetlight Conversion

South Hill, Virginia, a small municipality of 4,600 people, successfully completed the conversion of its 649 streetlights to LED technology in late August 2021. Town manager Kim Callis initiated the conversion, facilitated by Dominion Energy, which owns most of the Town's streetlights. Mr. Callis obtained Town Council approval and funding for the project by demonstrating greater public safety through improved illumination in addition to taxpayer relief through reduced utility bills. Director of Municipal Services Carl J. Dean[11] managed the implementation. He cites environmental stewardship, safety, a cost recovery period of only 3.2 years, and long-term savings as the benefits of conversion. Initial project work began in 2019, with work orders submitted to Dominion in June 2020. Dominion Energy's initial cost estimate was approximately $97,000. However, the total cost was closer to $86,000 due to existing LED streetlights in South Hill being mistakenly included in Dominion's initial conversion estimate. Financed through a one-time appropriation out of the Town's general fund, South Hill streetlight conversion will save roughly $27,000 per year. It is worth noting that while conversions of standard cobra head streetlights are generally $350 per fixture[12], Dominion's tariff structure subsidizes the cost of installation to keep the price at around $145 per fixture. Dominion's all-in conversion cost per fixture represents a savings of almost 50% compared to typical costs in surrounding states. Mr. Dean cited the low conversion cost as a significant factor for moving forward with the LED streetlight conversion.

The Town chose "Shoebox" model LEDs in the 4000K range, without optional remote-control capabilities. Dominion recommended a set of LEDs that could match the lighting efficacy of the Mercury Vapor and High-Pressure Sodium lights that they replaced. Table 2 below compares the wattages of the Town's traditional bulbs and those of their LED replacements.

Table 2: comparison of wattages for existing fixtures and LED replacements

Mercury Vapor and HSP Wattage	LED Replacement Wattage
70W	37W
100W	45W
150W	54W
250W	72W

South Hill's LED streetlight conversion took longer than anticipated due to inaccurate data and Dominion's work order process of only submitting 50 lights at a time. Mr. Dean's advice for other small municipalities in the Dominion territory is to be very prudent with the paperwork. The entire project, including all fixtures selected and procured by Dominion, had to be completed before the conversion could begin. Providing a detailed inventory of existing lights, including type and specific location, will facilitate a smoother process with faster results.[13]

Stakeholder response to the South Hill conversion has been positive. Members of the public have called Municipal Services to praise the work, thanking them for beautifying their neighborhoods while providing more consistent light color and levels. Below are pictures of a streetlight pre- and post-conversion for reference[CR1] [NB2] [NB3] .

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[1] https://mwcog.webex.com/recordingservice/sites/mwcog/recording/d89d2b0cf79e1039b7fe005056813c95/playback

[2] https://philaenergy.org/public_bids/pea-and-the-city-of-philadelphia-request-for-proposals-rfp-for-led-streetlighting-controls-and-networking/

[3] https://philaenergy.org/wp-content/uploads/2021/03/Philadelphia-LED-Streetlighting-RFP-Final-updates-4-29-21.pdf

[4] https://www.inquirer.com/business/philadelphia-streetlight-conversion-smart-led-savings-20190822.html

[5] https://www.sandiego.gov/sustainability/energy-and-water-efficiency/programs-projects/smart-city

[6] https://spectrum.ieee.org/cops-smart-street-lights

[7] Thanks to Deborah Moran for her assistance in providing information and assistance in the creation of this case study.

[8] Analysis conducted by Clean Energy Solutions Inc. for Maryland Energy Administration's Municipal LED Streetlight Program:

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

[9] Research done by the Cities of Seattle and Portland, findings published on Urban Sustainability Director's Network: https://mydigitalpublication.com/publication/?i=425294&article_id=2839863&view=articleBrowser

[10] https://www.gaithersburgmd.gov/government/projects-in-the-city/led-street-light-conversion

[11] Thanks to Carl J. Dean for providing all the information used in this case study, as well as the pictures attached at the end of the article.

[12] Average price of conversion of cobra head fixtures from Montgomery County, customer-owned LED streetlight conversion.

[13] Conducting a field-audit of existing lights prior to LED conversion can resolve discrepancies with utility data and billing. This can help eliminate confusion when in the design phase and during installation.
