STEP-BY-STEP GUIDE

Improving Efficiency in Municipal Street and Public Space Lighting

Efficiency Vermont

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INTRODUCTION

Street and public space lighting typically plays an important role in any municipality's nighttime landscape. Lighting can be used to enhance public safety and security while also enhancing the aesthetic appeal of the surrounding properties. However, street lighting can be one of the highest constant electric loads and energy costs for a municipality. By eliminating unnecessary street lighting and converting older lighting technologies to LEDs, municipalities have an opportunity to reduce the cost of outdoor lighting while enhancing the nighttime environment.

This guide presents a step-by-step process for Vermont municipalities to upgrade your street and public space lighting to LED technology.

STEP 1: FORM A TEAM

Forming a team of individuals committed to working on reducing municipal energy costs is a critical first step in tackling municipal energy use. Vermont has more than 130 volunteer town energy committees or energy coordinators which are active in promoting energy efficiency and renewable energy in their communities. Energy committees can play a key role in ushering the energy auditing and investment process through your community, including gaining support from selectboards/city councils/school boards, undertaking public outreach efforts, and securing funding for municipal efficiency investments.

A group or committee of five to seven people with a diverse range of skills and experience will provide the foundation for a good team. Consider asking people with the following experience and skills to be on the committee: individuals in the energy efficiency/building trades, school board and/or selectboard members, individuals with economic/financial backgrounds, individuals with writing skills (to prepare grant proposals) and organizing skills (to get people involved), and students and/or teachers from the local high school. Other desirable backgrounds include local business owners, members and staff of environmental and community organizations, long-time residents and newcomers, retirees and elderly, people from different geographic regions of your town, journalists, and marketing specialists.

Perhaps the most important qualification for potential committee members is time and energy. It may be helpful to establish term lengths for energy committee members as people are more likely to serve if they know it is for a finite period.

STEP 2: CONDUCT A NEEDS ASSESSMENT

When considering improving the efficiency of municipal outdoor lighting in your community, an important question to ask is: where is municipal lighting needed in the community?

Municipalities generally install street and public area lighting for practical reasons, such as for safety, to support outdoor public activities or increase commerce, and sometimes strictly for aesthetics. Several locations and reasons for providing outdoor lighting are:

OUTDOOR PUBLIC SPACES:

Spaces where people are likely to gather, walk, or recreate including:

- Parks with walkways: lighting can add a sense of safety and aesthetic to encourage recreational use;

- Recreational areas (tennis courts, basketball courts, volleyball courts, skating rinks, etc.): lighting can extend the hours of recreation and also provide a sense of safety to the participants;
- Parking lots for municipal buildings (town halls, libraries, schools, etc.): lighting can provide needed safety and convenience for getting to and from these public buildings. Outdoor lighting also provides a sound basis of comfort for when special evening activities or meetings are required. Some public buildings may benefit an increase in security with proper lighting measures and discourage vandalism.
- Downtown street lighting: lighting can lend a sense of aesthetic to the streetscape while promoting an increased sense of security and safety leading to enhanced commerce for the associated businesses; and,
- Other locations (train or bus depots, etc.): lighting can increase the sense of safety or public awareness for using such facilities.

ROADWAYS:

In Vermont, roadway lighting has usually served as an added safety measure for busy transportation corridors and a visual signal that travelers have arrived at key town centers, attractions, or intersections. Roadway lighting uses also include: improving visibility of unusual road conditions such as sharp or blind curves, high density neighborhoods, roads passing by or through large destination centers, and approachways to and through town centers.

To improve the efficiency of municipal street and public space lighting, you will want to review all of the locations identified above to see if current and projected needs for these spaces are being met. Many of these locations may be over-lighted. In the past when energy was relatively cheap, municipalities erred on the side of more lighting rather than less. However, it is time to re-evaluate municipal outdoor lighting needs due to the higher costs of power, the carbon footprint of electricity production, and the value of making a more dark-sky-friendly environment.

STEP 3: PREPARE A STREET LIGHTING INVENTORY

When conducting an inventory of the features and locations of the municipal outdoor lighting, it is important to include key information for all municipal outdoor lighting fixtures in the town, including:

LIGHTING FIXTURE LOCATIONS:

Ask your electric utility to send you a copy of their list of the municipal outdoor lighting in your town, including the ages, types, and wattages of each, and a map of their locations. In many cases, your municipality or utility may not have this information. Thus, a critical part of your efforts will be to help map the locations of lighting fixtures and compile their associated ages, types, and wattages.

If a map does exist, you will want to conduct a field assessment to: 1) verify the locations of the fixtures, 2) ensure that the numbers are in agreement with the utility billing, and 3) determine if there are some locations where fixtures have been eliminated or lighting intensity reduced. If the electric utility cannot provide a map, you can acquire a copy of the town map from the town's lister or planning/zoning department and add lighting fixture locations to it.

LIGHTING FIXTURE TYPES:

Identifying the fixture types and wattages will also be important in determining what replacement LED fixtures will be needed. A brief description of fixture types you are most likely to find is described below (for a more detailed description of fixture types, see Appendix A):

- **Metal Halide Lamp:** Typically fairly large sized lamps with a bulbous shape, that emit a very bright white to bluish light. The color tends to shift with these lamps over time and it is common to see a row of identical fixtures, each emitting a slightly different color.
- **High-Pressure Sodium Lamp:** These lamps are large in size with a bulbous shape similar to metal halide lamps. The distinctive difference for these lamps is the golden yellow light they emit derived from the sodium gas within.
- **Mercury Vapor Lamp:** These lamps are very similar in shape to metal halide lamps. There are fewer and fewer of these lamps in service because of their lower efficiency. Further, federal law now bans the sale of mercury vapor fixtures and components. These lamps tend to emit a more gray-greenish light and have a lower wattage and therefore dimmer appearance. In addition, they tend to become dimmer over time rather than fail outright, which keeps them in service beyond their useful life.

For all the above lamp types, a larger bulb means a brighter light output and a higher wattage use. Your utility should be able to provide the type and wattage of the light fixtures in your town.

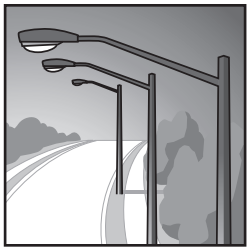
FIXTURE HOUSING TYPES:

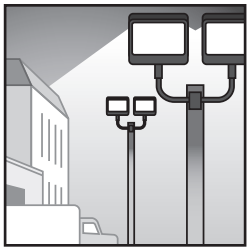
All of the above lamp types are installed in a fixture housing designed to hold the lamp, protect it from the elements, and spread the light in a controlled fashion, by way of reflectors in the fixture housing.

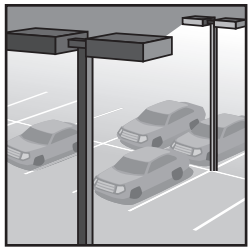
When attached directly to a utility pole, a *cobrahead* or flood style is generally used. The cobrahead, as the name implies, looks like a metallic head of a snake with a bulb in it, attached to the end of a tubular metal arm. A *flood light* tends to look like a stubby box mounted directly on or close to the utility pole with a much shorter arm, the light aimed in a general direction. This type of light fixture tends to spread the light out in a wide arc with usually little dark-sky control features and can also cause a fair amount of glare. Most utility pole installed fixtures, including cobraheads and floods lights, are leased directly from utilities.

Fixtures are also often installed on dedicated lighting poles. These fixtures can be either very plain square-shaped or historically decorative to match the historical character of a community. The plain square-shaped fixtures are called *shoebox* fixtures, while decorative historical fixtures are generally referred to as *post-top* with a historically-styled metal and glass diffuser top. These types of fixtures may or may not be more dark-sky compatible and emit less glare, especially from a distance. Most lights on dedicated light fixture poles are owned and maintained by the associated property owners.

FIXTURE HOUSING TYPES


Cobrahead


Flood Light


Shoebox

Post-Top

STEP 4: DETERMINE OWNERSHIP OF LIGHT FIXTURES

A critical step in the process of improving the efficiency of municipal outdoor lighting is understanding whether your light fixtures are leased through your electric utility or owned by the municipality. Your electric bill may be broken-out with specific information about street lighting fees. However, this information may be difficult to assess as these fees may be incorporated into other electric fees. If this is the case, contact your electric company to determine whether your municipality leases some or all of its outdoors lighting fixtures. Most municipalities in Vermont lease their lighting fixtures from their electric companies.

The next step is to designate and mark each of the lighting fixtures as either leased from your utility under street lighting or security rate tariff, or whether they are owned by the town. Under a street lighting or security rate tariff, the municipality pays a flat monthly fee per fixture which includes the maintenance and automatic replacement of failed fixtures, as well as cost of energy used. The fee amount is governed by the wattage of the fixture. Alternatively, if the fixtures are owned by the town, the maintenance and replacement of the fixtures is the responsibility of the town, and the utility is only paid for the energy used.

DECIDE ON LEASING VERSUS TOWN OWNERSHIP:

Your municipality may have a choice to either continue to lease the lighting under a special utility tariff or to take over ownership of the lighting fixtures. If your municipality wants to own the lighting system, then an independent metered service would need to be instituted to monitor electric usage of outdoor municipal lighting. Under municipal ownership, energy costs are paid monthly to the utility, and all fixture purchase, installation, and maintenance costs are borne by the municipality. The big advantage of a town-owned lighting system is that the locations of the light fixtures are not dependent upon existing utility pole locations, and the style can be chosen to best match the look the town desires to project. However, a municipal-owned system will require on-going maintenance for system components that will eventually need replacement, and these costs will be the responsibility of the town.

UTILITY TARIFFS:

It is important to understand that electric utilities have different tariff structures available for outdoor lighting. Some utilities allow for cost-effective LED retrofit projects, while others may not. Some utilities offer tariffs that allow individuals to use utility-owned poles, but install their own fixtures yet may still restrict the installation and maintenance of such fixtures to the utility crews. The cost-effectiveness of pursuing a specific LED-retrofit project varies by utility and should be carefully considered by your municipality.

Tariff restrictions can inhibit the extent of or options for a retrofit project. For example, the Municipality of Hartford (VT) is currently in the process of converting a large portion of their outdoor lighting to LED. Hartford has numerous villages in its municipal district served by two different utilities. Under one utility's tariff, it makes economic sense for the municipality to convert to LED, while under the other utility's tariff it does not.

Further, there may be additional charges to a municipality that seeks to upgrade its lighting and currently leases its lights before the older lighting technology has reached the end of its useful life. These charges include costs associated with retiring the "un-depreciated" value of the fixture, and are specific to each fixture location and age. Oftentimes, the simple payback can be less than five years even with these the un-depreciated costs applied.

STEP 5: IDENTIFY AND ELIMINATE UNNECESSARY LIGHTING FIXTURES

The most cost-effective step you can take to improve the efficiency of municipal outdoor lighting is to eliminate unnecessary lighting. Many fixtures may have been placed in service 20–30 years ago, and may no longer serve their intended purpose. In order to determine if light fixtures can be removed, you will need to evaluate what lighting is currently in place and compare this to the lighting levels that are actually needed for their associated purpose. Undertaking field measurements is the best way to determine whether lighting can be reduced or eliminated. Below are some guidelines for making those measurements and applying the results.

CONDUCT FIELD LIGHTING MEASUREMENTS:

Light meters are an invaluable tool for conducting field measurements of lighting levels. There are many simple light meters available from local electrical supply companies or over the internet. These devices are all hand-held and battery powered devices suitable for this type of application. They can be purchased for under $100.[1]

When using the light meter, place the meter directly on the ground. The light sensing mechanism should be horizontal to the ground and not in the shadow of any surroundings (including you.) Most meters have a cord so that you can achieve some distance between the meter sensor and the output reader.

As noted earlier, a critical step is having or developing an accurately scaled map of light fixtures in your municipality. Your light readings should be made in conjunction with this map. These maps should have a symbol for utility poles making it easier to identify those poles with light fixtures.

For each light fixture, make multiple recordings of lighting levels at different locations, and try to find the locations where lighting levels are highest and lowest. It is important to concentrate on areas where the light is intended to serve (sidewalks, streets, crosswalks, etc), as well as identifying where the light is shining but not needed. In upgrading their outdoor lighting, the Town of Thetford (VT) recently eliminated 25 percent of their streetlights, resulting in an annual savings of 4,400 kWh and $1,700 per year.

Even if light fixtures cannot be removed altogether, some installations may have more fixtures or higher wattages than needed. As a general guide for Vermont municipalities, adequate lighting for street and sidewalk illumination will, on average, fall between the 0.25 and 1.0 foot-candle (fc).[2] The lower value (.25 fc) is adequate for paths, walkways, and lesser trafficked streets, while the higher value (1.0 fc) will be adequate for most busy streets and intersections. Installation of higher foot-candle values than these should only be used for specific and limited applications. A lighting professional should be used to help determine adequate light levels for those special lighting areas requiring higher lighting levels.

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[1] Be sure to get a lighting meter that has a low light level range (0 to 20 foot-candles), as all measurements taken will be in the lowest part of this range (probably no more than 10 foot-candles at maximum locations). Note that most meters manufactured today will have both "foot-candle" and "lux" settings. The "footcandle" (fc) is considered an English metric unit, while the "lux" is an international metric unit. The conversion from one to the other is extremely close to 10 to 1 (10 lux = 1 footcandle), so all one needs to do is move the decimal point over one space to convert a reading from one unit to another.

[2] One key concept with the above listed foot-candle levels is "average." All of the traditional light sources are considered point sources of light. Their most noticeable operational trait is much higher brightness directly under and near the fixture often referred to as a "hot spot" and very dim illumination half-way between fixtures. In fact, this "hot spot" under the fixture is an undesirable trait of older lighting technologies. Alternatively, LED light fixtures are composed of many individual LED lamps clustered together and made to operate in a very precise light emission pattern so that fewer are aimed directly below the fixture and more are aim away from the fixture, thereby making a more uniform average value experienced farther away from the fixture location. By eliminating or reducing this "hot-spot", LEDs can save more energy and improve visibility.

PREPARE LIST OF LIGHTS RECOMMENDED FOR REMOVAL AND CONDUCT TRIAL OUTAGE:

Once you have made a determination about what outdoor lighting to eliminate, present this list to municipal decision makers and the public and solicit their input on the proposed list. Based upon their input, prepare a modified list. Ask your electric utility to temporarily turn off selected lights for a given period of time and seek additional community input on the trial outage. Then, present a revised list to municipal decision-makers, gain their approval, and ask your utility to remove unwanted lights. Your municipality may need to address potential liability issues associated with its decision to modify or eliminate lighting. You might want to ask a professional consultant to help determine the risk that may be associated with a particular streetlight removal or reduction.[3]

STEP 6: CONSIDER LED REPLACEMENT LIGHTING

New LED style lighting offers a departure from the single, large lamp lighting now present in outdoor lighting. LED lighting systems are based upon grouping clusters of individual LED lights into modules which operate as a unified system. Unlike all other lighting technologies, LEDs are inherently directional, i.e., all of the light can be directed out from the fixture without relying on a reflector which improves efficiency. For all other lamp technologies, a significant percentage of the light produced by the bulb is trapped within the fixture housing. Also, because individual LEDs can be aimed in slightly different directions under the fixture, a more even illumination pattern is delivered to the area being lighted. By taking advantage of these two benefits of LEDs, an LED fixture with lower wattage and lumen output can effectively match the performance of a higher wattage single lamp fixture using old technology.

LED fixtures are more efficient, offer good color rendition, and last longer compared to older technologies, as the table below summarizes.

TABLE 1: LIGHT FIXTURE REPLACEMENT SUMMARY*

Metric	LED	Metal Halide	High Pressure Sodium
Wattage Range	20-280	50-400	50-400
Lamp Life in hours	50,000-100,000+	12,000-20,000	24,000+
Energy Use	low	medium	medium
Color Rendition	very good	good to very good	poor to moderate

*Please note that above wattages are listed for comparison purposes only. Actual performance of technologies when installed in different light fixtures can vary widely, and a municipality will need to look at their individual situation when replacing with LED to determine how much can be saved, and how much lighting quality can be improved.

[3] "Energy and Cost Saving Opportunities in Municipal Street lighting," 2010. Sustainable Energy Resource Group, Thetford, Vermont.

LEDs also reduce light pollution — whether into the night sky or onto property where light unintended or unneeded. All older lighting technologies produced light in all directions from the bulb and rely on reflectors to help project the light in a useful direction. However, reflectors present challenges for precisely controlling light. Reflectors always have efficiency losses, and often times do not properly control 100% of the light. Light that is not properly controlled can end up going upwards causing "skyglow," or light spillage onto adjacent property lines or spaces where light is not needed. All light directed into the night sky or into areas where light is not needed is wasted, and this is another area where LEDs can save energy.

Further, the fixture housings for LED may look different than older technologies. Since LED fixtures are made up of arrays of small individual LED lights, they can be made with a broad, flat look. However, a number of manufacturers are producing LED fixtures that look similar in style to older fixtures for aesthetic purposes. It is valuable to have a sample LED fixture before making a final decision on choosing replacement fixtures.

It is important to recognize that LED performance and the appropriate replacement wattage can vary widely by the specific LED products used and specific fixture replaced. As the table below indicates, LED replacements can save between 25–75% of electric use depending on the type of lighting being replaced. Municipalities will need to look at their own individual situation and fixture types to determine the appropriate product and replacement wattage. A lighting professional can assist with this task. The follow table provides rough savings estimates and replacement wattages that can be used for budgetary purposes.

TABLE 2: TYPICAL WATTAGE REPLACEMENT AND SAVINGS FOR LEDS

System Type	Typical Wattage	LED Replacement Wattage*	Percent Energy Savings
100W mercury vapor	125	30-65	50-75%+
70W metal halide	94	45-75	25-50%+
100W metal halide	125	65-95	25-50%+
175W metal halide	205	105-155	25-50%+
250W metal halide	295	150-220	25-50%+
70W high pressure sodium	94	45-70	25-50%+
100W high pressure sodium	122	65-90	25-50%+
150W high pressure sodium	189	95-140	25-50%+

*Replacement Wattages listed are approximate. Actual replacement wattages can be higher or lower than those listed. Specific replacement wattages for individual LED projects should be determined by a lighting professional using a photometric analysis of foot-candle light levels.

STEP 7: DETERMINE HOW NEW LED FIXTURES WILL BE CONTROLLED

All lighting systems require a control mechanism for operation to turn on and off the lights. Choosing the right control mechanism is equally as important to choosing the right LED fixtures. Since control systems are used on a daily basis, automatic control methods are more reliable and cost-effective. In addition, automatic controls save energy by turning lighting systems off or reducing light output when they are least needed. One advantage to LED lighting is its ability to be turned on and off without the need to warm up or cool down, thus quickly restore full brightness when it is needed. The following section describes possible control methods and their effect for saving energy.

PHOTO-EYES:

Photo-eyes are the most common control method and are used by all power companies when you lease a light. The photo-eye detects when daylight is available and keeps the fixture turned off during those times. When it gets dark, the light turns on and stays on until daylight returns. The photo-eye is mounted on top of the fixture, with a "built-in" option for all exterior fixtures. If the town purchases their own fixtures for mounting on utility-maintained poles, it is best to ensure that the photo-eye type matches those that the utility uses for their lights. This will help keep maintenance costs down when the utility needs to replace worn out sensors.

TIME-CLOCKS:

Time-clocks are also available for lighting control and offer a little more flexibility than simple photo-eyes. Generally, time-clocks are used for groups of fixtures rather than individual ones since they are more expensive and require access for making any programming changes. Time-clocks can offer additional benefits where different time cycles are needed at different areas. For example, perimeter lighting mounted on a building may be programmed to go off early in the evening when workers have left, but parking area lighting may be kept on until late in the evening or all night for security reasons.

STEP-DRIVERS:

Fixtures are now becoming available that have built-in step drivers or dimmers. A step-driver allows the fixture to be run at a reduced light level to save energy late in the night when the need for brighter light is not as critical. Step dimmers can be controlled by a remote time-clock or switch, although some step drivers are being produced with photo-eyes that automatically reduce the lighting level half-way through the night. LEDs are particularly well-suited to this type of control.

MOTION SENSORS:

As the name applies, a motion sensor only activates the associated light when there is someone in proximity and commonly used to enhance security. Because people or moving objects are usually not outside late at night, significant savings are possible by using a motion sensor to either dim or turn off the light during unoccupied times.

COMBINATIONS OF ABOVE:

All of the above controls can be used in combination. However, each degree of control becomes an added cost to the system so that the energy saved with each added feature must be weighed against these additional costs. Combinations of controls may be most cost-effective when larger numbers of light fixtures are being controlled.

Any use of control strategies beyond simple photo eye control will yield additional savings in energy and its cost. A simple step driver that turns the wattage down to half in the middle of the night will yield an additional 25% savings for the system. Bear in mind that unless the lighting system is owned wholly by the municipality, control options will be limited. Straight utility leasing will only have photo-eye controls, while municipal-owned fixtures mounted on utility poles will only have self-contained fixture-centric control options, such as photo eyes with step dimming the only cost effective possibilities.

STEP 8: PREPARE A FINAL PROJECT SCOPE AND BUDGET

Based upon the information gathered in Steps 1–6 above, prepare a final scope of work and budget for improving the efficiency of municipal outdoor lighting.

PREPARE PROJECT SCOPE:

The following is a list of the elements that should be checked off as part of preparing the project scope:

- Remove unneeded streetlights: As noted earlier, the most cost-effective step is to identify those areas and locations where outdoor lighting is unnecessary and where removal of fixtures will still provide adequate light but at reduced levels.
- Replace existing fixtures with new LED fixtures: Determine quantities and locations of each type of existing fixtures which are to remain and there replacement types. At a minimum, you need to find comparable LED based lighting that can perform equivalently to the existing light fixture. Be sure to evaluate if there are specific locations that can have their lumen output reduced and still be effective for their function.
- Add new fixtures, if needed: There may be some circumstances where supplemental lighting really is needed to improve unsafe conditions or correct deficiencies in required performance. Any significant and completely new major lighting initiatives should be conducted with the aid of professional consultants or designers.
- Determine lightings controls: Be sure to include how lighting controls will fit into the overall project scope. Simple lighting controls, such as a photo-eye, will be built into each fixture as an optional feature. This will raise the price nominally for the fixture, but no other installation or operational costs are required. Control methods, such as time-clocks or motion sensors, will entail additional installation and maintenance costs and should be anticipated as part of the project cost. If your municipality already has time-clocks or other control system in place, it most likely will be able to be reused as is for any retrofit applications.

CREATE A PROJECT BUDGET:

Once the project scope has been determined, prepare a project budget that can be used as a basis for procuring funds and implementing the work. All anticipated costs should be included as best as can be determined.

It is important to include both hard and soft costs for the project estimate, including the projected energy-savings and payback. Hard costs include the costs of the actual light fixtures, the conduit and wires needed to circuit them, the controls components, and the contractor cost to install them, among other costs. Soft costs include designer fees (for more complex projects), public review meetings, project management, and any un-depreciated costs for early retirement of fixtures. Most hard costs tend to be at least

anticipated, while soft costs are more likely to be forgotten or underestimated. It is best to really try to budget for all likely possible costs that could occur or be needed and then add an additional 10% contingency for unforeseen conditions and adjustments.

A typical summary chart shown below can be used for estimating a project budget. The estimated current costs for simple replacement of existing light fixtures with new LEDs have been included and assume self-contained photo-eyes as the base control means. Costs for installation are based upon recent utility fee estimates for replacing a fixture on an existing utility pole. Costs for design fees for significant system changes or implementing other controls will be project specific. The pricing below will also change with time and varying market conditions so be sure to keep a contingency fund as part of the total budget.

TABLE 3: BUDGET TEMPLATE FOR MUNICIPAL OUTDOOR LIGHTING PROJECT*

Budget Item	Quantity (A)	Cost per Item (B)	Total Item Cost (A x B)
Consultant Fee	1		
Replace small wattage light (>100 watts)	X	$350	
Replace medium wattage light (100–200 watts)	X	$550	
Replace large wattage light (<200 watts)	X	$750	
Add new fixtures (if any)	(add up total of x's above)	$ (as needed for sizes and quantities)	
Power company installation fee	(add up total of x's above)	$200	
Un-depreciated/Early Requirement Costs (if any)	1	$100	
Additional design fees	1	(as needed)	
Additional controls system cost	1	(as needed)	
Project management costs		(as needed)	
Total Project Cost			
10% Contingency			
TOTAL PROJECT BUDGET			

*The costs provided are rough estimates and should only be used for rough budgetary purposes. Actual costs may vary widely.

CALCULATE ENERGY SAVINGS:

The energy savings from an LED lighting retrofit can be substantial. The follow chart gives an indication of the typical savings that can be achieved from simple one-for-one replacements, with photo eye control for all night operation of the fixture. Additional controls will yield greater savings. Efficiency Vermont can assist in determining the energy and cost savings for the project.

TABLE 4: TYPICAL ENERGY-SAVINGS ANALYSIS

System Type	Typical Wattage	Annual Energy Use (KWH)	LED Replace Wattage*	Annual Energy Use(KWH)	Annual Energy Savings (KWH)
100 W mercury vapor	125	547.5	34	148.9	398.6
70 W metal halide	94	411.7	55	240.9	170.8
100 W metal halide	125	547.5	70	306.6	240.9
175 W metal halide	205	897.9	140	613.2	284.7
250 W metal halide	295	1,292.1	195	854.1	438.0
70 W high pressure sodium	94	411.7	70	306.6	105.1
100 W high pressure sodium	122	534.4	70	306.6	227.8
150 W high pressure sodium	189	827.8	140	613.2	214.6
250 W high pressure sodium	300	1,314.0	195	854.1	459.9

*Replacement Wattages listed are approximate. Actual replacement wattages may be higher or lower than those listed depending on the specific situation. Specific replacement wattages for each LED project should be determined by a lighting professional using a photometric analysis of foot-candle light levels.

STEP 9: BUILD SUPPORT

One of your key steps will be to enlist the support of your local elected leaders, such as selectboard and/or city council, and your town citizens. Your committee should work in lock-step with your selectboard from the project outset and throughout the entire process to help ensure their endorsement of any funding requests. It is absolutely critical that you build support among elected officials and residents for making energy efficiency improvements — before you ask for funds. For those towns that already have an energy committee, a sub-committee specifically assigned to this project may be in order to best focus on its particular needs and benefits. If you have done your job, the selectboard/city council will work with you to develop the appropriate funding approach.

Ask to be on the agenda of a selectboard's meeting to inform them of your interest in reducing municipal lighting energy costs, and to solicit their input on how to best proceed.

One of your key tasks is to clearly communicate information about the costs and potential savings in manner that is easy for the public and elected officials to digest. Thus, it is worthwhile spending the necessary time to prepare clear and factual informational materials about what efficiency improvements will be made, associated energy savings and costs, and the payback period. It is also helpful to use graphics to display the information. Further, your committee should make the information available through a variety of forums, including setting up a table at town meeting, publishing articles in the local newspaper, sending out e-mail alerts, and even holding a public information meeting.

With the rise in social networking options and interests, the use of internet based communication avenues could be quite beneficial. The Front Porch Forum may be available in your community as a public soap box and dialog for issues and projects such as this. Accounts on Twitter or Facebook could be set up specifically to follow this project, get the word out, and solicit public input.

Also, many manufacturers of LED lighting products are willing to loan or sell a sample of their light fixtures so that a demonstration of the look and effectiveness of an LED product can be observed and experienced first hand. The town of Hartford had several models demonstrated before choosing the product line for their town.

STEP 10: SECURE FUNDING

Energy efficiency improvements require upfront capital investments that pay for themselves in reduced energy costs over time. Efficiency investments should be considered on par with other investment decisions by your town. As mentioned earlier, LED retrofit projects yield simple paybacks under 5 years unaided, and considerably less with outside funding or incentives.

Municipalities have a variety of funding options at their discretion that can be utilized for energy efficiency improvements. Your municipality may choose to combine or leverage several of these options which include:

DISCRETIONARY FUNDS:

Many towns have a budget line item called "Road Repairs/Maintenance/ Improvements." These monies are appropriated at the selectboard's discretion and can be a good source of funding for relative small sums (up to $5,000), that can be applied for towns requiring a relatively small public lighting system improvement project.

BUDGET ITEMS:

A line item in the town budget is probably the most common approach to financing building efficiency measures. Budgets serve as a way of communicating with residents about the scope of the proposed improvements, and the relative costs and benefits of the project. This financing mechanism is ideally suited for moderate amounts of funding.

BONDING:

If the cost of efficiency improvements is substantial, a bond issue may be appropriate. Bonding for energy efficiency is usually financed through general obligation bonds (i.e., the bonds are paid in yearly increments out of general revenues.) Bonds can be a favorable financing option depending on the expected net energy savings and costs. If the annual expected energy savings exceed the annual debt service of the bond, this results in a favorable cash flow. Factors affecting whether to bond include receptiveness of residents toward additional indebtness and other capital needs of the town.

GRANTS OR REBATES:

There are a number of potential grant funding sources for municipal building efficiency improvements. These include:

AMERICAN RECOVERY AND REINVESTMENT ACT (ARRA):

ARRA has money available through the Energy Efficiency and Conservation Block Grant (EECBG) program. This grant program is designed to assist eligible entities, including municipalities, in implementing energy efficiency and conservation strategies to reduce fossil fuel emissions, reduce total energy use, and improve energy efficiency in the transportation, building, and other appropriate sectors. These funds are administered through the Vermont Clean Energy Development Fund (CEDF). See http://recovery.vermont.gov/energy for current information on the Vermont-specific energy funding and www.eecbg.energy.gov/ for more information on the block grant program.

EFFICIENCY VERMONT:

As the state's energy efficiency utility, Efficiency Vermont provides technical assistance and financial incentives to Vermont households and businesses, to help them reduce their energy costs with energy-efficient equipment and lighting and with energy-efficient approaches to construction and renovation. For more information, contact Efficiency Vermont at 1-888-921-5990 or visit www.efficiencyvermont.com.

STEP 11: IMPLEMENT PROJECT

Once you have secured project funding, it is important to develop an implementation plan. Below are some of the steps that need to be taken to make your project a reality.

ESTABLISH PROJECT MANAGER:

You will want to meet with responsible committees or municipal government board to assign a project manager to oversee responsibility of the process. Since municipal funding will be involved, there must be a clear understanding of the municipality's need for proper documentation and record keeping regarding billing and contract fulfillment. Start a job folder or a three ring binder and neatly organize all information pertinent to the project and keep meeting minutes for all meetings and copy all attendees and other interested parties.

SECURE THE OUTSIDE DESIGNER OR CONSULTANT FOR PROJECT (IF REQUIRED):

You will want to secure an outside consultant as soon as the project gets the go ahead from the municipality or voters.

ESTABLISH TIMELINE:

It is important to anticipate key milestones for reference, and hold regular job meetings with key participants to assess progress and air any concerns along the way. You should allow at least one month's time to get a formal plan together with enough information on specific quantities and types of fixtures involved for bidding (longer for larger or more complicated plans), and give two weeks minimum time for the bidding of materials once the design and work scope has been completed. Installation time will vary based upon the extent of the work requested, but generally you will want to allow 4–6 weeks for the receiving lighting products once ordered, and allow a budget of two hours install time per fixture replaced by utility crew.

PROCURE LED LIGHTING FIXTURES:

If the municipality has decided to take over or retain ownership of the lighting fixtures, a bidding process will need to be developed to procure the LED fixtures. A bidding document and specification will be required to ensure that the municipality procures the lowest price product that meets the specifications. In the bidding document, be sure to ask for unit pricing (for each main item) for miscellaneous adjustments that may come up along the way. You also may want to include a small percentage of key spare parts with the bid package. In the bidding document, you will want to include language about holding bid prices for at least 60 days so that a final best choice can be made if different product lines are being considered. If this is a larger project and a project manager has been included with the budget, bring the project manager on board so that he/she can get familiar with the details of the project and be able to help with the bidding process and review.

Once bids are received, review and compare bids, decide on the winner that best fits overall needs and desires for community. Be sure to hold all received bid info in confidence until the final bid day and time has passed. Once you have selected the winning bidder, you will need to sign a contract signed between municipality and the winning bidder using standard town contract form or equipment purchase order. Be sure to keep a percentage of payment requests as retainage, if products or services for the project are not 100% delivered at the time of the billing invoice. This helps to ensure that you will get a completed project.

CONCLUSION

Vermont municipalities are eager to move forward with saving energy. Municipal outdoor street lighting offers enormous opportunities for reducing municipal electric bills. This guide is intended as primer to help Vermont municipalities take the steps necessary to reduce municipal street and public lighting costs.

APPENDIX A

TOWN OF HARTFORD VERMONT – CASE STUDY

The following study describes how the Town of Hartford, Vermont recently conducted an evaluation of their street lighting system and solicited bids for replacement of over 300 of their municipal light fixtures.

BACKGROUND:

The Municipality of Hartford is composed of several villages and districts, including White River Junction, Wilder, Hartford, and Quechee. In an effort to reduce municipal expenses, Town Manager Hunter Riesenberg worked with the Highway Superintendent Allyn Ricker and Town Engineer Chuck Wise to evaluate if savings could be generated from reducing the amount of outdoor public lighting provided by the municipality. In April 2010, Green Mountain Power Corporation (GMP) revised their tariff regarding outdoor public lighting which allowed customer-owned fixtures installed on their leased poles and also providing for LED leased lighting options as well. Hartford wanted to see if the new tariff was cost-effective to their needs and desire. GMP provides leased lighting for about 85% of the town.

PROCESS:

The Hartford team first conducted an inventory of the Municipality's outdoor public lighting. They found 860 street lights within the Town of Hartford. Originally, 562 of those street lights were paid by the municipality, the remaining being privately installed and funded. After the team's first lighting review, the Municipality recommended that 207 of those fixtures be removed, 7 more be added in critical locations, and 348 be kept at their present location. Of those remaining 348 light fixtures, 300 were identified as making economic sense because they were covered under the new GMP tariff.

Next, the Hartford team conducted a technical evaluation to determine which lighting could be replaced with more efficient light fixtures. The Municipality hired Kirick Engineering Associates (KEA) to help evaluate the new tariff structure, get an understanding of what LED quality products were available, and to determine if the option of purchasing new LED based lighting would be cost-effective. The analysis matched specific products from Efficiency Vermont's incentive approved list of LED manufacturers to the existing lighting types to be replaced. The vast majority (80%) of the existing fixtures cited for replacement were 100 watt mercury vapor fixtures, with smaller quantities of 70 watt mercury vapor and 400 watt mercury vapor.

KEA then assembled a Request-for-Quotation (RFQ) for bid pricing for each of the manufacturer's specific product lines, with fixture counts for each type required. Since GMP and the Municipality of Hartford could not agree at the time of RFQ on the actual counts of the existing fixtures being leased, a unit pricing quote for each fixture type was included with the RFQ so that field adjustments could be made when the exact counts were determined.

Once bids were received, each manufacturer was given the opportunity to present their case, show samples of the proposed fixtures (each manufacturer's product had a different look), and verify warrantees and life expectancies of the various components that may need maintenance. The Municipality also wanted to know how much of each product was

American made. The Municipality decided to use simple photo-eye controls for all-night lighting and wanted to ensure controls being used for the LED replacements matched those used by GMP to better facilitate future maintenance.

RESULTS:

The following spreadsheet shows the final results of the bidding process. The bid is based upon a total of 307 fixtures. The total installed cost includes anticipated electric company undepreciated cost penalties and estimate for their crews to install. Efficiency Vermont's incentive is based upon $300 per LED fixture installed. Simple payback calculations are based on a blended average of all the fixture installed costs and annual operational costs, as well as projected annual savings generated from the installation. Projected annual savings are consistent due to GMP's tiered tariff structure which has a consistent fee regardless of slight variations in wattage use within the tier.

As of October 2010, Hartford had begun the project and expected to be completed before 2011.

Bidder	Fixtures Cost (Bid)	Total Install Cost	Efficiency Vermont Incentive	Simple Payback in Years (without incentive)	Simple Payback in Years (with incentive)	Total Annual KWH Saved	Projected Annual Cost Savings
Bidder A	$95,626	$187,726	$50,000	4.44	3.26	130,288	$42,245

APPENDIX B

V.P.S.B. No. 291

GREEN MOUNTAIN POWER CORPORATION
ALL DIVISIONS
OUTDOOR LIGHTING RATE 18

SECTION 1

A. AVAILABILITY:

Street, area and flood lighting, traffic signal and specialty lighting equipment, energy and maintenance service is available within Green Mountain Power Corporation's ("GMP") service territory under this rate for GMP-owned or Customer-owned equipment to any city, village, town, fire district, political subdivision, Customer association or individual Customer in accordance with the specifications hereinafter set forth.

SAMPLE – DO NOT USE

SECTION 2

A. TERMS AND CONDITIONS TARIFF:

GMP's other Terms and Conditions tariff in effect from time to time, where not inconsistent with any specific provisions hereof, are a part of this Rate 18.

B. DURATION:

For traffic signal, street lighting and flood lighting, the term of service is one year from the date of installation and thereafter until cancelled by the Customer on 60 days written notice. GMP may allow earlier termination at its sole discretion upon a showing of extraordinary circumstances. For temporary, decorative holiday lighting, the term of service is the duration of the holiday season.

C. SUSPENSION OF SERVICE:

Where service has been suspended at the Customer's request, the minimum charge shall not be applicable during such suspension, but in lieu thereof, an initial service fee of $35.00 plus

a reconnection fee of $35.00 during working hours or $150.00 during other than normal working hours shall be made when service is re-established at the request of the Customer. For each connection required, service may not be suspended for a period of less than four months.

Move Ins-Move-Outs: GMP shall provide a credit of $35.00 to any customer whose Move In or Move Out order is not completed within three business days of the date promised to the customer on the Service Order. See Terms and Conditions tariff for additional credit instructions.

D. LATE PAYMENT CHARGE:

Payment for service under this rate is due on presentation of the monthly bill. If GMP on or before the next monthly billing date does not receive payment, a late payment charge of 1% shall be imposed upon the unpaid balance, including any prior unpaid late payment charges. The late payment charge shall be assessed on such unpaid balances once each month after it is initially imposed on an unpaid balance, so long as a balance remains unpaid. The Late Payment charge is not applicable to residential accounts.

SAMPLE – DO NOT USE

E. STREETLIGHT INSTALLATION:

GMP will furnish to the Customer, installation standards upon request for the type of lighting system proposed. GMP will complete new installation of less than three streetlights within seven business days of the Lighting Application being submitted to GMP. This completion standard shall apply to orders of less than three streetlights and where the poles and electric service for the light fixtures already exist.

F. INCOME TAX SURCHARGE:

All charges billed to the Customer for installation costs under this tariff will be increased by the current tax liability to cover the cost to GMP of federal and state income taxes payable on contributions-in-aid-of-construction. Customers who build their own lighting systems and then

transfer ownership to GMP will be charged the income tax surcharge based upon the Customer's actual costs of building the system. The Customer will be responsible for providing GMP with documentation of their actual costs. If the Customer fails to provide actual cost data, GMP will assess the surcharge based upon GMP's estimated value of the lighting system.

G. ALTERNATIVE REGULATION PLAN

This tariff is subject to the GMP's Alternative Regulation Plan Rider ("ARP Rider"), which includes a quarterly Power Adjustor and an annual Earnings Sharing Adjustor; except that the Power Adjustor does not apply to service under this tariff. These Earnings Sharing Adjustor appears as a separate line item on the Customer's monthly bill. For a complete description of these adjustors, see the ARP Rider.

SAMPLE – DO NOT USE

SECTION 3

A. GMP-OWNED EQUIPMENT ON GMP POLES:

In the case of lights owned by GMP and installed on GMP owned poles, GMP shall furnish, and maintain all poles, wires, lamps and other associated equipment and furnish energy at the rates set forth below. Reference to GMP-owned poles in this Rate 18 shall include poles solely and jointly owned.

STREET AND AREA LIGHTS

Mercury Vapor*			Sodium Vapor		
Watts	Lumens	Price/Month	Watts	Lumens	Price/Month
100	3,200	$13.45	70	5,200	$13.70
175	7,200	$16.55	100	8,500	$15.12
250	9,800	$23.94	150	14,400	$17.34
400	17,500	$30.98	200	19,800	$20.09
			250	24,700	$22.13

*Not available for new installation. Applicable to Mercury Vapor installed after April 30, 1992; prior mercury vapor installations are subject to Rate 16. Failed/inoperative mercury vapor street and area lights will be replaced by GMP with light emitting diode ("LED") lights and billed to the Customer at the charges for LED lights set forth below.

	LED		
20 LED	2070 Lumens	42 System Watts	$12.99
30 LED	3105 Lumens	60 System Watts	$14.35
40 LED	4140 Lumens	84 System Watts	$16.44
50 LED	5175 Lumens	99 System Watts	$17.70

FLOODLIGHTS

	Sodium Vapor	
Watts	Lumens	Price/Month
250	24,700	$24.50
400	45,000	$30.74

SAMPLE – DO NOT USE

B. ORNAMENTAL LIGHTING AND POLES:

GMP shall own, supply and maintain all ornamental lighting and poles, with energy supplied by underground facilities at the rates set forth below. Installation of ornamental poles, luminaries and wires will be paid for by the Customer as a line extension under GMP's line extension tariff and Public Service Board ("PSB") Rule 5.600. The Customer will be required to purchase and install 2" Sch. 40 electrical grade EPVC conduit and install pre-cast concrete bases for mounting the light poles. Customers should contact GMP's engineering department for details and assistance.

Sodium Vapor

Type	Watts	Lumens	Price/Month
Road Cut-Off	70	5,200	$13.70
Road Cut-Off	150	14,400	$17.34

LED

20 LED	2070 Lumens	42 System Watts	$12.99
30 LED	3105 Lumens	60 System Watts	$14.35
40 LED	4140 Lumens	84 System Watts	$16.44
50 LED	5175 Lumens	99 System Watts	$17.70

SAMPLE – DO NOT USE

C. CUSTOMER-OWNED LIGHTS ON GMP-OWNED POLES:

Customers may purchase from outside vendors and own all lighting equipment necessary for a lighting system, including luminaries, arms, brackets, photo cells, bulbs and other associated equipment necessary to provide street and area lighting in compliance with GMP's standards with specifications subject to GMP's prior approval. GMP or its approved contractors shall install customer owned lighting systems on GMP owned poles at the Customer's expense.

GMP shall maintain all streetlight systems on all GMP owned poles as set forth in Section 4 below. The charge for the rental of poles for Customer owned lights on GMP's poles is $4.00 per quarter per pole or such other rate from time to time in effect for Other Attachees under GMP's tariff, Rules and Regulations for Pole Attachment Service and PSB Rule 3.700. GMP shall own and maintain all poles, wires and other equipment and apparatus necessary for supplying secondary voltage to Customer owned lighting systems on GMP owned poles.

D. CUSTOMER OWNED LIGHTS ON CUSTOMER OWNED POLES:

On Customer owned poles, 1) the Customer may furnish and install all poles and associated equipment either overhead or underground, if in compliance with GMP standards with specifications subject to GMP's prior approval or 2) at the Customer's request, GMP will install, in compliance with GMP standards, all poles and associated equipment based on a time and material bid price. The Customer shall have the choice of maintaining the streetlight system or having GMP provide maintenance as set forth in Section 4 of this tariff. The Customer will be required to own and maintain all equipment on the Customer's side of the meter.

E. SYSTEM CONVERSIONS FROM AN EXISTING LIGHTING SYSTEM TO AN ALTERNATIVE LIGHTING SYSTEM:

GMP will have the right to require those Customers wishing to modify an existing lighting system to reimburse GMP for the undepreciated cost of the existing lights plus all costs, including make-ready costs, of making the conversion not recovered in the monthly charge for alternative lights.

SAMPLE – DO NOT USE

SECTION 4

A. MAINTENANCE SERVICE TO CUSTOMER-OWNED LIGHTING SYSTEMS:

GMP will provide maintenance service described below for Customer-owned lighting systems on GMP poles and for Customer owned lighting systems on Customer owned poles where so chosen by the Customer as provided in paragraph D above 1) for a fixed monthly fee of $3.34 per month per lamp, regardless of size or 2) on an actual time and materials basis, at the Customer's option. Maintenance service for limited access highway lighting and the associated access and exit ramps is subject to the regular monthly maintenance charge of $3.34 plus a monthly maintenance surcharge of $2.73 per light per month to cover GMP's additional costs of performing routine maintenance on limited access highways.

Maintenance of the luminaire shall include replacement, as necessary, of the lamp, and photoelectric control. GMP will supply the materials as part of the monthly maintenance fee as long as they are GMP stock items. For non-standard GMP fixtures, the Customer must provide and maintain a spare parts inventory. Maintenance services will not include painting or other maintenance services for customer-owned ornamental poles.

If the luminaire, poles or other equipment must be replaced as a result of vandalism, accident or any other cause, the Customer shall pay to GMP the cost of removal of the existing equipment and the cost of the new equipment including installation costs. The Customer shall also pay for actual costs of any materials and labor necessary for maintenance and repairs above and beyond lamp and photo cell maintenance described in the preceding paragraphs including repairs and/or for the replacement of any physically damaged lighting equipment, regardless of the cause, nature or extent of physical damage.

GMP will perform maintenance and lamp replacement during normal working hours and will complete the repair within seven business days of being notified.

SAMPLE – DO NOT USE

SECTION 5

A. HOURS OF OPERATION:

Street, area and floodlights, which are photo-cell controlled, shall be operated each and every night from one-half hour after sunset until one-half hour before sunrise, a total of approximately 4,380 hours each year.

B. ENERGY SERVICE TO CUSTOMER-OWNED LIGHTING SYSTEMS:

GMP will supply unmetered electric energy for Customer-owned outdoor photovoltaic cell controlled lighting equipment totaling approximately 4380 hours of operation per year for traffic control lighting, for temporary decorative holiday lighting, and for limited access highway lighting at the rates set forth below. The annual kWh consumption shall be determined by GMP based upon the total nominal wattage of the equipment, multiplied by the average number of

hours of operation each month. The rates specified below for photo-cell controlled lighting equipment are based on average daily operation of approximately 12 hours. For installations greater than 1,000 watts, a multiple of the 1, 000-watt rate will be utilized based on the total installed usage.

No billing adjustments will be made for individual service outages. For lighting systems maintained by the Customer it is the Customer's responsibility to provide proper and timely maintenance to equipment to minimize outage time. If GMP is providing maintenance, it is the Customer's responsibility to notify GMP immediately of any failure of lights to operate.

SAMPLE – DO NOT USE

ANNUAL, MONTHLY AND DAILY RATES

PRICE PER LAMP OR HOLIDAY INSTALLATION

Lamp or Holiday Installation Nominal Power Rating (Watts)	Annual Rate	Monthly Rate	Daily Rate
60	$ 38.33	$ 3.19	$0.105
70	$ 46.36	$ 3.86	$0.127
100	$ 59.50	$ 4.96	$0.163
150	$ 82.13	$ 6.84	$0.225
175	$ 94.17	$ 7.84	$0.258
200	$ 105.12	$ 8.76	$0.288
250	$ 128.12	$ 10.67	$0.351
400	$ 195.28	$ 16.26	$0.535
1000	$ 467.20	$ 38.91	$1.280

Monthly LED Energy Only Rates to Customer Owned Lighting Systems

20 LEDs	42 System Watts	$1.60
30 LEDs	60 System Watts	$2.15
40 LEDs	84 System Watts	$2.90
50 LEDs	99 System Watts	$3.36

Pole Rental fee for Customer Owned Lights on GMP poles:

$4 per quarter per light; Billed quarterly based on GMP's $16 annual rate under its Tariff, Rules and Regulations for Pole Attachment Service and PSB Rule 3.700 to reflect each light in service at the end of the quarter. The charge will be adjusted as required to reflect the rate from time to time in effect for Other Attachees under said Tariff.

EFFECTIVE:

Effective on a bills rendered basis on or after October 1, 2010.

Issued: August 25, 2010.

By: _____

Title: VP, Power Supply & Risk Management

SAMPLE - DO NOT USE