REALTERM ENERGY

How many people does it take to change a streetlight?

INFRASTRUCTURE CHALLENGES AND LED STREETLIGHT UPGRADE INSTALLATION BEST PRACTICES

This White Paper outlines many of the challenges surrounding the current state of streetlight infrastructure across North America and describes installation and project management best practices related to LED upgrade projects.

INSTALLATION BEST PRACTICES WHITE PAPER

Streetlights are all around us, and if you're like most people you don't normally pay a lot of attention to them until there's a problem, or you are considering an upgrade. For the uninitiated, an upgrade to LED streetlights would seem to be as simple as changing a light bulb, only on a bigger scale. By now, you have heard many variations of the joke: "How many (insert group here) does it take to change a light bulb?" Before proceeding, we'd like to share three of our favorites:

How many psychologists does it take to change a light bulb?
None, but the light bulb has to want to change.

How many folk singers does it take to screw in a light bulb?
Two. One to change the bulb, and one to write a song about how good the old light bulb was.

How many existentialists does it take to screw in a light bulb?
Two: One to screw it in and one to observe how the light bulb itself symbolizes a single incandescent beacon of subjective reality in a netherworld of endless absurdity reaching out toward a cosmos of nothingness.

While the jokes pertain to the common household light bulb, it's fairly common that many approach changing their municipal streetlights in the same fashion. Since the earliest days of the electric streetlight, maintenance has more or less been confined to changing burnt-out bulbs, with almost no consideration for design. If it felt underlit, just replace it with a higher wattage, like one would do at home. After all, goes the thinking, how hard can it be to change a few streetlights?

The answer is, it depends.

DID YOU KNOW?

Early oil-based lamps were used by the Greeks and Romans to protect travelers from hazards and for keeping potential robbers at bay. Since then, there have been several major advancements in the efficiency of both the energy source (candle→whale oil→gas→electricity) and light fixtures (glass lanterns→arc lamps→incandescent→high-intensity discharge <metal halide and high-pressure sodium>→LED). While most communities benefit from a wide variety of decorative lighting fixtures to give character to the streetscape, by and large the provision of streetlights remains primarily motivated by public safety.

Given this focus on public safety, it is a little odd that unlike the maintenance of roads and highways (which are strictly governed by standards and generally carry hefty penalties for contravention), there are very few standards that govern the actual delivery of light to the street. It seems that the simple provision of light sources has been the primary consideration, while such factors as energy efficiency, good design, potential light pollution, ongoing performance, maintenance, and others, have been more of an afterthought.

Most major cities have developed their own standards, but generally these are either engineering standards for such physical elements as overhead wiring, poles, and fixtures, or aesthetic-driven guidelines around what is acceptable in the downtowns and other targeted areas. However, very few municipalities have detailed standards or guidelines around their ongoing operation. It's as if we all just take it for granted because it's just there, part of the urban furniture, and therefore overlooked.

The complexity and resources required to upgrade a streetlight network to LED depend upon the state of the current infrastructure, the scale of the project, and the desired outcome in terms of project management and product performance. This paper will examine the first two factors and describe some best practices around installation and project management.

STREETLIGHT INFRASTRUCTURE MANAGEMENT

It's unlikely that anyone enters municipal politics with a burning passion for streetlights. Elected officials have an incredibly wide range of issues to grapple with, and streetlights are usually far, far down on that list. Only recently have technological advancements and the compelling economics of upgrading streetlights to LED pushed this issue back on the radar screen of elected officials and the staff that assist them in their deliberations. The same applies for most Boards of Directors at municipal and cooperative utilities that provide street lighting services.

In addition to budgetary concerns, politics and the lack of legal standards, there are two other obstacles standing in the way of proactive streetlight management: the lack of accurate inventories and fragmentation of ownership. There's a popular adage that states that if you can't measure it, you can't manage it, and this applies perfectly to streetlight operations and maintenance. The vast majority of municipalities do not have an accurate idea of their monthly energy or maintenance costs nor of their current inventory. While those communities or utilities that own their own streetlights usually have a decent idea of their energy costs (though the accounting of maintenance costs varies dramatically), it is exceptionally rare to find one with a complete inventory of all fixtures and their individual attributes (see our White Paper on Photometric Design for a complete list). For those that own none or only some of their lights, it is common to see significant discrepancies in what the utilities and municipalities believe is physically on the street, versus what's actually there. In our experience in analyzing well over 200 communities, we have found that when comparing the city's inventory with those of the utility, both end up being wrong, sometimes significantly so – 100% of the time!

While some systems are incredibly well maintained, most current streetlight networks have certain weaknesses such as wire deterioration, poor pole condition, a lack of proper fusing, and a lack of bonding. As previously mentioned, the lack of legal standards has led to inconsistency in specifying new streetlights as well as their actual operation and maintenance. Not surprisingly, inconsistent policy often results in erratic enforcement, which has further compounded other challenges (see below). As a result, anyone considering an upgrade should plan on encountering some potential hazards.

A WORD ON MUNICIPAL STANDARDS

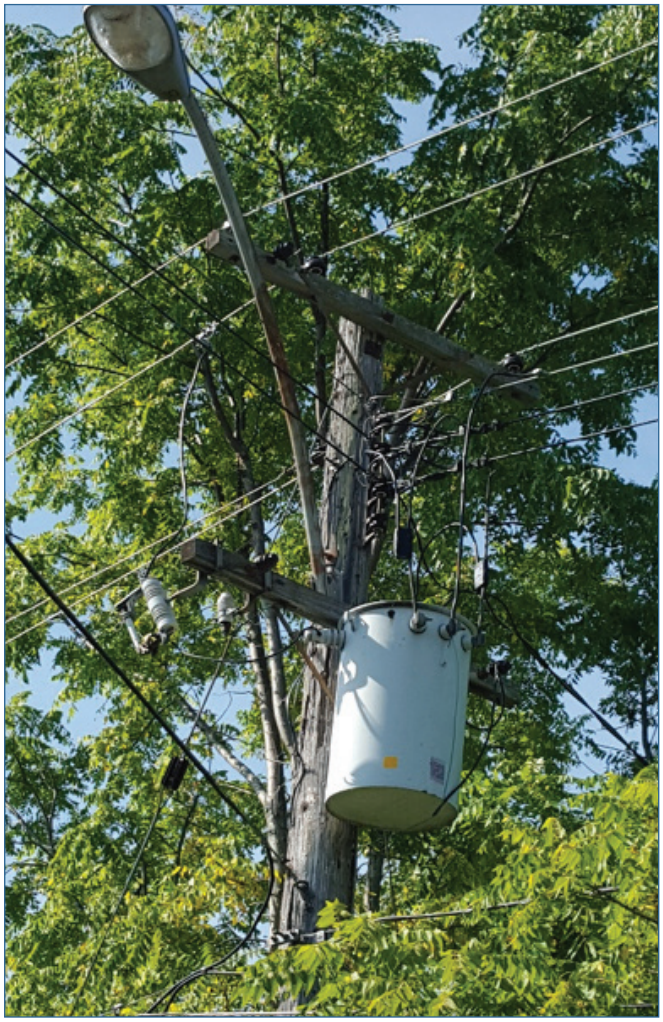
High quality municipal street lighting standards vary in detail but address how proposed lighting will: **(a)** contribute to roadway user safety, **(b)** assist in preserving the experience of the night sky, **(c)** provide respect for the privacy of residential space (minimize light trespass), **(d)** assist in the conservation of energy, **(e)** provide a consistent and standard approach to design, and **(f)** ensure financial sustainability with respect to construction, maintenance and operating costs.

The Illuminating Engineering Society (IES), the Municipal Solid State Street Lighting Consortium, the American Association of State Highway and Transportation Officials, and the International Dark Sky Association have some excellent technical information that is helpful for standards development. Certain state and country transportation departments can also offer some helpful guidance.

EXAMPLES OF HAZARDOUS INFRASTRUCTURE AND INSTALLATION PITFALLS

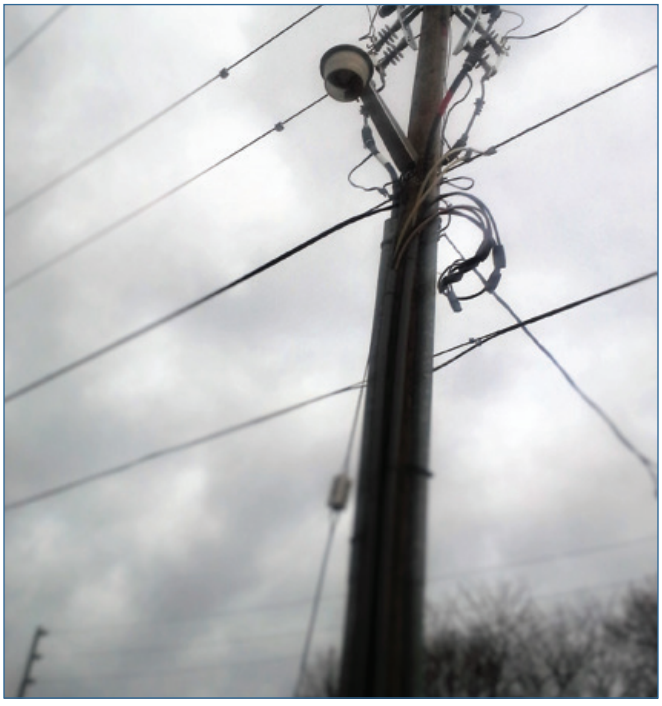
The quality and condition of wiring, fuses, poles, and arms all vary tremendously and should be scoped out fully during the asset inventory gathering-stage of the project. Failure to do so will almost certainly result in time delays and cost overruns during installation, and may cause significant and costly performance issues later on. Ungrounded poles can and do present what's known as a 'step-touch' hazard (whereby poles and other metal surfaces can become electrified), a dangerous and potentially life-threatening condition that must be dealt with immediately to ensure public and worker safety.

Access issues such as the one pictured below are also a common occurrence:



Other safety issues include the utility laying secondary cables across the back of the davit arm when they installed new poles:

Or when the fixture is much too close to the primary wire as in this example our team called the 'death trap':



Occupational electrical-related fatalities are a significant and ongoing problem and a particular hazard to those who routinely work near electrical sources. Studies have shown that the highest proportion of electrocution deaths is among electricians and apprentices, power linepersons, and those working in construction and manufacturing industries.

SAFETY FIRST!

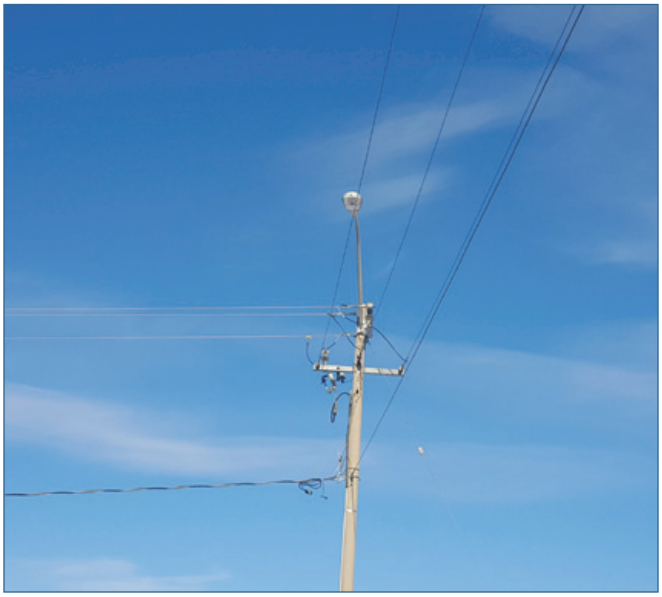
Contractors should comply with Industry Codes at all times

All quality installers will be familiar with the Codes and Standards that govern their industry. While certain states and provinces have local documentation, the National Electrical Safety Code published by the IEEE (or the very similar Canadian Electrical Code for Canadian projects) is a great place to start.

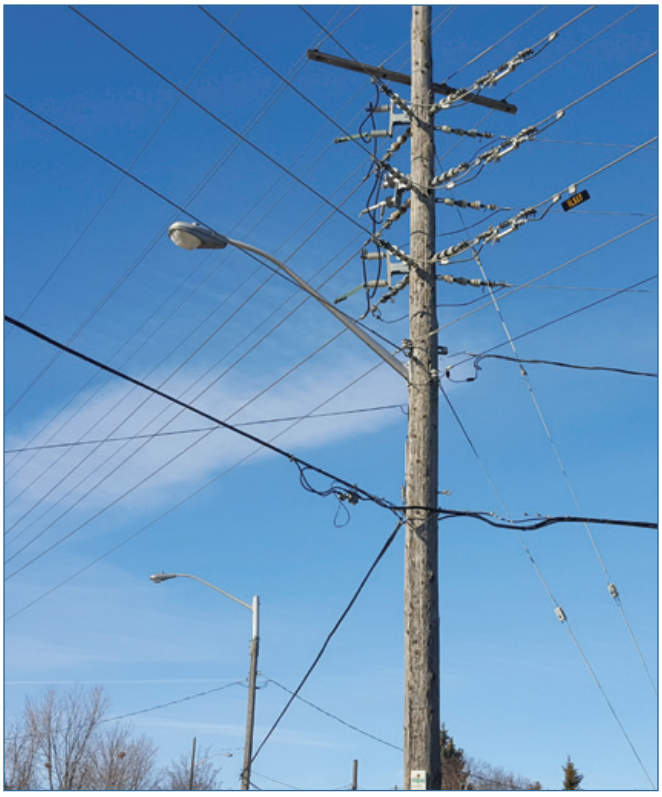
The Code has emerged as a foundational element in the culture of safety that has grown up around the business of installing, operating and maintaining both underground and overhead electric supply and communication lines, as well as conductors and equipment in electric supply stations. Utilities, contractors and others look to the code for practical safeguarding guidelines.

Primary wires are those at the top of the pole and usually carry from 1,000 to 46,000 volts of electricity from a substation. Only qualified personnel should go anywhere near primary wires and most utilities strictly limit or prohibit access.

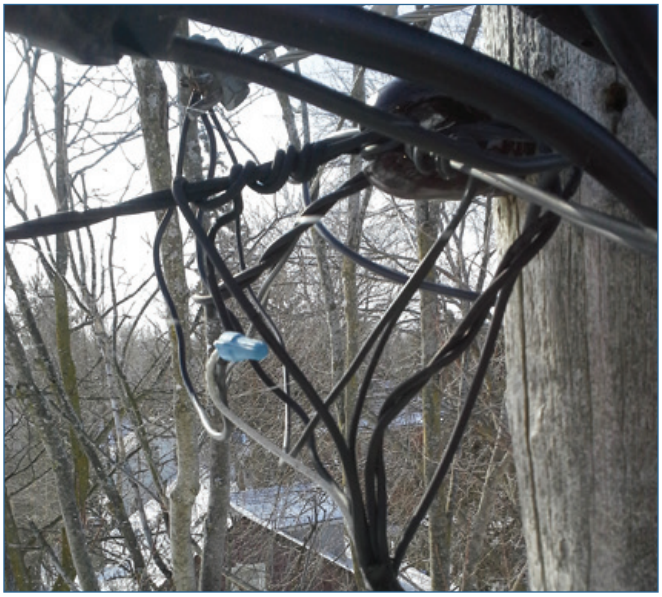
Sometimes you will inherit the mess that previous contractors may have left behind as in this instance (below), where the davit arm is mounted between and through the primary phases:



Or here in this double fail where the light in the foreground is too close to the primary cable and the one in the background is mounted on a loose metal extension on a wood pole:



It is also very common to see bad fuses, no fuses at all and wiring in all states of disrepair as in this tricky mess our install crews had to straighten out:

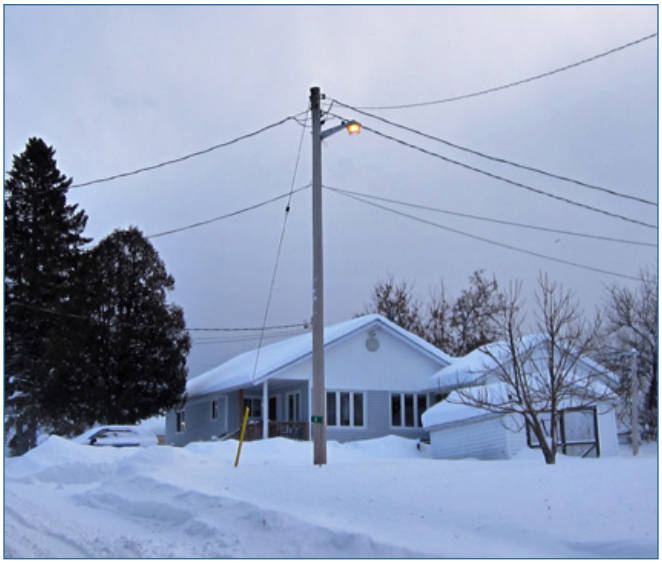


The importance of finding a reliable and experienced installation team cannot be overstated. First, your installers usually will have to be more than licensed electricians or journeymen but also skilled problem-solvers. They will also have to deal with the full range of weather issues including rain and heat, which slows down projects for different reasons (cold is usually not an issue), plus a wide range of insects and animals that are quite at home in the streetlight network, and are sometimes determined to stay that way.

DID YOU KNOW?

Birds, insects, and rodents can become long-term tenants inside both streetlight fixtures and poles. And like all such tenants they dislike being dislodged from their comfy homes. We've even had a startled mouse jump into the overalls of one of our installers, which sounds funny after the fact, but presented a genuine hazard to an equally startled installer 30 feet in the air!

Finally, it is also possible to run across some strange scenarios at times, as in this example, where the fixture is facing away from the street, illuminating only the resident's driveway:



HUMAN-FOCUSED INSTALLATION PITFALLS

Just like every other industry, levels of integrity can vary widely amongst installation contractors. Individual installers often can and do cut corners or exaggerate their experience, so take care with any firm that quotes significantly lower costs than the market rate. Similarly, not all installers deploy a disciplined approach to the actual installation, and this can lead to timely and expensive delays during the project, costly repairs later for sub-standard workmanship, or even failure to pass inspections.

Considerable efficiencies exist when inventories, routes, and crews are planned in advance. For example, a quality installer may have a higher hourly rate, but if he is efficient and organized, and can install more fixtures per day, without some of the issues that a less qualified firm might leave behind.

A high-quality contractor puts a premium on safety. Safe work practices need to be utilized at all times when working near powerlines and proper procedures put in place for operating High Reach equipment, loading and unloading of material, as well as proper use of ladders.

In certain areas, workers will also have to prevent against theft, vandalism, as well as homeless people trespassing into their vehicles. Police details may be required and should be considered for reasons other than simply closing down intersections.

INSTALLATION AND PROJECT MANAGEMENT BEST PRACTICES

The best practices outlined below are subjective in that they are defined by standard practices here at RealTerm Energy (RTE) as well as some other quality projects we have been fortunate enough to study. We have had the good fortune of working with many excellent municipal and utility staff people that have often suggested process improvements and helped us to improve upon deficiencies. As in life, most best practices are learned the hard way, and we share them with our readers in the hopes that they will avoid similar mistakes.

RTE prides itself on its excellent design processes that are supported by an accurate inventory of the actual assets, incorporating recognized roadway classifications and recommended practices for design. We do not proceed to the installation stage until these stages have been completed and vetted by the client, and we highly recommend that anyone considering an upgrade spend the time necessary for a proper GIS-based asset inventory and robust photometric design. In our considerable experience, it always pays off in the end.

As a LED streetlight specialist, RTE follows a very detailed installation and project management work flow. To enable your preparations for selecting a partner or even if you plan to do it on your own, there are seven general principles that should apply to any streetlight upgrade:

1) Plan and prepare for the delivery, unloading, and secure storage of new fixtures as well as the recycling of old fixtures in a properly licensed facility.

2) Utilize your initial inventory and designs to plan routes and equip installers with an App that stores a complete file on all of the work that is performed at each location. This both enables them to save time at each pole (versus paper records) and can allow you to see progress in real time.

3) Incorporate construction and road maintenance schedules (parades, road closures, etc.) into installation plans in advance to avoid the potential for time delays and cost overruns.

4) Hold a kick-off meeting between your staff, the installers, and the Project Manager to clarify scope, expectations, and reporting cycles.

5) Insist that your Project Management firm provides training for the installation teams and maintains an expert presence at the initial stages.

6) Conduct random inspections throughout the installation phase (concentrating on the earlier work at first) to ensure installers do a quality job throughout your community.

7) Insist on a full commissioning process that includes a sign-off on all services, training for staff, as well as an overview on maintenance and warranty provisions.

INSTALLATION CASE STUDY: CITY OF BARRIE

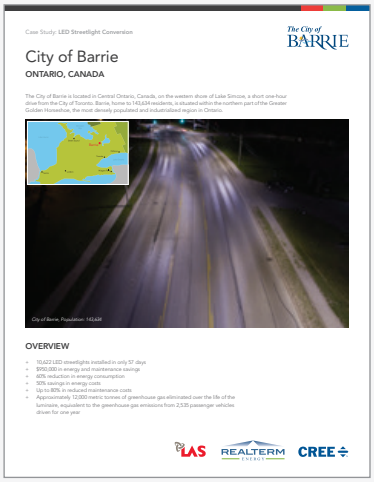
Barrie's City Council entrusted RealTerm Energy to assess its existing streetlight network, create an energy efficient and cost-effective street lighting design and coordinate the purchase and installation of the new LED lights.

"Many municipalities seemed to be going with a one-for-one replacement and we trusted the GIS mapping and the photometric design to bring additional value to the project," said Barry Thompson, Manager of Energy Management for the City of Barrie.

In the fall of 2015, RealTerm Energy delivered a complete turnkey LED streetlight upgrade in the City of Barrie. The Municipality had ambitious goals of finishing the entire project by the end of 2015 in order to qualify for a utility incentive. With a proven installation protocol that allowed for rapid deployment without any sacrifice in the quality of the installation, the conversion of all 10,622 LED streetlights was completed in 57 working days, several weeks ahead of the original completion date. Installation crews worked day and night to make this happen. RealTerm Energy also provided a real-time installation map that was posted on the City's website allowing the installation progress to be tracked by all residents.

"The LED streetlight conversion project went very smoothly. We found their field crew to be extremely responsive to any issues or requests we made and everything was done in a very professional manner," added Thompson.

An overnight success story….three years in the making.


Case Study: LED Streetlight Conversion

The City of BARRIE

City of Barrie

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OVERVIEW

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