Memo

Date: October 2, 2013

To: Community Development Committee
Commissioner Thomas Hawkins, Chair
Commissioner Todd Chase
Commissioner Randy Wells

From: Teresa Scott, Public Works Director

Via: Russ Blackburn, City Manager

Subject: City of Gainesville Street Lighting Practices and LED Use

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At the August 14, 2013 Community Development Committee meeting, Public Works staff was asked to provide information on the current street lighting practices including information on existing and planned implementation of LED lighting.

The Standard Practice for Public Lighting, last revised 2/8/1999, regulates the design of new roadway lighting systems in the City of Gainesville. Current standards are based upon guidelines from the American Association of State Highway and Transportation Officials (AASHTO) and the Illumination Engineers Society (IES) which have been updated subsequent to the last revision to City standards. A comparison of City standards with the most recently adopted AASHTO/IES guidelines is shown in Table 1. City standards are largely similar to the recommended AASHTO/IES guidelines; the primary diversion is in average footcandles, which are slightly lower than AASHTO/IES guidelines.

Table 1. Comparison of City of Gainesville and AASHTO/IES Lighting Standards

		Average Footcandles (minimum)		Average / Minimum Footcandles	
Roadway Classification		City	AASHTO/IES	City	AASHTO/IES
Major	Commercial	1.6	1.7	3:1	3:1
	Intermediate	1.2	1.3	3:1	3:1
	Residential	0.8	0.9	3:1	3:1
Collector	Commercial	1.1	1.2	4:1	4:1
	Intermediate	0.8	0.9	4:1	4:1
	Residential	0.6	0.6	4:1	4:1
Local	Commercial	0.8	0.9	6:1	6:1
	Intermediate	0.7	0.7	6:1	6:1
	Residential	0.4	0.4	6:1	6:1

Average (minimum) footcandles is a measure of the 'brightness' at any given point along the roadway. The ratio of Average to Minimum footcandles is a measure of lighting quality; the lower the ratio, the more even and uniform the lighting.

The City is charged either an 'agency' or 'rental' rate for street lights currently offered by GRU, depending on the type of installation (Agency lights are those that the City or another agency has purchased, while rental lights are purchased by GRU). GRU's inventory consists of the current 'standard' high-pressure sodium (HPS) lamp, selected due to its relative energy efficiency, longevity, and consistent light output throughout its lifespan; Mercury Vapor and Metal Halide fixtures are used in limited circumstances, primarily in pedestrian lighting applications. The City pays recurring operation and maintenance expenses through GRU billing. The vast majority of street lights are 'rental lights' owned and maintained by GRU, as shown in Table 2. LED lights are not currently available on GRU's inventory, therefore LED street lighting is owned and operated by Public Works, with electricity supplied by GRU through a meter(s) at each lighting location.

Table 2. Light Inventory by Billing Group

Billing Group	Fixtures
City of Gainesville - Agency	1,246
City of Gainesville – Rental	11,601
Alachua County	5,288
Non-Government Rental	13,590

The first use of LED street lighting in the City was initiated in May of 2011. Funded through a grant from the U.S. Department of Energy, twenty-five LED pedestrian scale lights were installed on SE 1st Street (100-200 block) and a control HPS pedestrian scale light was also installed. The results indicated that as much as 9,350 pounds of carbon dioxide emissions and $664.76 in energy savings would be achieved over the 20 year anticipated life of each fixture.

Subsequently, Public Works has included LED lighting in the design of three additional projects. The first, the Porter's Connections to the 6th Street Rail Trail have 3 solar powered LED pedestrian light fixtures. The second, streetscaping of Main Street from N 8th Avenue to S Depot Avenue, will utilize 113 LED fixtures and 45 HPS lights. Construction of this project is underway. The third is Segment 2 of the Depot Avenue reconstruction project, from SW 11th Street to S Main Street. Currently under design, the project is expected to utilize 132 LED fixtures: 39 roadway lights and 93 trail and pedestrian lights. A special lighting district was also approved by the City Commission for the Urban Village area with the intent to use LED fixtures; a total of 82 are planned in conjunction with this project.

Attachments:
City of Gainesville Standard Practice for Roadway Lighting
LED Lighting Cost Analysis [Draft]
LED Street Light Study: Final Report for Grant DE-SC0002611 [Draft]

City of Gainesville
Standard Practice for Public Lighting

1.0 PURPOSE

The Roadway Lighting Committee of the Illuminating Engineering Society (IES) of North America states "The principal purpose of roadway lighting is to provide quick, accurate, and comfortable seeing at night. These qualities of seeing may safeguard, facilitate, and encourage vehicular and pedestrian traffic."

1.1 OBJECTIVE

The primary objective of this Standard Practice for Roadway Lighting is to serve as the foundation for the design of fixed lighting systems for roadways within the Gainesville city limits. Upon adoption, this standard will define recommended and authorized lighting levels to be used in the design of new roadway lighting systems. This standard is not intended to be applied to existing lighting systems until such systems are redesigned.

1.2 GOALS

1. Promote the safety of pedestrian, bicyclist, and automobile driver interaction.

2. Preserve and enhance an attractive and desirable urban environment for residents within neighborhoods and along collector and arterial roads.

3. Promote and maintain the vitality and attractiveness of public spaces and business districts within the City.

4. Preserve and enhance the tree canopy and urban forest.

5. Promote energy conservation and maximize the benefit of public lighting expense.

6. Solicit community involvement in the assessment of lighting needs, requirements, and practices within the City.

7. Develop and promote a public notification process to inform citizens of proposed or pending lighting projects.

8. Establish lighting standards of good quality and reasonable levels of illumination.

2.0 TECHNICAL REQUIREMENTS

The execution of a standard lighting practice is dependent upon: roadway classifications, pavement classification, roadway illumination factors, and roadway illumination standards.

2.1 TYPES OF LIGHTING SYSTEMS

1. Street lighting: lighting designed in accordance with IES standards to provide illumination of that portion of the street used by vehicular traffic.

2. Pedestrian lighting: lower level lighting intended to illuminate the pedestrian walkway that generally runs parallel to that portion of the street used by vehicular traffic.

3. Dual lighting: a lighting system designed, to the maximum extent possible, to meet the needs of both the street lighting and pedestrian lighting systems.

4. Walkways and Class I bikeways lighting: lighting for corridors that are designated for the "exclusive use" of pedestrians and cyclists, and are removed from vehicular traffic conflicts. Lighting systems for these types of facilities shall be in accordance with the IESNA Document DG-5-94 entitled "Recommended Lighting for Walkways and Class 1 Bikeways".

2.2 ROADWAY CLASSIFICATIONS

Determination of roadway classification (major, collector, and local) and sub classification (commercial, intermediate, and residential) will be consistent with the roadway classifications and sub classifications defined by the Illuminating Engineering Society (IES). The Public Works Department will be responsible for determining a roadway's classification, to the maximum extent possible determinations shall be consistent with the Florida Department of Transportation's Functional Classification.

1. The following descriptions of roadway classification will be used:

   a) Major Road: Commonly referred to as "Arterial" roadways. These streets are designed as routes, which generally serve and interconnect the major centers of activity in the urban area. As defined in F.S.334.03: "a route providing service which is relatively continuous and of relatively high traffic volume, long average trip length, high operating speed, and high mobility importance." Within the municipal limits, all state highways, and most county roads, are classified as arterial streets.

   b) Collector Road: As defined in F.S. 334.03: "a route providing service which is of relatively moderate average traffic volume, moderately average trip length, and moderately average operating speed. Such a route also collects and distributes traffic between local roads or arterial roads and serves as a linkage between land access and mobility needs."

   c) Local Road: As defined in F.S. 334.03: "a route providing service which is of relatively low average traffic volume, short average trip length or minimal through-traffic movements, and highland access for abutting property."

2. The following description of roadway sub-classification will be used:

   a) **Commercial Area:** Densely developed business area outside, as well as within, the central part of the municipality. Nighttime vehicular and/or pedestrian traffic within such areas would be characterized as relatively heavy.

   b) **Intermediate Area:** Developed area outside, as well as within, the central part of the municipality comprised of libraries, community recreation centers, large apartment complexes, industrial buildings, or neighborhood retail stores, etc. Nighttime vehicular and/or pedestrian traffic within such areas would be characterized as moderate to moderately heavy.

   c) **Residential Area:** Developed area comprised of residential developments, or a mixture of residential and small commercial developments. This definition includes areas of single-family homes, town houses, small apartment buildings, and conservation areas. Nighttime vehicular and/or pedestrian traffic within such areas would be characterized as light.

3. Lighting requirements for a roadway of a single classification will differ among commercial, intermediate (mixed use), and residential segments of that roadway. Proper sub classification of a roadway will be largely dependent upon the zoning of the properties, which abut the roadways(s) under consideration. Such a review will help determine the appropriate lighting levels based on standardized recommendations. Operating practice may demand that the irregularities in zoning, conflicts in zoning, or repeated changes in zoning within a roadway segment will not absolutely impact the classification of a roadway segment. A smoothing technique (or generalization) may be utilized to insure that changes in lighting levels are gradual, not abrupt. Such practice will normally be done in a manner, which will distribute the effects of smoothing or generalizing away from residential areas.

2.3 PAVEMENT CLASSIFICATION

The proper application of a roadway lighting standard is dependent upon the classification (standardized description) of the pavement's reflectance characteristics. The City's roadways will be classified as R2/R3 (as defined within the IES standards) unless otherwise determined b the City's Public Work Department.

2.4 ROADWAY ILLUMINATION FACTORS

There are four (4) important illumination factors to be considered in the proper design of a new roadway lighting system:

1. Average maintained illumination of the roadway (measured in foot-candles). The desired or target quantity of illumination for a roadway is based upon roadway classification and sub classification.

2. Ratio of the average maintained illumination to the minimum maintained illumination of the roadway. This ratio is a measure of illumination quality. A low ratio is an indication that the roadway illumination is relatively "even" or uniform in appearance. Therefore, a lighting system designed to attain a low ratio will promote superior night vision and reduce fatigue.

3. Ratio of the maximum maintained illumination to the minimum maintained illumination of the roadway. This ratio is also a measure of illumination quality. A low ratio is an indication that both visual hot spots (intense illumination) and dark spots (negligible illumination) have been minimized. Therefore, a lighting system designed to attain a relatively low ratio will reduce the need for reflex vision adaptation resulting from extreme variations of illumination.

4. Glare is the sensation produced by luminance (light) greater than that to which the eyes have adapted. Therefore, a lighting system designed to minimize glare will improve night vision by reducing fatigue and distraction. Glare will be controlled by the careful selection of lamp fixture and installation practice.

2.5 ROADWAY ILLUMINATION STANDARDS

The 1984 American Association of State Highway and Transportation Officials (AASHTO) Streetlighting Guidelines will be used to establish maximum standard illumination levels for major and collector roadways. The AASHTO Guidelines will be augmented by IES standards with regard to light quality criteria. The "AASHTO" guidelines are rooted in "IES" standards.

Table 1

Roadway Class	Sub Class	Average Foot-candles	Max/Min Ratio	Ave./Min Ratio
Major	Commercial	1.6	10:1	3:1
	Intermediate	1.2	10:1	3:1
	Residential	0.8	12:1	3:1
Collector	Commercial	1.1	10:1	4:1
	Intermediate	0.8	12:1	4:1
	Residential	0.6	12:1	4:1
Local	Commercial	0.8	20:1	6:1
	Intermediate	0.7	20:1	6:1
	Residential*	0.4	20:1	6:1

* optional selection only

All street lighting systems shall be designed based upon the above criteria, except systems designed for local residential roadways which will comply with those standards outlined in Section 2.6.

2.6 LOCAL RESIDENTIAL ROADWAY DESIGN STANDARD

Standard lighting practice along local residential roadways will not adhere to AASHTO guidelines (or IES standards) for economic reasons. Given that neighborhoods and their needs differ from one to another, the following guidelines will apply:

1. Standard Lighting System: standard lighting fixtures will be installed at critical areas of the roadway (potential area of conflict) such as: intersections, high volume driveway connections, curves, and cul-de-sacs. Mid-block light fixtures will be installed to "fill in" the roadway. Generally, lights are installed every 200 to 300 feet.

2. Minimum Lighting Option: standard lighting fixtures will be installed at critical areas of the roadway (potential area of conflict) such as: intersections, high volume driveway connections, curves, and cul-de-sacs.

3. Maximum Lighting Option: standard lighting fixtures will be installed in such a manner and quantity to attain the recommended AASHTO (IES) lighting guidelines specified in Table 1 above. This option may be exercised only if standard fixtures are to be installed (without exception).

2.7 DESIGN DEVIATIONS

It is not always possible to satisfy all the elements of a properly designed lighting system due to physical and material limitations. This is particularly true in retrofit situations. A "best fit" approach will be taken to best satisfy all applicable requirements. Priority will be given to those elements that promote quality illumination. Minor deviations from the illumination values and quality standards should be expected and accepted. **Good engineering practice shall be exercised in order to minimize all such deviations.**

3.0 STANDARD MATERIALS

3.1 LAMPS

The standard lamp used on all roadways within the City will continue to be high-pressure sodium (hps).

Advantage: This type of lamp is very energy efficient, relatively long lived, and it emits a relatively consistent light output (measured in lumens) throughout its rated life.

Disadvantage: Emits light predominately in the yellow/orange range of the light spectrum which results in limited color rendition.

Exceptions: In order to clearly delineate the Central City District (CCD), a special interest area, metal halide lamps will continue to be used for street lighting purposes and mercury vapor lamps will continue to be used for pedestrian lighting purposes.

3.2 FIXTURES

The standard fixture (or lamp housing) used for all new and replacement lighting projects along major, collector, and local roadways will be of a "cutoff" design.

Advantages: This type of fixture directs the lamp's output downward towards the roadway thereby: (a) minimizing glare and (b) promoting maximum efficiency.

Disadvantages: May require a closer placement of fixtures to adhere to specific lighting standards. There may be and erroneous perception of less light due to the reduction or absence of glare.

Exceptions: Established neighborhoods differ from one to another, therefore, non-cutoff "area" lights, though not recommended, may continue to be installed along local roadways provided that:

1. Infill light: An existing lighting system is to be merely augmented (not a total system redesign). A simple majority of the property owners immediately adjacent to the proposed light must request a fixture similar to the style existing within the neighborhood.

2. Total system redesign: A simple majority of the neighborhood property owners must request fixtures similar to the style existing within the neighborhood.

3.3 STRUCTURES

The standard structures (or poles) used for roadway illumination will be either treated wood or concrete poles. The determination as to which structure is used is dependent upon the following factors:

1. Compatibility with existing utility structures

2. Aesthetics

3. Contribution in aid of construction (FDOT, etc.)

4. Budgetary constraints

Based upon the selection criteria outlined above, the following application guidelines will be used with regard to the selection of structures **dedicated to street lighting:**

1. Concrete poles will continue to be used along some major, collector, and local roadways. A strong public preference for dark colored poles has been registered. GRU will continue its review of potentially cost effective and more aesthetically pleasing alternatives to the standard wood pole.

2. Wooden poles will continue to be used along some major, collector, and local roadways. Wood poles will continue to be the typical structure along local residential roadways. GRU will continue its review of potentially cost effective and more aesthetically pleasing alternatives to the standard wood pole.

3. The occasional use of more attractive non-standard poles (dark colored aggregate cement or steel poles, possibly fluted, octagonal, or hexagonal in shape) may be warranted along highly visible major, collector, or local roadways, and/or other areas of special interest. See section 5.0.

3.4 STRUCTURE PLACEMENT

The width of the right of way and /or roadway, fixture mounting height, structure setback requirements, fixture mounting arm length, and the lamp wattage all have an effect upon the physical placement and the number of lighting structures. The following installation practices will be used:

1. Alternate side lighting is required on all roadways comprised of four (4) or more travel lanes.

2. Alternate side lighting may be required on roadways comprised of three (3) lanes, dependent upon other design limitations.

3. A choice between alternate or single side lighting may be available along two (2) lane roadways and along some three (3)-lane roadways. On such roadways, regardless of classification, there may be compelling reasons to choose one alternative or the other. The least number of structures and fixtures required to meet the desired result should be installed.

4. Center lighting roadways with medians will be the preferred option when FDOT Design Standards can be met. The selection of this option may be further constrained by the number of turn lanes within the median area. A significant number of such lanes may preclude the regular placement of structures. Where feasible, the installation of double-armed frangible structures within the median may provide an attractive and cost effective street lighting alternative.

All lighting structures shall be placed within the public right-of-way (ROW) or easements. The placement of structures within sidewalks shall be avoided.

3.5 LIGHTING CONDUCTOR INSTALLATION

In general, the following lighting conductor installation practices will be used:

1. The visual intrusiveness of overhead lighting conductors shall be reduced by using the following designs: minimize the number of road crossings, maximize the benefit of installations which parallel the roadway, make unavoidable crossings perpendicular to the roadway, and utilize off roadway (rear lot) energy sources where practical and available. Zig-zag connections along the roadway shall be avoided.

2. Conductors will be placed underground in conjunction with the installation of underground electric distribution facilities within new developments.

3. Conductors will be placed underground if such work is funded specifically by the General Government or any outside agency (FDOT, etc.). The City will actively seek grants and alternate funding sources to assist with the expenses of undergrounding utility lines.

4. The monthly rental rate(s) for structures which are physically limited to accept only underground conductors may include the capital cost of installation (material and civil infrastructure) required to construct the underground service to that structure.

4.0 MAINTENANCE

In general, all public streetlights will be maintained once every five (5) years to insure maximum energy efficiency and proper operation. This preventative maintenance program will include revamping, cleaning, and the installation of a new photoelectric control.

GRU will establish and complete a phased program to replace all mercury vapor lamps with standard high-pressure sodium units within the next five (5) years. The sole exception to this program will be the pedestrian lights located within the CCD. This program will promote energy savings and a more uniform lighting system throughout the city.

5.0 SPECIAL LIGHTING DESIGN AREAS

The City Commission may designate Special Lighting Design Area(s) (Special Area). A Special Area warrants lighting practices that deviate from the standards with respect to design, type of structure, type of fixture or level of illumination.

A Special Area shall be designated as one of the following:

1. Special Commercial Areas

Pedestrian lighting should be installed utilizing structures and fixtures of traditional or unique design. Such fixtures should be of low mounting height and may be used in conjunction with high massed metal halide "hockey puck" style lights. Special attention should be given to lighting pedestrian areas attractively. Structures and fixtures should be dark colored. Lighting conductors should be placed underground as funds permit.

2. Historic Neighborhoods

Pedestrian lighting should be installed utilizing structures and fixtures of traditional or unique design. Such fixtures should be of low mounting height and may be used in conjunction with more traditional hps streetlights. Special attention should be given to lighting pedestrian areas attractively. Structures and fixtures should be dark colored. Lighting conductors should be placed underground as funds permit.

3. Gateway Streets

These streets serve as an introduction to our City and deserve an impressive, yet cost effective treatment. Major attention should be given to installing attractive lighting and "street furniture", particularly in areas with substantial nighttime pedestrian and bicycle activity. Structures and fixtures should be dark colored. Lighting conductors should be placed underground as funds permit.

4. Greenway Corridor

The "Greenway Corridors" are an important asset to the City. The roadways that traverse such areas deserve special treatment. Major consideration should be given to installing attractive lighting and "street furniture", particularly in areas with substantial nighttime pedestrian and bicycle activity. Illumination levels associated with the local residential roadways are appropriate along these roadways. . Structures and fixtures should be dark colored. Lighting conductors should be placed underground as funds permit.

5. High Bicycle and Pedestrian Use Areas

Bicycle and pedestrian friendly lighting should be installed utilizing structures and fixtures of traditional or unique design. Fixtures should be of low mounting height and may be used in conjunction with more traditional hps streetlights. Special attention should be given to lighting pedestrian areas attractively. Structures and fixtures should be dark colored. Lighting conductors should be placed underground as funds permit.

5.1 PROCEDURES FOR DESIGNATING SPECIAL LIGHTING DESIGN AREA (S)

The procedures for designating a Special Area are as follows:

1. All requests should be submitted to the City Manager for review and recommendation. A request may be submitted by a redevelopment board, neighborhood association, business association, or other appropriate group.

2. The City Manager will obtain input from appropriate staff (Public Works, Community development, Gainesville Regional Utilities, etc.). This review will address issues relating to the boundary of the area, planning implications, electrical system implications, compatibility with adjacent roadway lighting, funding etc.

3. The City Manager will make a recommendation to the City Commission.

4. Once approved by the City Commission, the Special Area boundaries will be identified on a map at the Public Works Department.

5. Any changes to the boundary require approval by the City Commission. Any such request must be submitted to the City Manager for review and recommendation.

6. Requests to remove a Special Area designation must be approved by the City Commission.

5.2 OPERATIONAL CONSIDERATIONS

The operational considerations for Special Areas are as follows:

1. All public transportation lighting must be on public right-of-way or easement and/or on a city-owned facility.

2. All special lighting instruments require approval by the Public Works Department.

3. Special lighting plans that include lighting on a state and/or county road in a Special Area require approval of that agency.

4. Unanticipated issues that arise regarding design, cost, construction, etc. will be jointly resolved by the General Manager for Utilities and the City Manager.

5. If a private property owner, within a Special Area requests to use the same structures and fixtures associated with a special lighting plan, all costs will be the responsibility of that property owner and privately contracted out for installation.

5.3 FINANCIAL CONSIDERATIONS

Typically, the use of special structures, fixtures and lamps results in higher installation, operation and maintenance costs than standard streetlighting. The entity responsible for incremental cost increases shall be determined as part of the City Commission approval of Special Area designation.

The General Manager for Utilities, or designee, will establish the financial schedule.

6.0 ROADWAY LIGHTING INSTALLATION PROCEDURES

The procedures utilized for approving the installation of streetlights will be based on the classification of the roadway; local, collector, or major. The City of Gainesville's Official Roadway Map will be used to determine a roadway's classification.

1. Request for one (1) streetlight on a local street

    a. A single streetlight may be requested by the residents/propery owners that live adjacent to the proposed streetlight. If the City determines the streetlight meets the standards, the property owners immediately adjacent to the proposed streetlight will be given an opportunity to vote by mail. A majority of the property owners responding must vote yes in order for the streetlight to be installed. The ballot process will be conducted by the Public Works Department. The ballot will include the following information:

- Description of proposed location
- Date ballot must be returned
- Approval/disapproval of installation
- Comments
- Name, address and phone number of the property owner voting

The property owners will be notified in writing of the ballot results.

2. Request for two (2) or more streetlights on a single local street

    a. A request for two (2) or more streetlights on a single street may be submitted by the residents/property owners living on the street or by a City Agency/Board. If requested by the property owners/residents, it must be signed by at least 15% of the residents/property owners living on the street. The street segment shall be determined by the Public Works Director or designee.

    b. If the City determines that some or all of the proposed streetlights are warranted, The property owners on the street or street segment will be given the opportunity to vote by mail. A majority of the property owners responding must vote yes in order for the streetlight to be installed. The ballot process will be conducted by the Public Works Department. The ballot will include the following information:

- Description of proposed location of streetlights
- Date ballot must be returned
- Approval/disapproval of installation of streetlights
- Comments
- Name, address and phone number of the property owner voting

The property owners will be notified in writing of the ballot results.

3. Streetlighting for safety issues

   a. The minimum lighting option as identified in Section 2.6 for installation of streetlights on local roadways (Section 2.5) states that streetlights should be installed at critical areas of the roadway (intersections, high volume driveways, curves, cul-de-sacs, dead-ends, etc.). If the Public Works Department determines that a streetlight is warranted at a critical location, the Public Works Director (or designee) may approve the streetlight installation after notifying the adjacent property owners in warrant.

4. Requests for neighborhood or subdivision streetlighting

   A request for new streetlighting or modifications to existing lighting within a neighborhoods or subdivision may originate from the property owners/residents/neighborhood association, a City Agency or Board or GRU.

   a. Requests originating from the property owners/residents/neighborhood association.

      - Requests must be signed by at least 15% of the residents/property owners or a request may come from a recognized neighborhood association. If the City determines that streetlight improvements are warranted, the property owners will be given the opportunity to vote by mail. A majority of the property owners responding must vote yes in order for the streetlight to be installed. The ballot process will be conducted by the Public Works Department. The ballot will include the following information:

      - Drawing of proposed streetlight plan
      - Date ballot must be returned
      - Approval/disapproval of streetlight plan
      - Comments
      - Name, address and phone number of the property owner voting

      - The property owners will be notified in writing of the ballot results.

b. Requests made by GRU

- If in conjunction with construction of a new or upgraded electrical system, it is determined that a streetlighting system upgrade is warranted, the Public Works department will notify the property owners in the affected area. **Balloting process, in accordance with Section 6.0.4.a., will be required when there is a significant increase or decrease in the level of illumination or the number of streetlights.** The notification will include the following information:

- Drawing of proposed streetlight plan
- Letter describing scope and reason for project
- Phone number of person/agency that may be contacted for information or registering concerns
- Date of anticipated installation
- Date by which concerns need to be registered

- The streetlighting system will be constructed to local residential roadway design standards as defined in Section 2.6.1.

5. Requests for streetlights on city collector and/or major roads

a. Requests for streetlights may be made by the residents/property owners living along the roadway, the Public Works Department, City Agency or Board, GRU or the City Commission. The Public Works Department will mail a notice to the abutting property owners advising them of the streetlight project. Such notification shall be provided early kin the design process to insure the opportunity for public input. The notification shall include information relating to the standard lighting practice in the City, standard material and lamp/fixture characteristics. The Public Works Department and GRU will work with individual property owners to solve any conflicts that may arise. However, conflict resolution will not jeopardize the integrity of the streetlight design.

6. Procedures for approving the installation of lighting systems on collector and arterial roads maintained by Alachua count and the FDOT.

a. The procedures for installation of lighting systems along collector and arterial roadways that are maintained by Alachua County and FDOT are determined by that agency which has jurisdictional control. On Alachua County and FDOT projects, the City will submit a request to FDOT or Alachua County that the responsible agency consider:

- Installing a lighting system based upon the standards adopted herein by the City Commission;

- Installing underground lighting conductors when such conductors are installed apart from other overhead electric distribution facilities;

- Installing non-standard (upgraded) lighting structures when such lighting is being installed apart from other overhead electric distribution facilities.

Lighting Cost Analysis

LED VS. HPS LIGHTING LIFE-CYCLE COST COMPARISONS FOR PEDESTRIAN LIGHTS

INTRODUCTION

The City of Gainesville is conducting a streetlight study to assist in determining the potential advantages of utilizing LED fixtures for public lighting. Data from May 2011 to August 2012 has shown that LED Pedestrian light fixtures use about half as much electricity of that of a traditional, High-Pressure Sodium (HPS) fixture (see Table 1). However, a light that uses half as much electricity does not translate to a 50% energy cost savings. Electricity is not the only component of the monthly utility bill, as other fees included in the bill are independent of electricity consumption (See Figure 1).

A simplistic general analysis cannot be used when comparing LED lights to conventional lights in the City of Gainesville. Gainesville Regional Utilities (GRU) bills the City in two way; Agency Lights or Metered Lights. Agency Light are billed a predetermined flat rate which includes electricity and maintenance on the light whereas metered lights are billed using a formula that includes electricity consumption and all applicable taxes and fees. Maintenance on metered lights is the responsibility of the owner. LED fixtures must be billed as Metered Lights because they are not a GRU standard.

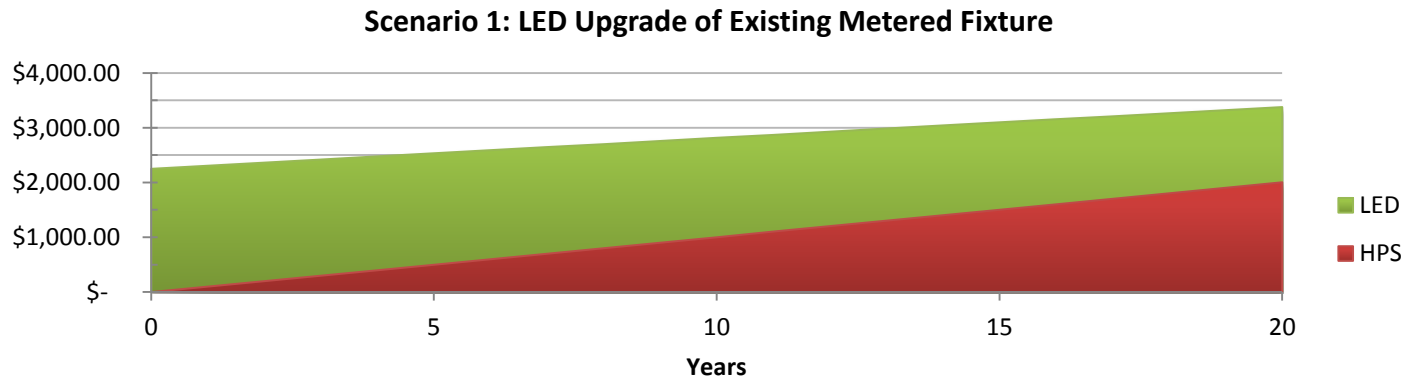
This report looks at potential savings by comparing capital and energy costs of using LED lights.

UPGRADE SCENARIOS

When looking at upgrading public lighting, there are several scenarios with different results as to which fixture type is the most economical to light an area. This report includes two major types of comparisons; comparing metered HPS Lights to metered LED Lights and comparing HPS Agency Lights to metered LED Lights. The former is relatively straight forward since the only variable that isn't shared between the two alternatives is the power consumption. The latter is more complicated since the cost of the metered LED lights is dependent on how many lights are connected to each meter, whereas the Agency lights are billed at a flat rate. For simplicity in this report, all metered lights are estimated in a 25 lights per meter configuration unless other noted.

Scenario 1: LED Upgrade of Existing Metered Fixture

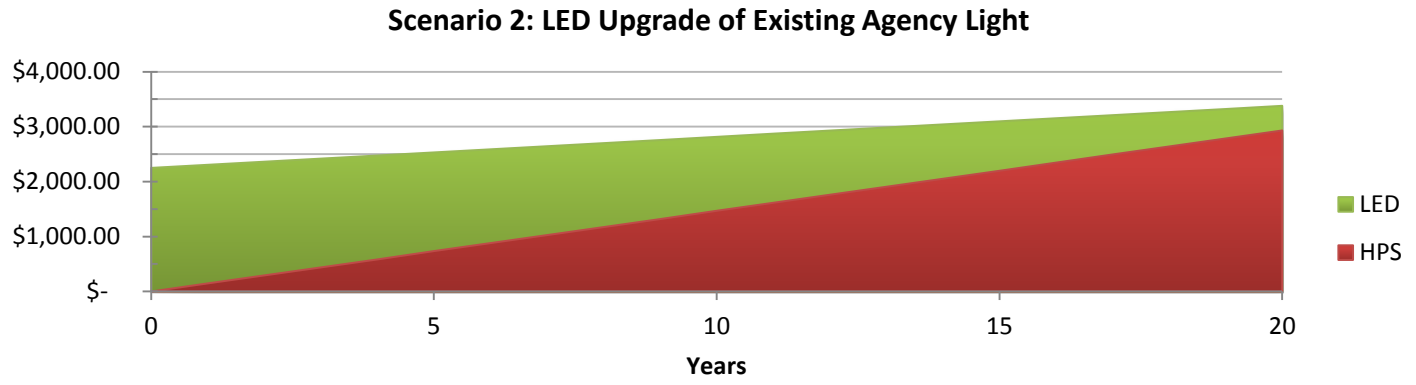
In this scenario, we look at upgrading an existing pedestrian light with an LED fixture. The alternative is to leave the existing HPS fixture as-is. The results of this scenario are shown in the graph below:



As you can see from the graph, the initial capital cost of the LED Light Fixtures is too high for the energy savings to overcome during the 20 year life cycle. At their current estimated capital cost, LED Fixtures will not break even in this scenario until after 51 years. LED Fixtures become cost effective during the 20 year life cycle only once the capital cost is less than $874.

Scenario 2: LED Upgrade of Existing Agency Light

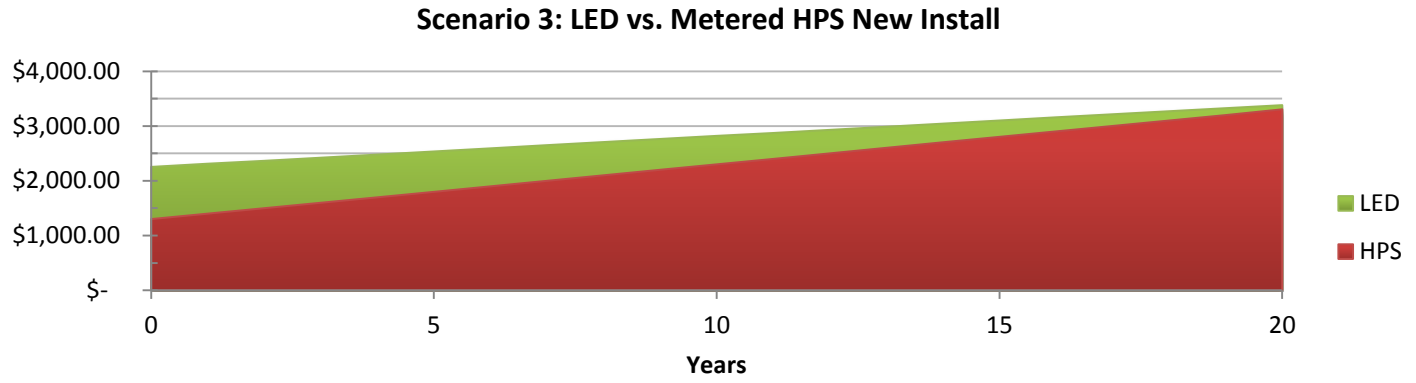
This scenario is similar to Scenario 1, except that instead of the existing light being metered, it is an "Agency Light," which are being billed at a flat rate. Due to the electric customer charge which is billed per meter, the unit price of metered lights goes down as the number of lights per meter goes up. As previously stated, the unit cost per month of LED fixtures is assumed to be in a 25 lights per meter configuration. The results are shown in the graph below:



The graph shows that under this scenario the LED Upgrade is about $450 more expensive over the 20 year life cycle. The LED upgrade becomes cost effective during year 25 or if the capital cost is below $1,802.

Scenario 3: LED vs. Metered HPS New Install

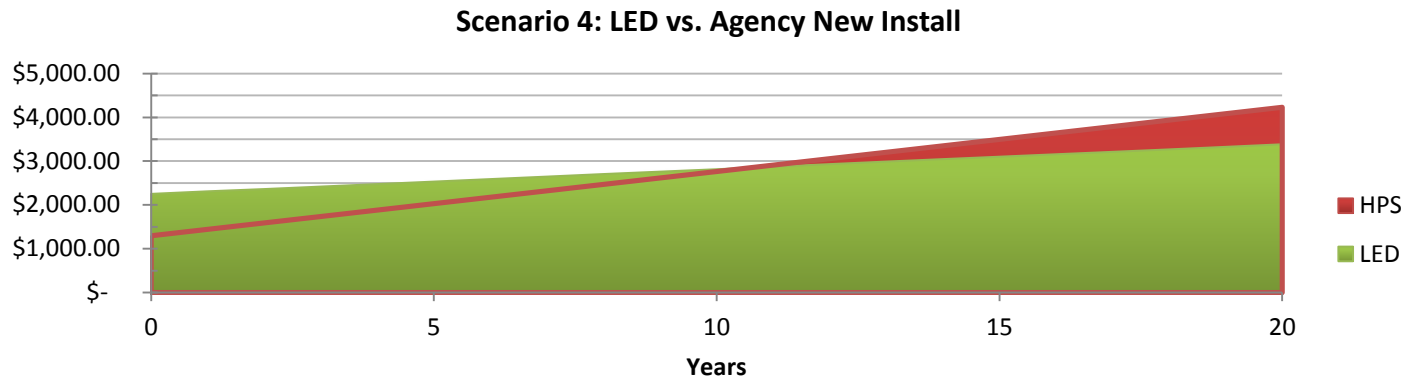
In the first two scenarios covered by this report, one of the alternatives was for the existing fixture to remain resulting in a large difference in initial costs between the two alternatives. In this scenario, a new light fixture will be installed with either an LED or an HPS fixture.



With both options have capital costs in this scenario, the two alternatives share a very similar life-cycle cost with the LED fixture costing $80 more at the end of the 20th year.

Scenario 4: LED vs. Agency New Install

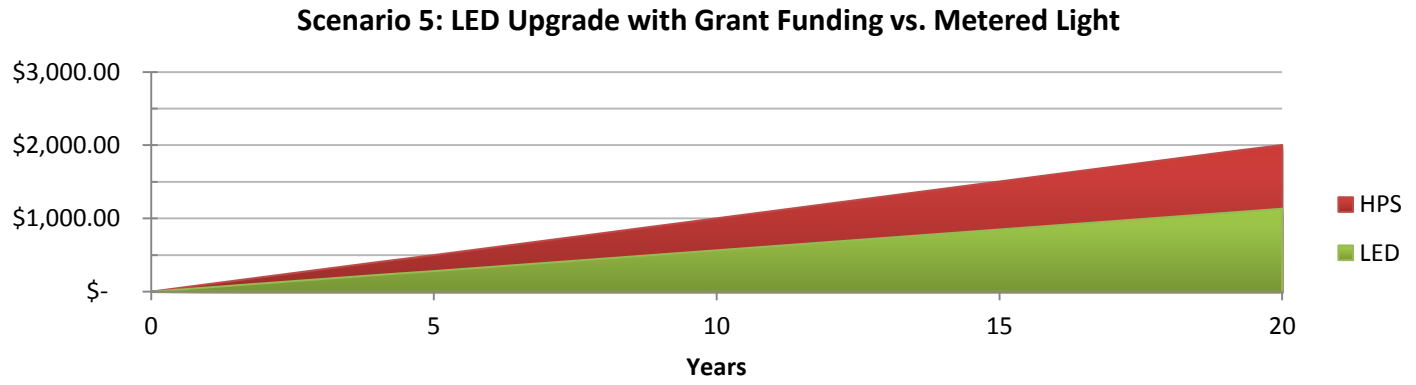
Similar to scenario 3, this scenario compares capital and electric costs of LED and HPS fixtures. Different from scenario 3, however, in this analysis the HPS is billed as an agency light.



With the LED fixtures again in a 25 lights per meter configuration, the savings seen over 20 years is substantial. The City could expect to save about $850 per light, or more than $21,000 for the 25 light system, during the 20 year life cycle. The financial advantage increases as the number of lights per meter increases. If the number of lights per meter increases to 50, LED fixtures save about $968 per light.

Scenario 5: LED Upgrade with Grant Funding vs. Metered Light

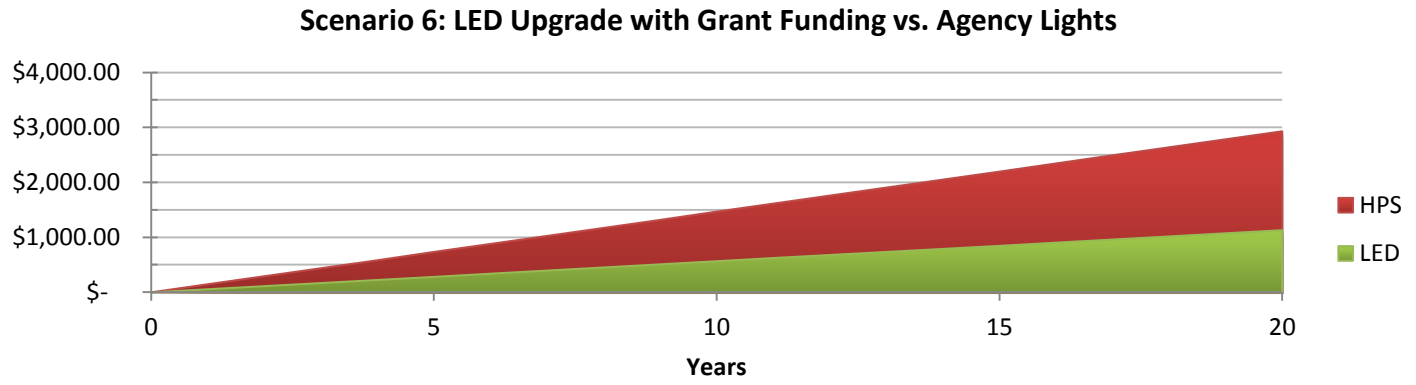
The last set of scenarios look at either installing new or upgrading existing fixtures in which initial capital costs will not be incurred by the City due to grant funding. This scenario compares costs if both fixtures were metered.



As illustrated by the graph, and as expected under this scenario, the LED fixture shows considerable savings over the traditional fixture. The LED fixture is expected to save about $3.50 per month, and a total of $873 after the 20 year life cycle.

Scenario 6: LED Upgrade with Grant Funding vs. Agency Lights

This scenario is similar to Scenario 5, except the existing lights are being billed as Agency lights instead of metered. Again, when comparing metered to flat rate billing, the number of lights per meter becomes a factor. The results of this analysis are shown in the table below.



Again as expected, the LED Fixtures provide great savings to the City when the capital costs are externally funded. The City could expect to save more than $1,800 per light under the 25 lights per meter configuration after the 20 year life cycle. That savings would amount to over $45,000 in savings for the entire 25 light system. The City would see a financial benefit under this scenario if there are 3 or more LED fixtures per meter.

CONCLUSIONS

This report looks only at the financial considerations of upgrading between LED and traditional HPS light fixtures. Other factors, such as maintenance costs, environmental impacts, future electric rates, etc., should also be considered.

In regards to the life-cycle costs analyses performed in this report, the following conclusions can be made:

- Scenarios 1 & 2: There is not a financial advantage to upgrading to an LED fixture if the existing fixture is sufficient, regardless of if the existing fixture is metered. The initial capital costs are too high for the energy savings to overcome.
- Scenario 3: LED and HPS metered fixtures have nearly identical life cycle costs for a new install or upgrade. LEDs will likely become the cost effective solution in this scenario soon, as electric rates go up and LED capital costs go down.
- Scenario 4: There is a substantial financial advantage to choosing an LED fixture over an Agency Light for a new install or upgrade given that there are at least 6 lights per meter. With 25 lights per meter, LED fixtures will save almost $850 per light over the 20 year life cycle. There is no financial advantage to upgrading an existing system of Agency Lights to LED fixtures if the number of lights per meter is less than 6.
- Scenarios 5 & 6: The is a very clear financial advantage for the City to choose LED over HPS given that grant funding eliminates capital costs incurred to the City. Under this financial condition, the City could save up to $45,000 over the 20 year life cycle with 25 lights per meter.

In summary, there are three rules of thumb that can be made.

1. If the existing light fixture is sufficient, an LED upgrade probably won't provide a positive return on investment until the capital cost greatly decreases.
2. If an existing system of lights is in need of replacement or a new light system is planned for installation, a case by case analysis should be performed to determine the possible metering configurations to choose the alternative with the lowest life-cycle cost. If it is possible to have a high fixture to meter ratio, it may be advantageous to have LED fixtures.
3. If grant funding is provided eliminating capital costs, an LED upgrade will almost certainly reduce life cycle costs for the City of Gainesville.

Assumptions, Findings, & Omissions

- An important omission to note from this report is the unknown cost of maintenance for LED fixtures. This is important when considering the scenarios that compare agency lights against LED fixtures since maintenance costs are included in the flat rate for agency lights. For scenarios in which both alternatives will be metered, the difference in maintenance is less since the owner would be responsible for maintenance either way, but it still should be considered since maintenance costs could be different between the two fixtures.

- Something of note that was not the original intent of this report is that the Traditional Metering Rates show that if the City will save money by converting agency lights to metered lights as long as there are more than six lights per meter. For example, if ten agency lights were connected to one meter, that system would save almost $465 per year.

- The efficiencies of both types of fixtures were assumed to remain constant. The available data does not prove that the rate of energy consumption, and specifically the ratio of electric consumption of the LED fixture compared to the HPS fixture, over the entire 20 year life cycle is consistent. If these two fixture types lose efficiency, even if it is at the same rate, the life cycle costs would be affected.

- This report assumes the pricing methodology and rates for metered and agency lights remain constant. If the cost of electricity increases, the return on investment for LED fixtures would increase as well.

- This report does not use time value of money equations when calculating the present value of future annuities. If capital funds were spent on traditional fixtures instead of LED fixtures and the cost difference was invested and saw a return, the benefit of electric savings seen by LED fixtures would be reduced. A present value is greater than the value of an equal sum of future annuities if the present value is gaining interest.

Appendix

Figure 1: Billing Methodology

- Electric Charge Per Month = kW-Hr * $0.08 for the first 1500 kW-Hr and $0.15 for every kW-Hr after that.

- Electric Customer Charge = $26.00 for every metered system.

- Electric Fuel Adjustment Charge = $0.051 per kW-Hr.

- Business Discount = 7% off of Electric Customer Charge and Electric Charge Per Month

- Florida Gross Receipts Tax = 2.5641% of the sum of Electric Fuel Adjustment, Electric Customer Charge, and Electric Charge Per Month minus the Business Discount.

- Bill Per Meter = Sum of Florida Gross Receipts Tax, Electric Fuel Adjustment, Electric Customer Charge, and Electric Charge per Month minus the Business Discount.

Figure 2: Fixture Costs

- LED Fixture: Catalog Number – COACH-Conversion S56-90W49LED4k-LE3. $2,250 This cost only includes removing the existing luminaire and replacing with this fixture. However, this cost was used in new construction estimates because other costs (poles, foundation, etc.) would also be incurred with HPS fixture, thus they can be ignored.

- HPS Fixture: GRU cost given from 1/21/2010. 100 W Metal Halide Traditional Light (black), cable or wire, lamp, photocell, misc. materials - $1,074.00. Labor and equipment - $222.00. Total - $1,296.

Table 1: LED Streetlight Study

LED System 1 - 12 Total Lights

Reading Date	Total kW-Hr	Total kW-Hr/ Light	kW-Hr/Light Since Last Reading	kW-Hr/Light/Day
5/18/2011	284	23.67	23.67	-
6/16/2011	555	46.25	22.58	0.78
7/21/2011	862	71.83	25.58	0.73
8/18/2011	1,130	94.17	22.33	0.80
9/19/2011	1,454	121.17	27.00	0.84
10/24/2011	1,836	153.00	31.83	0.91
11/17/2011	2,117	176.42	23.42	0.98
12/19/2011	2,504	208.67	32.25	1.01
1/18/2012	2,869	239.08	30.42	1.01
2/20/2012	3,257	271.42	32.33	0.98
3/20/2012	3,579	298.25	26.83	0.93
4/18/2012	3,876	323.00	24.75	0.85
5/17/2012	4,155	346.25	23.25	0.80
6/18/2012	4,457	371.42	25.17	0.79
7/18/2012	4,742	395.17	23.75	0.79
8/16/2012	5,020	418.33	23.17	0.80
Total Usage	4,736			
kW-Hr/Day/Light	0.87			

LED System 2 - 13 Total Lights

Reading Date	Total kW-Hr	Total kW-Hr/ Light	kW-Hr/Light Since Last Reading	kW-Hr/Light/Day
5/18/2011	375	28.85	28.85	-
6/16/2011	703	54.08	25.23	0.87
7/21/2011	1,115	85.77	31.69	0.91
8/18/2011	1,465	112.69	26.92	0.96
9/19/2011	1,885	145.00	32.31	1.01
10/24/2011	2,375	182.69	37.69	1.08
11/17/2011	2,735	210.38	27.69	1.15
12/19/2011	3,240	249.23	38.85	1.21
1/18/2012	3,714	285.69	36.46	1.22
2/20/2012	4,216	324.31	38.62	1.17
3/20/2012	4,630	356.15	31.85	1.10
4/18/2012	5,008	385.23	29.08	1.00
5/17/2012	5,348	411.38	26.15	0.90
6/18/2012	5,744	441.85	30.46	0.95
7/18/2012	6,125	471.15	29.31	0.98
8/16/2012	6,504	500.31	29.15	1.01
Total Usage	6,129			
kW-Hr/Day/Light	1.03			

Average kW-Hr/Day/Light = Total Electric Consumption / Total Days / Number of Lights

10,865 kW-Hr / 456 Days / 25 Lights = **0.95 kW-Hr/Day/Light for LED Fixtures**

HPS System - 1 Light

Reading Date	Total kW-Hr	kW-Hr/Light Since Last Reading	kW-Hr/Light/Day
5/18/2011	52	52.00	
6/16/2011	109	57.00	1.97
7/21/2011	166	57.00	1.63
8/18/2011	204	38.00	1.36
9/19/2011	263	59.00	1.84
10/24/2011	333	70.00	2.00
11/17/2011	383	50.00	2.08
12/19/2011	454	71.00	2.22
1/18/2012	520	66.00	2.20
2/20/2012	590	70.00	2.12
3/20/2012	649	59.00	2.03
4/18/2012	702	53.00	1.83
5/17/2012	752	50.00	1.72
6/18/2012	806	54.00	1.69
7/18/2012	856	50.00	1.67
8/16/2012	906	50.00	1.72
Total Usage	854		
kW-Hr/Day/Light	1.87		

Average kW-Hr/Day/Light = Total Electric Consumption / Total Days / Number of Lights

854 kW-Hr / 456 Days / 1 Lights = **1.87 kW-Hr/Day/Light for HPS Fixtures**

Table 2: LED Metering Rates

Lights/ Meter	kW-Hr/ Light/ Day	kW-Hr/ Meter/ Month	Electric Charge/ Month	Electric Customer Charge	Electric Fuel Adjust	Business Discount	Fla Gross Receipts Tax	Monthly Bill	Monthly Cost/ Light
1.00	0.95	28.92	$2.31	$26.00	$1.47	$(1.98)	$0.71	$28.52	$28.52
2.00	0.95	57.83	$4.63	$26.00	$2.95	$(2.14)	$0.81	$32.24	$16.12
3.00	0.95	86.75	$6.94	$26.00	$4.42	$(2.31)	$0.90	$35.96	$11.99
4.00	0.95	115.66	$9.25	$26.00	$5.90	$(2.47)	$0.99	$39.68	$9.92
5.00	0.95	144.58	$11.57	$26.00	$7.37	$(2.63)	$1.08	$43.39	$8.68
6.00	0.95	173.49	$13.88	$26.00	$8.85	$(2.79)	$1.18	$47.11	$7.85
7.00	0.95	202.41	$16.19	$26.00	$10.32	$(2.95)	$1.27	$50.83	$7.26
8.00	0.95	231.33	$18.51	$26.00	$11.80	$(3.12)	$1.36	$54.55	$6.82
9.00	0.95	260.24	$20.82	$26.00	$13.27	$(3.28)	$1.46	$58.27	$6.47
10.00	0.95	289.16	$23.13	$26.00	$14.75	$(3.44)	$1.55	$61.99	$6.20
11.00	0.95	318.07	$25.45	$26.00	$16.22	$(3.60)	$1.64	$65.71	$5.97
12.00	0.95	346.99	$27.76	$26.00	$17.70	$(3.76)	$1.74	$69.43	$5.79
13.00	0.95	375.90	$30.07	$26.00	$19.17	$(3.93)	$1.83	$73.15	$5.63
14.00	0.95	404.82	$32.39	$26.00	$20.65	$(4.09)	$1.92	$76.87	$5.49
15.00	0.95	433.73	$34.70	$26.00	$22.12	$(4.25)	$2.01	$80.58	$5.37
16.00	0.95	462.65	$37.01	$26.00	$23.60	$(4.41)	$2.11	$84.30	$5.27
17.00	0.95	491.57	$39.33	$26.00	$25.07	$(4.57)	$2.20	$88.02	$5.18
18.00	0.95	520.48	$41.64	$26.00	$26.54	$(4.73)	$2.29	$91.74	$5.10
19.00	0.95	549.40	$43.95	$26.00	$28.02	$(4.90)	$2.39	$95.46	$5.02
20.00	0.95	578.31	$46.27	$26.00	$29.49	$(5.06)	$2.48	$99.18	$4.96
21.00	0.95	607.23	$48.58	$26.00	$30.97	$(5.22)	$2.57	$102.90	$4.90
22.00	0.95	636.14	$50.89	$26.00	$32.44	$(5.38)	$2.67	$106.62	$4.85

Lights/ Meter	kW-Hr/ Light/ Day	kW-Hr/ Meter/ Month	Electric Charge/ Month	Electric Customer Charge	Electric Fuel Adjust	Business Discount	Fla Gross Receipts Tax	Monthly Bill	Monthly Cost/ Light
23.00	0.95	665.06	$53.20	$26.00	$33.92	$(5.54)	$2.76	$110.34	$4.80
24.00	0.95	693.98	$55.52	$26.00	$35.39	$(5.71)	$2.85	$114.06	$4.75
25.00	**0.95**	**722.89**	**$57.83**	**$26.00**	**$36.87**	**$(5.87)**	**$2.94**	**$117.77**	**$4.71**
26.00	0.95	751.81	$60.14	$26.00	$38.34	$(6.03)	$3.04	$121.49	$4.67
27.00	0.95	780.72	$62.46	$26.00	$39.82	$(6.19)	$3.13	$125.21	$4.64
28.00	0.95	809.64	$64.77	$26.00	$41.29	$(6.35)	$3.22	$128.93	$4.60
29.00	0.95	838.55	$67.08	$26.00	$42.77	$(6.52)	$3.32	$132.65	$4.57
30.00	0.95	867.47	$69.40	$26.00	$44.24	$(6.68)	$3.41	$136.37	$4.55
31.00	0.95	896.38	$71.71	$26.00	$45.72	$(6.84)	$3.50	$140.09	$4.52
32.00	0.95	925.30	$74.02	$26.00	$47.19	$(7.00)	$3.60	$143.81	$4.49
33.00	0.95	954.22	$76.34	$26.00	$48.66	$(7.16)	$3.69	$147.53	$4.47
34.00	0.95	983.13	$78.65	$26.00	$50.14	$(7.33)	$3.78	$151.25	$4.45
35.00	0.95	1,012.05	$80.96	$26.00	$51.61	$(7.49)	$3.87	$154.96	$4.43
36.00	0.95	1,040.96	$83.28	$26.00	$53.09	$(7.65)	$3.97	$158.68	$4.41
37.00	0.95	1,069.88	$85.59	$26.00	$54.56	$(7.81)	$4.06	$162.40	$4.39
38.00	0.95	1,098.79	$87.90	$26.00	$56.04	$(7.97)	$4.15	$166.12	$4.37
39.00	0.95	1,127.71	$90.22	$26.00	$57.51	$(8.14)	$4.25	$169.84	$4.35
40.00	0.95	1,156.63	$92.53	$26.00	$58.99	$(8.30)	$4.34	$173.56	$4.34
41.00	0.95	1,185.54	$94.84	$26.00	$60.46	$(8.46)	$4.43	$177.28	$4.32
42.00	0.95	1,214.46	$97.16	$26.00	$61.94	$(8.62)	$4.52	$181.00	$4.31
43.00	0.95	1,243.37	$99.47	$26.00	$63.41	$(8.78)	$4.62	$184.72	$4.30
44.00	0.95	1,272.29	$101.78	$26.00	$64.89	$(8.94)	$4.71	$188.44	$4.28
45.00	0.95	1,301.20	$104.10	$26.00	$66.36	$(9.11)	$4.80	$192.15	$4.27
46.00	0.95	1,330.12	$106.41	$26.00	$67.84	$(9.27)	$4.90	$195.87	$4.26
47.00	0.95	1,359.03	$108.72	$26.00	$69.31	$(9.43)	$4.99	$199.59	$4.25
48.00	0.95	1,387.95	$111.04	$26.00	$70.79	$(9.59)	$5.08	$203.31	$4.24
49.00	0.95	1,416.87	$113.35	$26.00	$72.26	$(9.75)	$5.18	$207.03	$4.23
50.00	0.95	1,445.78	$115.66	$26.00	$73.73	$(9.92)	$5.27	$210.75	$4.21

Table 3: Traditional Metering Rates

Lights/ Meter	kW-Hr/ Light/ Day	kW-Hr/ Meter/ Month	Electric Charge/ Month	Electric Customer Charge	Electric Fuel Adjust	Business Discount	Fla Gross Receipts Tax	Monthly Bill	Monthly Cost/ Light
1.00	1.88	57.22	$4.58	$26.00	$2.92	$(2.14)	$0.80	$32.16	$32.16
2.00	1.88	114.45	$9.16	$26.00	$5.84	$(2.46)	$0.99	$39.52	$19.76
3.00	1.88	171.67	$13.73	$26.00	$8.76	$(2.78)	$1.17	$46.88	$15.63
4.00	1.88	228.89	$18.31	$26.00	$11.67	$(3.10)	$1.36	$54.24	$13.56
5.00	1.88	286.11	$22.89	$26.00	$14.59	$(3.42)	$1.54	$61.60	$12.32
6.00	1.88	343.34	$27.47	$26.00	$17.51	$(3.74)	$1.72	$68.96	$11.49
7.00	1.88	400.56	$32.04	$26.00	$20.43	$(4.06)	$1.91	$76.32	$10.90
8.00	1.88	457.78	$36.62	$26.00	$23.35	$(4.38)	$2.09	$83.68	$10.46
9.00	1.88	515.00	$41.20	$26.00	$26.27	$(4.70)	$2.28	$91.04	$10.12
10.00	1.88	572.23	$45.78	$26.00	$29.18	$(5.02)	$2.46	$98.40	$9.84
11.00	1.88	629.45	$50.36	$26.00	$32.10	$(5.34)	$2.64	$105.76	$9.61
12.00	1.88	686.67	$54.93	$26.00	$35.02	$(5.67)	$2.83	$113.12	$9.43
13.00	1.88	743.89	$59.51	$26.00	$37.94	$(5.99)	$3.01	$120.48	$9.27
14.00	1.88	801.12	$64.09	$26.00	$40.86	$(6.31)	$3.20	$127.84	$9.13
15.00	1.88	858.34	$68.67	$26.00	$43.78	$(6.63)	$3.38	$135.20	$9.01

Lights/ Meter	kW-Hr/ Light/ Day	kW-Hr/ Meter/ Month	Electric Charge/ Month	Electric Customer Charge	Electric Fuel Adjust	Business Discount	Fla Gross Receipts Tax	Monthly Bill	Monthly Cost/ Light
16.00	1.88	915.56	$73.24	$26.00	$46.69	$(6.95)	$3.56	$142.56	$8.91
17.00	1.88	972.78	$77.82	$26.00	$49.61	$(7.27)	$3.75	$149.91	$8.82
18.00	1.88	1,030.01	$82.40	$26.00	$52.53	$(7.59)	$3.93	$157.27	$8.74
19.00	1.88	1,087.23	$86.98	$26.00	$55.45	$(7.91)	$4.12	$164.63	$8.66
20.00	1.88	1,144.45	$91.56	$26.00	$58.37	$(8.23)	$4.30	$171.99	$8.60
21.00	1.88	1,201.67	$96.13	$26.00	$61.29	$(8.55)	$4.48	$179.35	$8.54
22.00	1.88	1,258.90	$100.71	$26.00	$64.20	$(8.87)	$4.67	$186.71	$8.49
23.00	1.88	1,316.12	$105.29	$26.00	$67.12	$(9.19)	$4.85	$194.07	$8.44
24.00	1.88	1,373.34	$109.87	$26.00	$70.04	$(9.51)	$5.04	$201.43	$8.39
25.00	**1.88**	**1,430.56**	**$114.45**	**$26.00**	**$72.96**	**$(9.83)**	**$5.22**	**$208.79**	**$8.35**
26.00	1.88	1,487.79	$119.02	$26.00	$75.88	$(10.15)	$5.40	$216.15	$8.31
27.00	1.88	1,545.01	$123.60	$26.00	$78.80	$(10.47)	$5.59	$223.51	$8.28
28.00	1.88	1,602.23	$128.18	$26.00	$81.71	$(10.79)	$5.77	$230.87	$8.25
29.00	1.88	1,659.45	$132.76	$26.00	$84.63	$(11.11)	$5.96	$238.23	$8.21
30.00	1.88	1,716.68	$137.33	$26.00	$87.55	$(11.43)	$6.14	$245.59	$8.19
31.00	1.88	1,773.90	$141.91	$26.00	$90.47	$(11.75)	$6.32	$252.95	$8.16
32.00	1.88	1,831.12	$146.49	$26.00	$93.39	$(12.07)	$6.51	$260.31	$8.13
33.00	1.88	1,888.34	$151.07	$26.00	$96.31	$(12.39)	$6.69	$267.67	$8.11
34.00	1.88	1,945.57	$155.65	$26.00	$99.22	$(12.72)	$6.88	$275.03	$8.09
35.00	1.88	2,002.79	$160.22	$26.00	$102.14	$(13.04)	$7.06	$282.39	$8.07
36.00	1.88	2,060.01	$164.80	$26.00	$105.06	$(13.36)	$7.24	$289.75	$8.05
37.00	1.88	2,117.23	$169.38	$26.00	$107.98	$(13.68)	$7.43	$297.11	$8.03
38.00	1.88	2,174.46	$173.96	$26.00	$110.90	$(14.00)	$7.61	$304.47	$8.01
39.00	1.88	2,231.68	$178.53	$26.00	$113.82	$(14.32)	$7.80	$311.83	$8.00
40.00	1.88	2,288.90	$183.11	$26.00	$116.73	$(14.64)	$7.98	$319.19	$7.98
41.00	1.88	2,346.12	$187.69	$26.00	$119.65	$(14.96)	$8.16	$326.55	$7.96
42.00	1.88	2,403.35	$192.27	$26.00	$122.57	$(15.28)	$8.35	$333.91	$7.95
43.00	1.88	2,460.57	$196.85	$26.00	$125.49	$(15.60)	$8.53	$341.27	$7.94
44.00	1.88	2,517.79	$201.42	$26.00	$128.41	$(15.92)	$8.72	$348.63	$7.92
45.00	1.88	2,575.01	$206.00	$26.00	$131.33	$(16.24)	$8.90	$355.99	$7.91
46.00	1.88	2,632.24	$210.58	$26.00	$134.24	$(16.56)	$9.08	$363.35	$7.90
47.00	1.88	2,689.46	$215.16	$26.00	$137.16	$(16.88)	$9.27	$370.71	$7.89
48.00	1.88	2,746.68	$219.73	$26.00	$140.08	$(17.20)	$9.45	$378.07	$7.88
49.00	1.88	2,803.90	$224.31	$26.00	$143.00	$(17.52)	$9.64	$385.42	$7.87
50.00	1.88	2,861.13	$228.89	$26.00	$145.92	$(17.84)	$9.82	$392.78	$7.86

Table 4: Scenario 1 Life-Cycle Costs

Year	HPS	LED	Cost Effective LED*
0	$-	$2,250.00	$874.00
1	$100.20	$2,306.52	$930.52
2	$200.40	$2,363.04	$987.04
3	$300.60	$2,419.56	$1,043.56
4	$400.80	$2,476.08	$1,100.08
5	$501.00	$2,532.60	$1,156.60
6	$601.20	$2,589.12	$1,213.12
7	$701.40	$2,645.64	$1,269.64
8	$801.60	$2,702.16	$1,326.16
9	$901.80	$2,758.68	$1,382.68
10	$1,002.00	$2,815.20	$1,439.20
11	$1,102.20	$2,871.72	$1,495.72
12	$1,202.40	$2,928.24	$1,552.24
13	$1,302.60	$2,984.76	$1,608.76
14	$1,402.80	$3,041.28	$1,665.28
15	$1,503.00	$3,097.80	$1,721.80
16	$1,603.20	$3,154.32	$1,778.32
17	$1,703.40	$3,210.84	$1,834.84
18	$1,803.60	$3,267.36	$1,891.36
19	$1,903.80	$3,323.88	$1,947.88
20	$2,004.00	$3,380.40	$2,004.40
Savings		$(1,376.40)	
51.51	$5,161.40	$5,161.40	

***Maximum capital costs for to justify LEDs in scenario 1.**

Table 5: Scenario 2 Life Cycle Costs

Years	HPS	LED
0	$-	$2,250.00
1	$146.64	$2,306.52
2	$293.28	$2,363.04
3	$439.92	$2,419.56
4	$586.56	$2,476.08
5	$733.20	$2,532.60
6	$879.84	$2,589.12
7	$1,026.48	$2,645.64
8	$1,173.12	$2,702.16
9	$1,319.76	$2,758.68
10	$1,466.40	$2,815.20
11	$1,613.04	$2,871.72
12	$1,759.68	$2,928.24
13	$1,906.32	$2,984.76
14	$2,052.96	$3,041.28
15	$2,199.60	$3,097.80
16	$2,346.24	$3,154.32
17	$2,492.88	$3,210.84
18	$2,639.52	$3,267.36
19	$2,786.16	$3,323.88
20	$2,932.80	$3,380.40
Savings		$(447.60)

Table 6: Scenario 3 Life Cycle Costs

Years	HPS	LED
0	$1,296.00	$2,250.00
1	$1,396.20	$2,306.52
2	$1,496.40	$2,363.04
3	$1,596.60	$2,419.56
4	$1,696.80	$2,476.08
5	$1,797.00	$2,532.60
6	$1,897.20	$2,589.12
7	$1,997.40	$2,645.64
8	$2,097.60	$2,702.16
9	$2,197.80	$2,758.68
10	$2,298.00	$2,815.20
11	$2,398.20	$2,871.72
12	$2,498.40	$2,928.24
13	$2,598.60	$2,984.76
14	$2,698.80	$3,041.28
15	$2,799.00	$3,097.80
16	$2,899.20	$3,154.32
17	$2,999.40	$3,210.84
18	$3,099.60	$3,267.36
19	$3,199.80	$3,323.88
20	$3,300.00	$3,380.40
Savings		$(80.40)

Table 7: Scenario 4 Life Cycle Costs

Years	HPS	LED	Years	HPS	LED	Years	HPS	LED
0	$1,296.00	$2,250.00	**8**	$2,469.12	$2,702.16	**16**	$3,642.24	$3,154.32
1	$1,442.64	$2,306.52	**9**	$2,615.76	$2,758.68	**17**	$3,788.88	$3,210.84
2	$1,589.28	$2,363.04	**10**	$2,762.40	$2,815.20	**18**	$3,935.52	$3,267.36
3	$1,735.92	$2,419.56	**11**	$2,909.04	$2,871.72	**19**	$4,082.16	$3,323.88
4	$1,882.56	$2,476.08	**12**	$3,055.68	$2,928.24	**20**	$4,228.80	$3,380.40
5	$2,029.20	$2,532.60	**13**	$3,202.32	$2,984.76	**Savings**		$848.40
6	$2,175.84	$2,589.12	**14**	$3,348.96	$3,041.28			
7	$2,322.48	$2,645.64	**15**	$3,495.60	$3,097.80			

Table 8: Scenario 5 Life Cycle Costs

Years	HPS	LED	Years	HPS	LED	Years	HPS	LED
0	$-	$-	**8**	$801.60	$452.16	**16**	$1,603.20	$904.32
1	$100.20	$56.52	**9**	$901.80	$508.68	**17**	$1,703.40	$960.84
2	$200.40	$113.04	**10**	$1,002.00	$565.20	**18**	$1,803.60	$1,017.36
3	$300.60	$169.56	**11**	$1,102.20	$621.72	**19**	$1,903.80	$1,073.88
4	$400.80	$226.08	**12**	$1,202.40	$678.24	**20**	$2,004.00	$1,130.40
5	$501.00	$282.60	**13**	$1,302.60	$734.76	**Savings**		$873.60
6	$601.20	$339.12	**14**	$1,402.80	$791.28			
7	$701.40	$395.64	**15**	$1,503.00	$847.80			

Table 9: Scenario 6 Life Cycle Costs

Years	HPS	LED	Years	HPS	LED	Years	HPS	LED
0	$-	$-	**8**	$1,173.12	$452.16	**16**	$2,346.24	$904.32
1	$146.64	$56.52	**9**	$1,319.76	$508.68	**17**	$2,492.88	$960.84
2	$293.28	$113.04	**10**	$1,466.40	$565.20	**18**	$2,639.52	$1,017.36
3	$439.92	$169.56	**11**	$1,613.04	$621.72	**19**	$2,786.16	$1,073.88
4	$586.56	$226.08	**12**	$1,759.68	$678.24	**20**	$2,932.80	$1,130.40
5	$733.20	$282.60	**13**	$1,906.32	$734.76	**Savings**	$-	$1,802.40
6	$879.84	$339.12	**14**	$2,052.96	$791.28			
7	$1,026.48	$395.64	**15**	$2,199.60	$847.80			

LED Street Light Study

CITY OF GAINESVILLE
every path starts with passion
FLORIDA

FINAL REPORT FOR GRANT DE-SC0002611

U.S. DEPARTMENT OF ENERGY

Introduction

The City of Gainesville conducted a streetlight study to assist in determining the potential advantages of utilizing LED fixtures for public lighting. Data from May 2011 to May 2013 was collected and shows that LED Pedestrian light fixtures use about half as much electricity of that of a traditional, High-Pressure Sodium (HPS) fixture (see Table 1).

Lighting Configuration

A total of twenty five LED pedestrian scale lights were installed on SE 1st Street between SE 1st Avenue and SE 2nd Place in downtown Gainesville, Fl. These lights were installed behind two meters, 12 behind one meter and 13 behind the other. As a control to the study, one traditional High Pressure Sodium (HPS) pedestrian scale light was installed behind a third meter.

Results

The period of this study was between May 18, 2011 and May 28, 2013. During these 741 days, the LED lights used a total of 18,187 kilowatts for the 25 fixtures for an average of 727.5 kilowatt-hours per light. The sole traditional High Pressure Sodium fixture used 1,431 kilowatt-hourss during the same time period, about twice as much as each LED fixture.

Something to note is that Meter #1 contained 12 LED fixtures whereas Meter #2 contained 13 LED fixtures. Lights behind Meter #1 used approximately 0.89 kW-Hr per day, whereas lights behind Meter #2 used approximately 1.07 kW-Hr per day, about 20% more. This may be caused by an efficiency loss due to the additional conduit used to connect the thirteenth light to the system of Meter #2 compared to Meter #1. Therefore, it could be assumed that the High Pressure Sodium fixture would see a loss of lighting efficiency with more fixtures connected in series and thus, a conclusion could be reached that the LED fixtures are even more efficient than the High Pressure Sodium fixture than the data suggests.

The LED fixtures consumed an average of 0.98 kW-Hr per day whereas the High Pressure Sodium Fixtures consumed an average of 1.93 kW-Hr per day. This results in a reduction of 1.28 pounds of carbon dioxide emission and $0.091 of energy cost per light per day with the LED fixture. Extrapolated over a 20 year life cycle, each LED light installed results in a reduction of 9,350 pounds of carbon dioxide emission and $664.76 in energy costs (see Table 2).

TABLE 1: METER DATA

	Meter #1 (LED)			Meter #2 (LED)			Meter #3 (HPS)	
Reading Date	**Total kW-Hr**	**Total kW-Hr (Unit)**	**Unit Daily Use**	**Total kW-Hr**	**Total kW-Hr (Unit)**	**Unit Daily Use**	**Total kW-Hr**	**Unit Daily Use**
5/18/2011	284	23.67	N/A	375	28.85	N/A	52	N/A
6/16/2011	555	46.25	0.78	703	54.08	0.87	109	1.97
7/21/2011	862	71.83	0.73	1,115	85.77	0.91	166	1.63
8/18/2011	1,130	94.17	0.80	1,465	112.69	0.96	204	1.36
9/19/2011	1,454	121.17	0.84	1,885	145	1.01	263	1.84
10/24/2011	1,836	153	0.91	2,375	182.69	1.08	333	2
11/17/2011	2,117	176.42	0.98	2,735	210.38	1.15	383	2.08
12/19/2011	2,504	208.67	1.01	3,240	249.23	1.21	454	2.22
1/18/2012	2,869	239.08	1.01	3,714	285.69	1.22	520	2.20
2/20/2012	3,257	271.42	0.98	4,216	324.31	1.17	590	2.12
3/20/2012	3,579	298.25	0.93	4,630	356.15	1.10	649	2.03
4/18/2012	3,876	323	0.85	5,008	385.23	1	702	1.83
5/17/2012	4,155	346.25	0.80	5,348	411.38	0.90	752	1.72
6/18/2012	4,457	371.42	0.79	5,744	441.85	0.95	806	1.69
7/18/2012	4,742	395.17	0.79	6,125	471.15	0.98	856	1.67
8/16/2012	5,020	418.33	0.80	6,504	500.31	1.01	906	1.72
9/18/2012	5,370	447.50	0.88	6,967	535.92	1.08	967	1.85
10/18/2012	5,704	475.33	0.93	7,404	569.54	1.12	1,027	2
11/19/2012	6,079	506.58	0.98	7,909	608.38	1.21	1,096	2.16
12/26/2012	6,534	544.50	1.02	8,513	654.85	1.26	1,178	2.22
1/17/2013	6,804	567	1.02	8,854	681.08	1.19	1,228	2.27
2/20/2013	7,204	600.33	0.98	9,363	720.23	1.15	1,301	2.15
3/18/2013	7,495	624.58	0.93	9,724	748	1.07	1,353	2
4/18/2013	7,821	651.75	0.88	10,159	781.46	1.08	1,412	1.90
5/28/2013	8,187	682.25	0.76	10,659	819.92	0.96	1,483	1.78
Total	7,903			10,284			1,431	
kW-Hr / Day / Light	0.89			1.07			1.93	

TABLE 2: CO_2 AND COST RATES

State	Average Carbon Dioxide Emissions Rate (pounds per kWh produced)[1]	Average Electricity Rate ($ per kWh)[2]
AK	1.106	0.133
AL	1.299	0.08
AR	1.28	0.08
AZ	1.219	0.0886
CA	0.7	0.1251
CO	1.986	0.0906
CT	0.754	0.1364
DC	3.614	0.091
DE	1.804	0.0901
FL	1.348	0.0962
GA	1.388	0.0864
HI	1.655	0.207
IA	1.943	0.0927
ID	0.144	0.0629
IL	1.155	0.0834
IN	2.098	0.075
KS	1.871	0.079
KY	2.051	0.0657
LA	1.201	0.0887
MA	1.226	0.1344
MD	1.293	0.0846
ME	0.772	0.1323
MI	1.413	0.084
MN	1.588	0.0828
MO	1.881	0.0708
MS	1.409	0.0871
MT	1.573	0.081
NC	1.218	0.0865
ND	2.386	0.0699
NE	1.503	0.0714
NH	0.779	0.1351
NJ	0.713	0.1174
NM	1.992	0.0913
NV	1.573	0.102
NY	0.907	0.1572
OH	1.779	0.0851
OK	1.726	0.0795
OR	0.456	0.0725
PA	1.216	0.0986
RI	1.071	0.1304
SC	0.915	0.0867
SD	1.215	0.0777
TN	1.266	0.0698
TX	1.472	0.1093

State	Average Carbon Dioxide Emissions Rate (pounds per kWh produced)[1]	Average Electricity Rate ($ per kWh)[2]
UT	2.121	0.0752
VA	1.211	0.0816
VT	0.007	0.1296
WA	0.36	0.0654
WI	1.713	0.0966
WV	1.988	0.0621
WY	2.278	0.0748
U.S. Ave	1.363	0.0945

1 US Environmental Protection Agency eGRID2006 Version 2.1, April 2007
2 US Department of Energy, Energy Information Administration, Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division and State, 2005