LED Streetlights Make Dollars and Sense

Asheville, NC

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1. Document Purpose

This document describes the Asheville, North Carolina program for installing LED street lights as an energy efficiency strategy. It was prepared by John Cleveland for the USDN Innovation Working Group, based on information provided by Maggie Ullman, Energy Coordinator for the City of Asheville. (All quotes used in this document are from Maggie Ullman.)

The purpose of the case study is to share this best practice experience with other Urban Sustainability Directors Network (USDN) members at the September, 2011 Annual Meeting in Denver Colorado.

2. Executive Summary

Innovation Description

In 2010 the City Council of Asheville adopted a goal of reducing its carbon footprint by 20% over five years (4% per year). This resolution doubled the previous target of a 10% reduction over five years. The strategy for achieving this reduction includes a broad range of carbon reduction initiatives, one of which is a program to replace all 9,000 of the City's street lights with energy efficient LED fixtures. The LED street light program accounts for one-third of the targeted 20% carbon footprint reduction for the City.

"This innovation is less about LEDs than it is about the opportunity to build a return on investment model to finance sustainability initiatives. The LED initiative just happened to be the largest project with best ROI."

Highlights of this street light LED replacement strategy include the following:

- **Utility Relationship.** The Asheville street lights were owned and operated by the regional investor-owned utility Duke Energy Progress (DEP). Prior to the LED program, the utility billed the City for a flat monthly rate for maintenance, repair and energy consumption for each street light. This rate was regulated by the NC Public Utility Commission. The implementation of the LED program was made possible by the implementation of a new rate structure for street lights that allowed the City to own the LED fixtures installed on the utility owned arm and pole. The rate structure in turn provided a significant reduction in the per-light cost based on the lower level of energy used, as well as the reduced need for maintenance. The new rate structure cut the per-light monthly cost by 50% for streetlights with LED fixtures. The rate also detailed that the utility would be responsible for the costs of installation of the LED fixtures.

- **Green Capital Improvement Plan.** To finance many of the improvements capable of achieving a 20% carbon footprint reduction over five years, the City created a Green Capital Improvement Plan (Green CIP). The savings from each project are deposited in a capital improvements account whose funds can roll from one year to the next, these savings finance future initiatives.

  The LED streetlight cost savings are managed like an internal Energy Performance Contract (EPC) relationship, similar to what is done by ESCOs, except in this case managed directly by the City. This model is also seen as an Internal Energy Savings Revolving Program. The annual savings from the LED replacements are captured and used to both pay off the debt incurred for fixture procurement and also fund other energy

saving initiatives. Over 10 years, the LED savings are expected to generate $4.3 million in available funding above and beyond what is required to retire the installation debt.

Debt Financing and Repayment. The City authorized borrowing (in the form of general obligation bond issuance) of $1.75 million to implement the LED replacement program.[1] Two borrowing packages were assembled over two fiscal years. The amount borrowed for each year procured the LED fixtures and photocells.
The funding of the Green CIP fund required the City Council to leave the operations budget line item for street lights unchanged and authorize the allocation of the difference between that amount and what is actually required by the new LED rate structure to the Green CIP fund. The City Council authorized this internally managed energy performance contracting relationship for a minimum of 12 years (the time required to retire all the debt).

Performance Outcomes

Key performance outcomes from this innovation include the following.

Metric	Definition	Results
Energy Efficiency	kWh of energy saved	• 2,294,030 kWh annually
Carbon Reduction	Tons of CO2 equivalent saved	• Retrofitting of 7,500 lights will save approximately 1,083 tons of CO2 per year • Total carbon savings represents a 6.5% reduction in the City's carbon footprint
Cost Savings	Reduced cost of street light energy and maintenance	• Average savings is 50% of existing costs • Each retrofitted LED light saves an average of $53 in energy costs per year • Replacement of 7,500 fixtures will save an average of $401,476 per year
Return on Investment	Payback timeframe for capital investment	• 4.6 year payback

12 Year Financial Summary

Total 12 year debt financing costs (principal and interest)	($1,861,456)
Total 12 year savings generated	$4,828,342
Net savings	$2,966,886
Use of savings:	
o LED fixture replacement	$ 100,000
o Expanded Sustainability Office Staffing	$ 635,207
o Projected general rate increases	$ 1,175,000
o Surplus Revenue to Invest in Carbon Reduction Projects	$ 1,056,679

Critical Success Factors

[1] The first phase installation of 700 LED units was funded by $270,000 in Department of Energy EECBG funding.

- **Leadership commitment.** The LED street light program (and the other carbon reduction programs) received management support because they were part of an endorsed City Council policy.

- **A supportive policy context.** The City was able to lead the state by implementing the first project using a new utility rate after participating as a key stakeholder in rate development.

- **A sound economic model with positive returns.** The City Council endorsed the approach of savings reinvestment because the staff was able to demonstrate a reliable positive payback with detailed financial spreadsheets. Furthermore staff was able to demonstrate how this financial model provided a future funding strategy to multiple key policy initiatives that were previously unfunded.

3. Program Background

City Council Carbon Reduction Goals

The LED streetlight replacement program grew out of the City of Asheville's overall plan to reduce carbon emissions. In 2007, the City Council approved a carbon footprint reduction goal for municipal operations. In 2010 they doubled that goal to 4% per year until an overall reduction of 80% was achieved. (At 4% per year, this would occur in 20 years, or 2030, which is far more aggressive than the typical reduction goal of 80% by 2050 that many communities have endorsed.)

In 2008 the Office of Sustainability was formed to lead this effort. The first priority of the Office of Sustainability was to create the Sustainability Management Plan (SMP) to guide reduction efforts and prioritize opportunities. This plan was approved in 2009. The conceptual strategy for carbon reduction in the SMP is a three pronged approach: capital investment, management decision making, and creating an organization that values sustainability.

The Sustainability Management Plan was supported by input from the Sustainability Advisory Committee on Energy and Environment (SACEE). The SACEE consists of nine members appointed by City Council, including an ex-officio non-voting member for the electric power utility serving the City of Asheville. The term of office is three years. The Committee is supported by the Office of Sustainability. The mission of the SACEE is to support the Mayor and Asheville City Council in their charge to integrate sustainable principles related to energy and the environment into City operations and the broader community consciousness. Roles include:

- Policy Guidance: Provide technical assistance to the Mayor and Council on institutionalizing environmentally sustainable practices by evaluating and developing current and future policies in support of City sustainability commitments.
- Education: Increase awareness of matters related to energy and environmental sustainability by developing and implementing outreach and education activities aimed at changing behaviors across a diverse cross-section of the community.
- Partnership: Provide leadership and support in creating synergy among public and private partners in the region to maximize efforts towards a more environmentally sustainable future.

The Green Capital Improvement Plan

To translate the 20% target into concrete action strategies, staff created a five year carbon reduction strategy with specific projects. The plan projects a 20.94% carbon footprint reduction over five years.

One element of this strategy was the creation of a **Green Capital Improvement Plan (CIP)**. The Green CIP includes 4 ongoing activities including: LED streetlights, education, building maintenance, and energy management.

The design and financial performance of specific projects in the Green CIP are detailed in each annual operating budget as seen below. The number of projects, funding sources, distribution of revenue, etc., may change on a year to year basis as priorities shift and new opportunities arise.

	Operations Budget						
				Planning			
Revenue Source:	Adopted FY 11/12	Adopted FY 12/13	Adopted FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18
Streetlight Avoided Spending	131,670	271,404	401,479	401,479	401,479	401,479	401,479
Total Available Funds	**131,670**	**271,404**	**401,479**	**401,479**	**401,479**	**401,479**	**401,479**
				Planning			
Use of Funds:	Adopted FY 11/12	Adopted FY 12/13	Adopted FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18
Projected Rate Increases	60,000	55,576	100,000	100,000	100,000	100,000	100,000
Fixture Replacement		-	-	-	-	5,000	5,000
Sustainability Staff	25,000	29,161	46,046	47,000	48,000	55,000	55,000
Transfer to Green CIP	46,670	186,667	255,433	254,479	253,479	241,479	241,479
Total Use of Funds	**131,670**	**271,404**	**401,479**	**401,479**	**401,479**	**401,479**	**401,479**

Green Capital Improvement Project (CIP) Budget							
	Adopted FY 11/12	Adopted FY 12/13	Adopted FY 13/14	Planning FY 14/15	FY 15/16	FY 16/17	FY 17/18
Revenue Source:							
Transfer from Operations Budget	46,670	186,667	255,433	254,479	253,479	241,479	241,479
Transfer in from Capital Reserves							
Grant Funding							
Debt Proceeds	769,491	982,691					
Total Available Fund	**816,161**	**1,169,357**	**255,433**	**254,479**	**253,479**	**241,479**	**241,479**
	Adopted FY 11/12	Adopted FY 12/13	Adopted FY 13/14	Planning FY 14/15	FY 15/16	FY 16/17	FY 17/18
Use of Funds:							
Phase 1 LED							
Phase 2 and 3 LED	769,491	982,691					
Transfer to Capital Reserves	46,670	99,252	100,796	45,336	48,573	41,510	51,447
Transfer to Debt Service Fund		87,415	154,637	209,143	204,906	199,969	190,032
Total Use of Funds	**816,161**	**1,169,357**	**255,433**	**254,479**	**253,479**	**241,479**	**241,479**

Capital Reserves							
	Adopted FY 11/12	Adopted FY 12/13	Adopted FY 13/14	Planning FY 14/15	FY 15/16	FY 16/17	FY 17/18
Transfers In	46,670	99,252	100,796	45,336	48,573	41,510	51,447
Transfers out	-		-		-	-	-
Total	**46,670**	**145,922**	**246,718**	**292,054**	**340,627**	**382,137**	**433,584**

Green CIP Management

The Green CIP is managed by the Office of Sustainability which is a standalone office that reports to the Executive Director of Multi-Modal Transportation and Public Infrastructure. The Office of Sustainability has overall responsibility for the Sustainability Management Plan and implementing the Green CIP.

Utility Relationship and Regulatory Context

In 2006 DEP proposed the building of a peak energy power plant in Asheville to manage peak demand periods. The citizens of Asheville mobilized politically to stop the building of the plant. In response, DEP formed a regional stakeholder group (the Community Energy Advisory Council – CEAC) to advise DEP on how best to meet the energy needs of the region, specifically the management of peak demand. Through this council the utility had the opportunity to educate their customers about technical challenges, regulatory barriers and general utility perspective. Two years of this two way conversation resulted in a series of detailed recommendations from CEAC to the utility on how best to achieve these goals. Other exchanges of information took place at this Council as well including the City's design to see a market based solution to the challenges of reducing carbon footprint for streetlights.

"There are so many layers to the utility relationship. The fact that we had been working with them for many years on many different issues made a big difference. Plus we had a 'win/win' situation where we both wanted the same result."

This successful relationship supported the utility as they developed and researched new streetlight rates. DEP decided to pursue the current LED rate based on a projected series of events. First the portfolio of streetlights DEP owned were aging out and reaching the end of their lifespan. Faced with the need to begin upgrading their large street light portfolio the DEP lighting specialists began with product research. Convinced that LED's are the next standard for streetlights, DEP began to run financial projections. LED's are currently priced higher than mercury vapors, high pressure sodium or high intensity discharge lamps. To upgrade their portfolio DEP would need to finance the investment. In order to recuperate the DEP investment the basic rate for streetlights would be increased for municipalities. DEP was concerned that this creates a perverse incentive for the rate payer to choose upgrading to the utility's preferred technology.

The relationship built through the CEAC and the progressive nature of the Asheville area lead the utility to reach out to the city as a key stakeholder at this point. With the knowledge that municipalities can generally borrow money at a lower rate, DEP solicited the City's input to see if there would be interest from the municipality to purchase the fixtures in exchange for a significantly lower rate. The City saw this incentive based model as a strong opportunity to reduce carbon footprint and communicated willingness to implement full scale if a rate was available. DEP then pursued developing the "Customer Owned LED" rate. The City reviewed and shared input on the rate before DEP solicited utility commission approval.

4. Detailed Operational Description of the LED Streetlight Replacement Program

Program Management Responsibility

The LED streetlight program is managed by the Office of Sustainability.

- SETTING UP THE REPLACEMENT SCHEDULE: The replacement schedule is set by the Office of Sustainability through carefully balancing the speed which fixtures can be installed and thus the savings accrual from the lower rate with the total monies borrowed and therefore the debt service payment requirements.
- MANAGING THE UTILITY RELATIONSHIP: The Office of Sustainability is the key point of contact with the utility for this partnership. The Public Works Department serves as the operations contact in regards to future streetlight burn outs and replacements, fixture ordering and warrantees.

- MAINTENANCE: The Transportation Department fields the citizen calls relating to maintenance needs. Public Works then issues a work order for the utility to make a site visit to assess and tend to maintenance needs.
- MANAGING AND TRACKING THE FINANCES: The Office of Sustainability manages the finances, tracks the savings, initiates the spending and initiates any necessary account transfer and budget amendments. The Chief Financial Officer is responsible for debt issuance. The Budget Manager is responsible for establishing necessary accounts and budget programs.

Streetlight Rate Structure

The street lights are managed under a special LED street light rate structure – "Street Lighting Service Schedule, SLS-17". Under this regulatory arrangement, the utility owns the street light structures (poles) and charges the customer (city) for the cost of the electricity and service/maintenance expenses. The monthly charges vary by type of light and the lumens rating, which drives a different kWh use per month. The lights are on from dusk to dawn, and the charge is averaged over the full year and does not change as the length of the day changes.

The new LED rate structure allows two different options:

- The **standard option**, where the utility owns the LED fixture; and
- The **customer-ownership option**, where the customer owns the fixture, which is installed and maintained by the utility.

The City of Asheville chose the customer-ownership option. Under this option, they are responsible for purchasing a DEP-approved LED fixture. The utility is responsible for installing, operating and maintaining it. (All of these costs, including installation, are included in the monthly rate.) The City provides a replacement fixture if one of the existing fixtures fails.

The City worked with the utility to set up a purchase and installation schedule that was realistic for the utility to manage. This required several things:

- **Selecting a vendor.** The LED rate structure requires that the customer purchase "DEP-approved" LED fixtures. When the purchases were made the utility had three approved vendors: BetaLED, Leotek and GE. The City managed the procurement process for the fixtures with the manufacturers' representative.

- **Setting the number of lights to be replaced per year.** The City worked with the utility to figure out how many fixtures it could replace each year. The final plan calls for replacement of all 7,500 fixtures over an eighteen month period. The schedule and cost for each phase is summarized in the spreadsheet below.

Feature	Phase 1	Phase 2	Phase 3	Total
Source of Funding	EECBG Grants	Bond Proceeds	Private Placement Loan	
Amount	$272,000	$769,491	$982,691	$ 2,024,181
Fixtures Installed	730	2845	4,008	7,583
Bond Term	NA	10 years	10 years	
Estimated Interest Rate	NA	3%	1,44%	
12 month Savings after operational expenses and debt service is paid	$38,659	$150,667	$212,152	$ 401,478

- **Negotiating the phasing of the rate savings.** The rate changes for each individual streetlight had to be managed to ensure that the new rate was applied at a pro-rated amount based on individual fixture installation date.
- **Determining which lights to replace each year.** A geographic schedule was set up to identify which specific lights would get replaced on which street for each year.

Financial Model

The Green CIP (including the LED streetlight program) is managed as an energy savings revolving program or like an internal Energy Performance Contracting arrangement:

- The City borrows funds to make the energy efficiency improvements
- A baseline energy cost is established
- The difference between the baseline and actual costs after the efficiency improvements is calculated as the savings.
- Since those savings are accrued in an operational line item the first expenditure from those savings are operational such as staffing.
- The savings minus operational expenses are then transferred to the debt service fund to pay off the principal and interest on borrowed funds.
- Lastly any surplus is transferred to the capital reserves which can roll from one year to the next and be retained to support the Green CIP revolving fund in years with significant expenditures.

A total of $1,752,181 of the replacement cost was financed by a combination of a general obligation bond and a private placement loan issued by the City over two fiscal years. The interest rate for the bond was 3.0% and the private placement loan was 1.44% both over 10 year terms. The total cost of financing over the period of all the bonds will be $1,861,456. The total energy savings over this same time frame will be $4,828,342, resulting in net proceeds to the Green CIP fund of $2,966,886. This $2.9 million is allocated to the following purposes:

"Internal Energy Performance Contracting works well if you have projects where the savings are clear and easy to calculate so you don't have to use complex energy modeling software. LED replacement definitely fell in this category."

Staffing in the Sustainability Office	$ 635,207
LED Fixture Replacements	$ 100,000
Projected general rate increases	$ 1,175,000
Surplus Revenue to Invest in Carbon Reduction Projects	$ 1,056,679
Total	**$2,966,886**

The funding of the LED streetlight replacement program required the City Council to leave the budget line item for street lights unchanged and authorize the allocation of the difference between that amount and what is actually required by the new LED rate structure to the Green CIP fund. The City Council authorized this energy performance contracting relationship for a minimum of 12 years (the time required to retire all the debt).

Performance Metrics

The key performance metrics for this innovation include:

Metric	Definition	Results
Energy Efficiency	kWh of energy saved	• 2,294,030 kWh annually
Carbon Reduction	Tons of CO2 equivalent saved	• Retrofitting of 7,500 lights will save approximately 1,083 tons of CO2 per year • Total carbon savings represents a 6.5% reduction in the City's carbon footprint
Cost Savings	Reduced cost of street light energy and maintenance	• Average savings is 50% of existing costs • Each retrofitted LED light saves an average of $753 in energy costs per year • Replacement of 7,500 fixtures will save an average of $401,476 per year
Return on Investment	Payback timeframe for capital investment	• 4.6 year payback

5. Best Practice Lessons

There are several best practice lessons from this case study that can be helpful to other USDN members considering a similar strategy.

- **Clear goals and mandates.** The fact that the City had a top-level commitment to measurable carbon footprint reduction was critical to the implementation of this innovation. It created a performance mandate carbon reducing investments.

- **Working relationship with the utility.** Through its involvement with the Community Energy Advisory Council City staff had developed a productive working relationship with the utility that enabled it to negotiate the LED rate structure, as well as work out the logistical details for implementation.

- **Positive return economic model and detailed financial modeling.** The fact that the City staff could clearly demonstrate a large measurable improvement in an otherwise fixed cost of operations was critical to generating political support for this innovation. As Maggie Ullman noted: *"If you can make a revenue positive sustainability proposal, the political sell turns into a win/win proposition. This required detailed financial models. We needed to know what we were talking about because it involved serious long-term commitments. Because we were able to show that it more than paid for itself over the long term, City Council was willing to let us retain our earnings to fund our operations. It was incredibly helpful for me to be mentored by people from the Finance Department who guided me as I designed this analysis."*

- **Detailed program management.** The work of actually managing the planning and logistics for the replacement of 7,500 fixtures, and managing the detailed finances for the Green CIP fund accounting is not a trivial task and required strong program management skills.

Questions to Consider for Replication in Other Cities

Category	Questions
Political Will	• Is there a strong commitment to achieving carbon footprint reductions? • Is this commitment embodied in a public plan? • Are there measurable performance metrics that create an incentive for demonstrating progress?
Policy Environment	• What is the "business model" for City street lights? • Who owns the lights? • What is the rate structure? • Is there a rate structure that allows you to effectively capture the savings from LED replacements?
Utility Relationship	• Are the utilities incentivized to upgrade to LEDs? • Do you have a good working relationship with the utilities that can manage a technically complicated program structure?
Financial Model	• Is your political leadership comfortable with an internal Energy Savings Revolving program of the Performance Contracting model? • Will they let you retain your savings in excess of the implementation costs? • What kind of payback terms are they willing to consider? • Do you have the ability to raise the capital for front-end implementation? • Do you have the technical support to put the financial models together?
Program Management	• Do you have the staff to plan and manage a technically complicated implementation process?

6. Potential Next Steps for USDN

A number of USDN members have expressed interest in implementing a similar strategy in their communities. Since this strategy heavily depends on having the right regulatory environment (meaning a street light utility rate that allows the municipality to reap the savings from LED replacements), the first step would be to research the street light ownership and rate structure in the relevant utility region and state regulatory environment. As an example, the following USDN members have common utility providers across a range of state regulatory frameworks.

Utility	USDN Members	
Pacific Gas and Electric	• Alameda County, CA • Berkeley, CA • Palm Springs, CA • San Francisco, CA • San Jose, CA	
Ameren	• Columbia, MO • Branson, MO • Kansas City, MO • St. Louis, MO • Urbana, IL	
ComEd	• Evanston, IL • Oak Park, IL • Chicago, IL	
Xcel Energy	• St. Paul, MN • Minneapolis, MN • Denver, CO	
Duke Energy Progress or Duke Energy	• Asheville, NC • Raleigh, NC • Carey, NC • Orlando, FL • Orange County, FL • Sarasota County, FL • Leon County, FL	• Chapel Hill, NC • Charlotte, NC • Cincinnati, OH • Bloomington, IN

Steps in a broader USDN strategy to replicate LED street light replacement could include:

- Identify USDN members who are interested
- Identify the common utility providers across interested members
- Research the ownership and utility rate structure for each utility
- Determine where:
    - An appropriate rate structure is in place
    - The current rate structure needs slight changes to be effective
    - A new rate structure is needed
- Organize USDN members to collaboratively approach their utilities to secure the right rate structures
- Create common presentation materials for USDN members to pursue implementation in their municipalities
- Explore group buying to reduce the cost of LED replacements
- Collectively monitor the energy and CO2 savings and publicize the results