

*Final Report*

# **Conventional Vs LED Traffic Signals; Operational Characteristics and Economic Feasibility**

**A Project Sponsored by Arkansas Department of  
Economic Development**

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## Introduction

Light Emitting Diode (LED) Traffic Signals have become an efficient and effective alternative to traditional incandescent signals. The two main advantages of LED signals are- very low power consumption (10 W to 22 W) and very long life, as high as 7 to 10 years. When compared with the typical energy needs of an incandescent bulb, which is 135 Watts, the savings resulting from the low energy usage of LED signals can be as high as 93%. In addition to the low energy usage, the long life of LED signals means low maintenance costs, which makes LED signals a worthwhile investment and also environment-friendly.

Other benefits of LED signals include:

- Elimination of catastrophic failures. Unlike an incandescent bulb which has only one filament, an LED signal is made out of a matrix of several dozen LEDs. The signal continues to function even if several of these miniature diodes stop working. On the other hand, when the filament of an incandescent bulb fails, the display goes dark requiring immediate replacement.
- LED signals are brighter compared to incandescent traffic signals, which enhances intersection safety.
- Elimination of phantom effect. Incandescent traffic signals use reflectors behind the bulbs. For signals on east-west approaches during morning and evening hours, all colors seem to light up when the sunrays fall directly on these signals. This problem is eliminated when LED signals are used because there are no reflectors in LED signals.

The main disadvantage of the LEDs is their initial cost which can range from \$57.00 for a red display to \$127.00 for a pedestrian display. An incandescent bulb used for traffic signals typically costs about \$2.75 per bulb.

## The Arkansas Department of Economic Development LED Signal Study

The Arkansas Department of Economic Development awarded a \$10,000 grant in Feb. 2002 to the City of Little Rock to study the pros and cons of LED Traffic Signals. As part of the study, three intersections were retrofitted with LED signals and their energy usage was monitored and compared with that of three similar intersections which used incandescent signals. The intersections studied were:

<b>LED</b>			<b>Conventional</b>		
Main St.	–	3 <sup>rd</sup> St.	Main St.	–	7 <sup>th</sup> St.
Broadway St.	–	3 <sup>rd</sup> St.	Spring St.	-	Capitol Ave.
Chester St.	–	3 <sup>rd</sup> St.	Chester St.	-	7 <sup>th</sup> St.

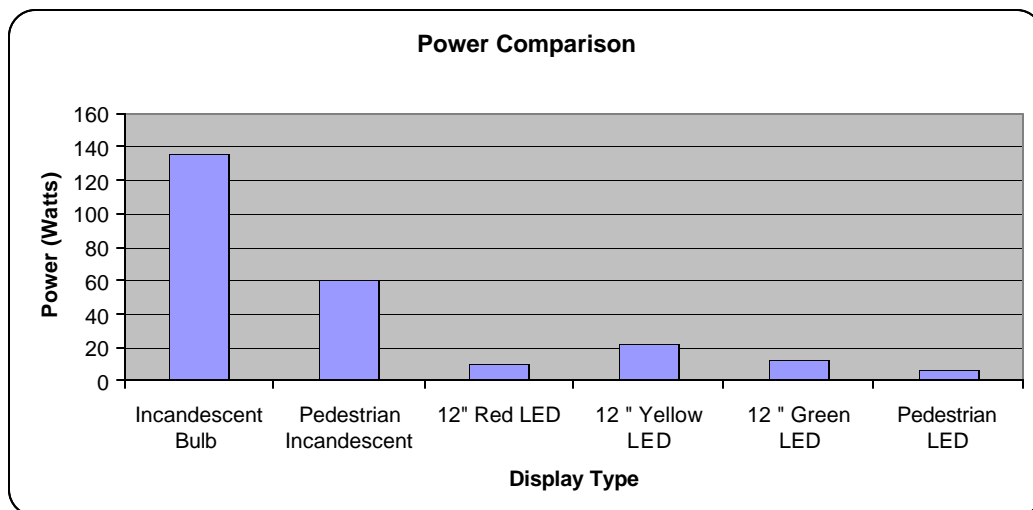
**Material and Installation Costs:**

	LED	Incandescent Bulb
Material	\$ 57.00 (Red) \$ 66.00 (Yellow) \$119.00 (Green) \$127.00 (Pedestrian)	\$2.75 per bulb
Labor (per retrofit installation)	\$55.00	\$55.00

**Typical Wattages**

As mentioned earlier, LED signals require very low power to operate. The typical power requirements range from 6 to 22 watts. The following table and chart illustrate the power requirements needed for incandescent bulbs and LED signals.

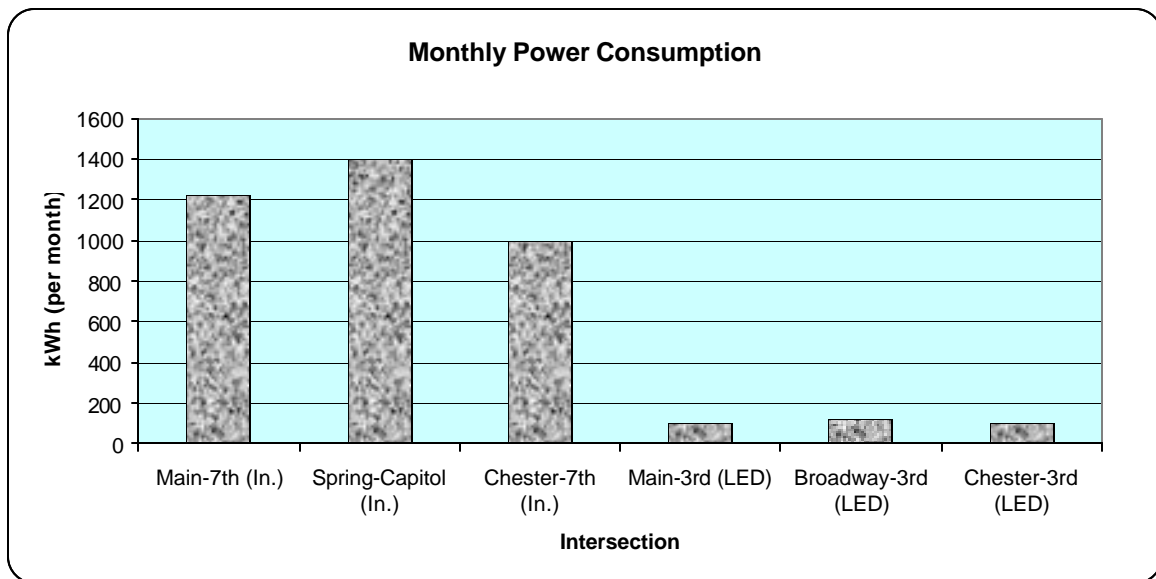
Display Type	Typical Power (Watts)
Incandescent Bulb	135
Pedestrian Incandescent	60
12" Red LED	10
12 " Yellow LED	22
12 " Green LED	12
Pedestrian LED	6



## Power Consumption and Energy Savings

Based on actual meter readings over a period of four months, the power consumption of the three intersections retrofitted with LEDs, including all hardware to operate the intersections, ranged from 103 kWh to 126 kWh per month with an average of 111 kWh. These intersections have 4 approaches with 6 lenses per approach (2 red, 2 green, 2 yellow) and two pedestrian heads per street, which is typical.

Based on actual meter readings over the same period, the power consumption for intersections with incandescent signals ranged from 990 kWh to 1400 kWh per month with an average of 1203 kWh. The chart below illustrates the power consumption characteristics of the two types of signals.



***Based on the above averages, the LED signals consume about 90% less energy than conventional signals with incandescent bulbs.*** For the 263 intersections in the city, the annual power consumption for the two different types of signals can be estimated at:

Conventional :  $263 \times 1203 \text{ kWh/month} \times 12 \text{ months/year} = 3,796,670 \text{ kWh}$

LED :  $263 \times 111 \text{ kWh/month} \times 12 \text{ month/year} = 350,316 \text{ kWh}$

***If all of the 263 intersections in the city were converted to have LED signals, the average energy savings would be about 3.45 million kWh per year***

## **Operational Characteristics**

Observation of LED signals in operation has resulted in the following findings:

- LED Signals are brighter than conventional signals
- Due to their low wattage, LED signals do not burn the lens coverings like the conventional incandescent bulbs. Incandescent bulbs tend to burn the lens coverings and darken them after a few years of operation, which reduces the brightness.
- The visibility of LED signals tends to be very directional which causes problems for signals attached to span wires. During times of high wind, the swaying signals appear dim depending on the degree of tilt. This can be solved by tethering the signal heads on both the top and bottom sides.
- Since LED signals require very low power to operate, it is feasible to run the signals with battery back-up during power failures.
- Since LED signals draw very low power, the intersection wiring will not deteriorate as rapidly resulting in less maintenance.
- During heavy snowstorms, LED signals may not generate enough heat to melt the snow that may get accumulated in front of the lenses. However, this is not a major problem in Arkansas where severe snowstorms are rare.

## **Cost Savings**

Due to their low wattage, LED signals consume significantly less power, which results in lower energy bills. In 2002, Johnson Controls Inc. signed a contract with the City of Little Rock to retrofit all of the 263 signalized intersections with LED signals. The retrofit operation was completed in early 2003. A cost comparison based on the average energy bills (from the energy provider) for 10 intersections of each kind (LED and conventional) showed a savings of 57.2%

The average energy bills (based on 10 locations) for a typical conventional signal and LED signal were \$61.50 and \$26.31 respectively. Therefore, for 263 intersections, the energy bill would be approximately \$16,175 for conventional signals and \$6,920 for LED signals. This results in a savings of approximately \$9255 per month or \$111,000 annually.

## **Conclusion**

Due to the many advantages of in terms of operation and energy consumption, the benefits of LED signals outweigh the initial investment. The City of Little Rock decided to retrofit all the traffic signals with LED signals and as a result of the citywide retrofit project, all the traffic signals in the City now use LED signal displays. The city now

requires LED signals on all new traffic signal installations. Thus far, the performance of LED signals has been very satisfying.

*Appendix*  
**Grant Expenditure Report**

The grant money was mainly spent for buying the LED signals and other needed hardware. The labor for retrofitting the test intersections with LEDs was paid for by the City of Little Rock. The following table shows the items purchased along with their cost. The \$189.56 excess spending was assumed by the City of Little Rock.

<b>Item</b>	<b>Quantity</b>	<b>Supplier</b>	<b>Unit Price</b>	<b>Ext. Price</b>
12" Red LED	24	Temple Inc.	56.86	1364.64
12" Yellow LED	24	Temple Inc.	65.68	1576.32
12" Green LED	24	Temple Inc.	118.92	2854.08
16" Ped Full Hand & Man Midwest R100T Combo Meter Socket	24	Temple Inc.	126.89	3045.36
Anchor URS1004-G-HO Plain Meter Socket	5	DESCO	148.6	743.00
MILB A7517 2-IN Myer's Hub	1	DESCO	24.78	24.78
	1	DESCO	2.75	2.75
			Total	9610.93
			Total	
			Taxes	578.63
			<b>Grand</b>	
			<b>Total</b>	<b>10189.56</b>