Energy Efficiency In Nebraska: A Community Investment

Street & Park Lighting

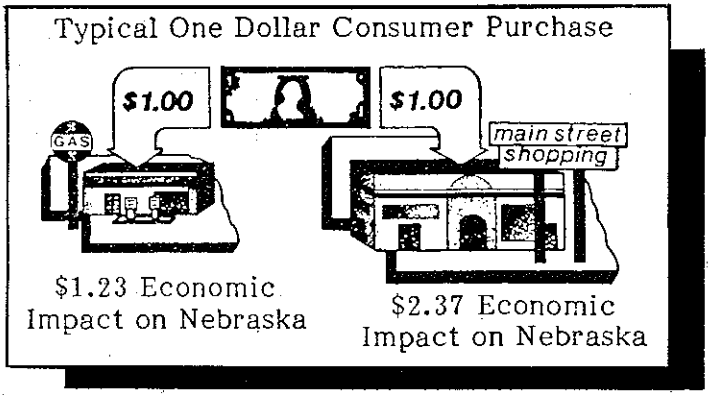
Why Invest in Energy Efficiency?

Typical Nebraska communities spend hundreds of thousands or even millions of dollars each year on energy consumption. This spending means there is less money available for purchasing other goods and services which do more for the local economy than conventional energy purchases.

Money spent on most energy is almost entirely exported out of state to traditional energy producers—such as oil, coal and gas-producing states or Saudi Arabia. Money spent on typical consumer purchases, on the other hand, stays in the local economy generating added income and job opportunities.

When you buy a loaf of bread from a local bakery, for instance, income is created for the baker, who may then be able to afford to install new equipment. In turn, the contractor may hire a new crew to install the bakery equipment. Income spent this way within the community is economic development. So, reducing energy consumption can benefit your town by increasing the amount of income available to build your community.

There are many different ways a town can reduce its energy consumption. One of them is to install energy-efficient street, park and recreational lighting. This pamphlet will show you how to analyze the street and park lighting in your town and take action to strengthen your community economy.



Where Do You Start?

To decide whether you can save money by changing your street and park lighting, you need to understand your current system. Check with your city officials to learn the sizes and types of street lamps in your town. You may want to prepare a map showing each lamp in town and the equipment it has, such as pole, bulbs and ballast (see the Glossary at the back for definition of terms). Also, find out who owns and maintains the lighting. If an outside utility owns and operates your system, improving lighting efficiency to capture the financial benefits may be slightly more difficult than if your town controls the system. But you may be able to negotiate an agreement with the utility to share the costs and benefits of a more efficient system.

How Much Will It Cost To Convert From Your Present System?

To decide whether it would be cost effective for you to change your present lighting system, you will need to compare the cost of converting and using a new system to the cost of using your current system. You can use the "Do-it-yourself" section at the back of this pamphlet to calculate the costs of both systems. The formulas are not complicated, but they do contain several variables you or your electric utility will have to identify to complete the calculations.

Keep in mind that while a new system may use the same poles as the old system, it will require new fixtures. The one-time cost of purchasing the new fixtures should be balanced against the energy and dollar savings which are realized for the life of the new system.

How Much Money Can You Save?

Efficient street and park lighting is a good investment for either a community or a utility. Depending on the type of lighting currently used, the electricity and maintenance costs of a new system can easily be low enough to provide both a significant savings and a reasonably short payback period (the amount of time it takes for the dollar savings to pay for the cost of replacement) on the costs of converting the system. Chart I shows the costs of operating different types of lighting systems.

You can do more, however, than just installing more efficient bulbs. Anything you do to reduce the amount of lighting will help save dollars. Look again at your map of your street and park lighting. Does your community have excessive lighting? Each lamp type puts a different circle of illumination on the ground, and you may find that with a new system there is an overlap of illumination and some lamps could be completely removed.

CHART I
ANNUAL COST OF BUYING AND OPERATING 25 STREET LAMPS FOR ONE YEAR

	Incan-descent	*Mercury Vapor*	*High Pressure Sodium*	*Low Pressure Sodium*
COST	$3,100	$1,025	$811	$629
Light Output (Lumens per Watt)	15,000	12,000	16,000	13,500
Bulb Life (Hours)	1,000-2,000	12,000-24,000	24,000	18,000
Watts (Including Ballast)	750	280	250	115
Estimated Bulb Purchase Cost	$12	$30	$64	$38
Annual Cost Per Lamp				
Electricity (At 3.5¢/kwh)	$107.62	$34.87	$21.53	$16.50
Bulb Replacement (Based on 1980 catalog price. Quantity bid may lower cost)	$16.40	$5.13	$10.93	$8.66
Total Cost/Lamp/Year	$124.02	$41.00	$32.46	$25.16

To cut costs you might want to look at reducing the amount of time the lights are on. Many systems use time clocks to activate the lights, but it is more efficient to use photo cells because they activate the lights according to the level of darkness rather than time. In addition, photo cells' sensitivity to light can be set so that the lights are on less. Setting street and park lights so they are on only one hour less each day (half an hour in the morning and half an hour in the evening) can add up to significant savings over the year.

More efficient lighting has another cost advantage: new types of bulbs often last longer. This means lower maintenance and replacement costs, as well as increased safety because of less lightout time. Remember to consider all these saving opportunities when deciding which system is most appropriate for your community.

What Are the Lighting System Alternatives?

For most towns, it may be best to switch to high or low pressure sodium lights. Both give off a large amount of lumens per watt, which means a lot of light is produced for each watt of electricity consumed. Replacing one type of lamp with another that produces more lumens per watt can provide the same amount of light with less electricity. Low pressure sodium lights are considered the most efficient lights commercially available and could produce the most savings. However, low pressure sodium lights give off a yellowish light which many people find unpleasant at first. Another disadvantage is that they require special care in disposal because the contents of the lamp burn or explode when exposed to air. High pressure sodium lights, which are also very efficient, are now most often installed because they provide better color rendition than low pressure sodium lights. Chart II describes the various types of street lights and their characteristics. This chart includes information on the most commonly used types.

CHART II
CHARACTERISTICS OF COMMON STREET LAMP TYPES

	Incan-descent	*Mercury Vapor*	*High Pressure Sodium*	*Low Pressure Sodium*
Lumens per Watt	17-20	35-57	70-140	100-150
Lamp Size (Watts)	145-150	175-1,000	50-1,000	55-180
Appearance of light	Warm White	Cool White	Golden White	Yellow
Color Rendition	Excellent	Very Good	Good	Poor
Lamp Life (hours)	1,000-2,000	12,000-24,000	24,000	18,000

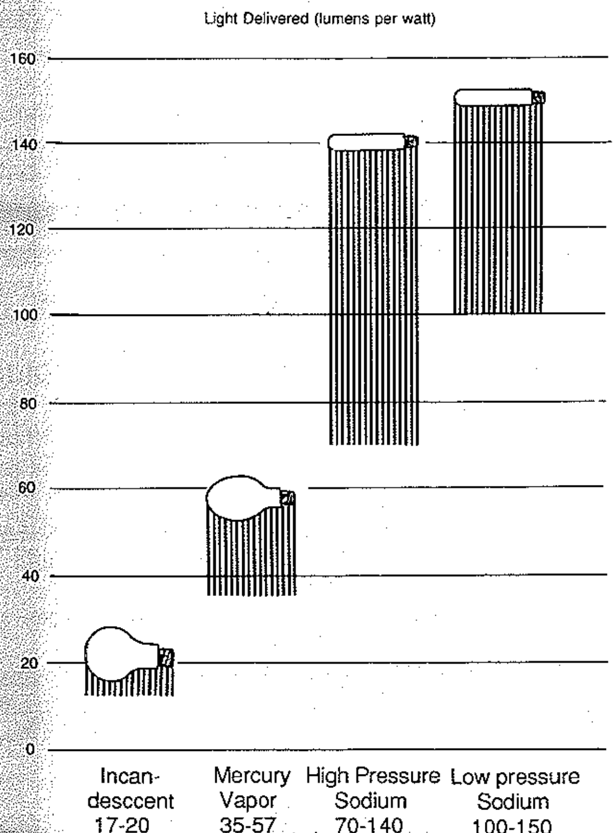


Chart III indicates reasonable conversions you might want to consider. Notice that conversions to mercury vapor lamps are not recommended: mercury vapor systems are now practically obsolete compared to the energy efficient high or low pressure sodium lights.

CHART III—CONSERVATION OPTIONS

CONVERTING TO HIGH PRESSURE SODIUM

IF YOU NOW USE		SWITCH TO		SAVE		
WATTS	LAMP LIFE (hours)	WATTS	LAMP LIFE (hours)	WATTS	OIL (Approx Barrels)	% OF INCREASE/ DECREASE OF LIGHT LEVELS
1500 W Incandescent	1000	400W High Pressure Sodium	24,000	1040W	50	+40%
1000W Incandescent	1000	250W High Pressure Sodium	24,000	700W	33.5	+10%
750W Incandescent	1000	150W High Pressure Sodium	24,000	565W	27.01	0%
1000W Mercury Vapor	24,000	400W High Pressure Sodium	24,000	640W	30.07/10	−10%
400W Mercury Vapor	24,000	250W High Pressure Sodium	24,000	160W	7.07/10	+25%
250W Mercury Vapor	24,000	150W High Pressure Sodium	24,000	115W	5.05/2	+30%
175W Mercury Vapor	24,000	100W High Pressure Sodium	24,000	75W	3.06/10	+15%

CHART III—CONSERVATION OPTIONS

CONVERTING TO LOW PRESSURE SODIUM

IF YOU NOW USE		SWITCH TO		SAVE		
WATTS	LAMP LIFE (hours)	WATTS	LAMP LIFE (hours)	WATTS	OIL (Approx Barrels)	% OF INCREASE/ DECREASE OF LIGHT LEVELS
1000W Incandescent	1,000	135W Low Pressure Sodium	18,000	822W	29 1/2	+10%
400W Mercury Vapor	24,000	135W Low Pressure Sodium	18,000	272W	98/10	+15%
175W Mercury Vapor	24,000	55W Low Pressure Sodium	18,000	115W	41/10	0%
100W Mercury Vapor	24,000	35W Low Pressure Sodium	18,000	60W	21/5	+20%
100W Incandescent	750	18 Low Pressure Sodium	12,000	70W	17/10	0%

A Do It Yourself Guide

To calculate the electrical costs for a group of lights, you need to know the following:

K = 1,000 watts or one kilowatt
N = number of lights, usually all the same size
W= size of the bulbs, in watts printed on the end of the bulb
B = size of the ballast, in watts used with all lamps except incandescent.
E = electricity in dollars per kilowatt hour
H = hours per year that the lights are on

The following formula is used to calculate the electrical cost (or EC) of using the lamps, in dollars per year:

EC (electrical cost) $N \times \frac{W + B}{K} \times E \times H = EC$

For example, if N (number) = 100 lights, W (watts) = 100 watts, B (ballast) = 0, E (electricity) = .04, and H (hours) = 1,000 hours, then the electrical cost (EC) would equal $400.00 per year for the lighting system.
The maintenance cost to replace each bulb when it burns out is dependent on the type of bulbs used, since different bulbs may have very different expected lives. The formula used to calculate the maintenance cost is:

MC (maintenance cost in dollars per year) $N \times \frac{PC + RC}{L} \times H = MC$

where PC = purchase cost of replacement lamp in dollars
RC = replacement cost (labor) to install new lamps
L = expected lamp life in hours
N & H are the same as used in the first example

The total cost of the lighting system is the electricity cost plus the maintenance cost for each type of lamp, or TC (total cost) = EC (electricity cost) + MC (maintenance cost).

Blank Calculation guides are on the following two pages so you can make your own calculations.

Do Your Calculations Here

Old System

Electrical Cost

__________ x ((__________ + __________) ÷ 1,000 watts =
no. of lights — size of bulbs in watts — size of ballast in watts

__________) x $__________ x __________ hrs. =
electrical cost in dollars per kilowatt hours — hours per year lights are on

$__________
electrical cost

Maintenance Cost

__________ x (($__________ + $__________) ÷ __________) x
no. of lights — purchase cost of replacement lamps — labor cost to install new lamps — expected lamp life in hrs.

__________ hrs. = $__________
hours lights are per year — maintenance cost

Total Cost

$__________ + $__________ = $__________
maintenance cost — electrical cost — total cost

Once you have found this cost, you can use the same formula to figure the costs of alternative systems.

The number of hours (H) the lights operate is a local policy decision, as is the number of lamps (N). You may be operating more lamps than you need or for longer than you need. Use these formulas to calculate the costs that would result from reducing these figures.

Do Your Calculations Here

New System

Electrical Cost

__________ x ((__________ + __________) ÷ 1,000 watts =
no. of lights; size of bulbs in watts; size of ballast in watts

__________) x $__________ x __________ hrs. =
electrical cost in dollars per kilowatt hours; hours per year lights are on

$__________
electrical cost

Maintenance Cost

__________ x (($__________ + $__________) ÷ __________) x
no. of lights; purchase cost of replacement lamps; labor cost to install new lamps; expected lamp life in hrs.

__________ hrs. = $__________
hours lights are per year; maintenance cost

Total Cost

$__________ + $__________ = $__________
maintenance cost; electrical cost; total cost

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Glossary

Ballast. The electrical device which supplies the proper voltage and current to start and operate a discharge lamp. The most common is the electric-magnetic type, typically a "black box" mounted inside the fixture. Solid state ballasts are also available for certain lamp types. Resistance or "self ballasted" mercury lamps have the ballast built into the lamp in the form of an incandescent filament. This reduces the lamps luminous efficiency by about one-half compared to externally ballasted lamps.

Bulb. The outer envelope of a light source; usually quartz or glass.

Circle of Illumination. Pattern or shape of area on ground lit by lamp.

Color Rendition. The colored appearance which a light source gives an object or a space.

High pressure sodium lamp. A high intensity discharge light source in which the light is primarily produced by the glowing sodium vapor. "High pressure" is a relative term since the internal operating pressure in the arc tube is less than atmospheric.

Lamp. The completed light source unit. A lamp usually consists of a light generating element (arc tube of filament), support hardware, enclosing envelope and base. Associated terms: bulb, arc tube, filament tube.

Lumen. The international unit of luminous flux or the time rate of flow of light. Used to specify light output of sources.

Lumen-hour. The unit of light quantity (luminous energy). Often used in calculating "cost-of-light" where result is given in "dollars per lumen-hour", or more often "dollars per million lumen-hours". The lumen-hour is analogous to the electrical unit of watt-hour or, more usually, kilowatt hours.

Mercury vapor lamp. A high intensity discharge light source in which glowing mercury vapor produces visible light.

Metal halide lamp. A high intensity discharge light source in which the light is produced by the glowing mercury and the halides of metals such as sodium, thallium and indium.

Tungsten Halogen. An incandescent lamp containing halogen gas which recycles tungsten (which would ordinarily be deposited on the bulb wall) back onto the filament surface. This type of lamp is sometimes called quartz-iodine or tungsten-iodine.

Where Do You Go From Here?

This pamphlet can only assist local communities in their preliminary review of possible lighting options. This information does not cover every situation which might exist in your community. If you wish, you may contact your local electric utility or a lighting firm for additional help. If your lighting system is large, you may want to talk to an electrical engineer or an electrical contractor. And as always, the Nebraska Energy Office is ready to help you find the right tools for your community's needs.

STATE OF NEBRASKA

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