Lighting Cost Savings Calculator

It's easy to save money by switching to energy-efficient lighting. For instance, you can substitute a compact fluorescent (CF) lamp or an LED lamp for an incandescent lamp. The fluorescents and LED's last longer and use a lot less power to produce the same amount of light as an incandescent. So even if you have to spend more for the lamp, you can still come out way ahead. (Caveats: many CF lamps should not be used with timers or dimmers and aren't fully bright at very low temperatures, although we sell plenty of dimmable CF lamps. LED lights are best for directional lighting, such as spot lighting, and aren't as effective at 360° lighting.)

Lighting costs include:

1. The cost of energy to produce the light;
2. The cost of maintaining the light, including time spent changing bulbs; and
3. The cost of the bulb or "lamp" that produces the light.

The cost you care most about is number 1, the energy cost. It's easy to place too much emphasis on number 3, the "first cost" of the bulb, because it's easy to identify.

Let's Take a Look at Energy Costs

The average cost of electricity in the U.S. is about 15 ¢/Kilowatt-hour. That's 15 cents for every thousand watts of power delivered for a period of an hour. You can use a 13 watt compact fluorescent (CF) bulb  instead of a 60 watt incandescent  and get the same amount of light. Plus, the CF may last 10,000 hours, versus the incandescent, which may last only 1,000 hours.

If you use a CF, you save 47 watts (60-13). Over the 10,000 hour life of the bulb, you'd save 47 watts * 10,000 hours/1,000 = 470 KW-hours. That's 470*15 ¢ = **$70.50** saved over the life of the bulb! Plus, one CF bulb lasts as long as 10 incandescents, so you save money on bulbs, and you don't have to set up a ladder to change the bulb nearly as often.

Now here's another example—and it might shock you: **It is less expensive to use a $45.00 LED MR16 cup lamp than a FREE halogen cup lamp.** That's right! If you use it 8 hours/day and pay 15 ¢/KW hour, you'll save $11.36/year with that high-tech LED lamp, and that' assuming you don't have to pay someone to change the bulb (as shown in our Lighting Cost Savings Calculator in the "Halogen v LED MR16 bulb" sheet, cell F25.) So you could take out halogen bulbs you've already paid for (essentially free, at this point) and save money by buying a $45 LED MR16. (Ours are less expensive, however.) If the light is inconvenient to change because of its location, you're even better off with the LED because it lasts so long.

If you have inefficient incandescent lighting, we'll help you find energy-efficient substitutes, such as CF or LED lamps. When your order arrives, take out your old incandescent bulbs (even if they still work) and *throw them away*. Incandescent bulbs were great technology for over 100 years, but it's time for an upgrade!

Energy-Efficient Lighting is a Great Investment

By far, the most important cost of lighting is the energy your lights consume, not the cost of your bulbs. That's a hard thing for people to really believe and act upon, so we've developed a calculator to help you see why getting rid of your old inefficient lighting is absolutely the right thing to do. You save money by spending more on the lamp. Energy-efficient lighting is one of the best investments you can make—low risk, with very high payoff.

Ways to Calculate Savings

Always compare bulbs with comparable light output to see which one is the better alternative for a given use. Light output is measured in lumens, and power consumption in watts. The 13 watt CF spring bulb  and the 60 watt incandescent  both generate about 850 lumens, but the CF bulb uses only 22% of the energy.

Our Lighting Cost Savings Calculator shows the savings of one type of lighting versus another using 3 methods:

Cost per Year. This is the easiest method to understand. If you compare the total cost of 2 different bulbs (energy, maintenance and first cost,) over long periods of time, what do they cost? If a bulb uses less energy to produce the same amount of light as another, it'll usually win, even if it costs more. For costs per year calculations, it's easiest to use "steady state" calculations, which factor in the life of the bulb. Therefore, if a bulb costs $10 and lasts 2 years, its cost per year is $5/year, even though you'd have to pay $10 to get started. Add in the energy and maintenance costs, and you'd have the total cost of the light.

Payback Period. Buying a more expensive light to save energy is an investment, and some people use Payback Periods to evaluate investments because the concept is straightforward: if you invest money in energy-efficient lighting, how long does it take to earn it back in savings? That's the payback period, in years, or months.

Net Present Value ("NPV.") Net Present Value is best way to compare 2 lighting alternatives: better than Cost per Year or Payback Period. One reason is that the NPV method will always provide a sensible answer, whereas other methods, such as Internal Rate of Return ("IRR") and Payback Period will not. For example, what if 2 bulbs cost the same, but use different amounts of energy to generate the same light? There's no difference in the first cost of the bulb, so the IRR and Payback Period are undefined. But the NPV method will tell you the energy-efficient bulb is the clear winner.

NPV analysis is a little harder for most folks to grasp because it's a bit more complicated. If you have a few minutes, please take a look at our NPV calculator and explanation for a little fancier investment analysis you can use to impress your clients and friends. You might want to turn on some relaxing music and grab your favorite beverage before you dig in.

Here is how to use the calculator:

You'll fill in the purple cells. The answers are in the green boxes. We provide several samples, such as CF versus Incandescent, Halogen versus LED MR16 Bulb, and Incandescent versus LED String. (They're shown as tabs at the bottom of the spreadsheet.) All the following comments refer to the CF versus Incandescent example.

1. The calculator compares 2 independent investment projects. You'll compare the cost of 2 different types of bulbs, for example, LED versus halogen or incandescent versus CF. Decide what 2 bulbs you're comparing and give your projects names in cells D5 and E5. ("Incandescent" and "CF" in the example.)

2. On row 7, put the power consumption (wattage) of each bulb. (60 watts and 13 watts in the example.)

3. On row 8, put the cost of procuring the bulb, including any sales tax, inbound freight or other costs you may pay to get the bulb to the location it is to be used. ($1.00 for the incandescent and $6.00 for the CF, in this example.)

4. If you pay somebody to change the bulb, such as a janitor, put the fully burdened cost per hour of employing that person in cell B9. ($20/hour, in the example.) You may enter $0/hour.

5. Estimate how long it will take to change the bulb and enter the number of minutes per bulb (or string) in B10. If the person changing the bulb needs to move store fixtures, disassemble a luminaire, replace an entire light string or use a ladder or lift, the labor time and costs of replacing a bulb or string may be significant. In this case, a long-life light source will save you money. (The example uses 6 minutes to change each bulb.)

6. On row 14, enter the service life of the bulb. (The example uses 1,000 hours for the incandescent and 8,000 hours for the CF.)

7. In cell B16, enter your cost of electricity. The best way to find this is to look at your electricity bill. Figure out the "marginal" cost of electricity, which is the cost of the last kilowatt-hours of power your bought. In many utility districts, the cost of electricity rises the more electricity you use. If you reduce power consumption, you'll save money at the highest rate. Be sure to factor in all the taxes and surcharges. Frequently, the true cost of electricity is higher than you think. For example, the average cost of electricity in California is under 15 ¢/KWh according to some published sources, whereas some customers pay over 28 ¢/KWh at the margin because of the high penalty rates assessed for excess usage. (The example uses 15 ¢/KWh.)

8. In cell B17, enter the air conditioning burden, as a percentage of the wattage of the bulb. Lights give off heat, and you may need to pay money to air condition to offset the heat generation. This number can be as high as 30%. If the lights are outdoors, use 0. (The example uses 10%. This increases the effective energy cost from 15¢/KWh to 16.5¢/KWh, as shown in cell B18.)

9. In cell B20, enter the number of hours per week the light is on. (40 hours in the example.) There are 168 hours per week, so do not enter more than 168.

10. The Cost per Year savings is shown in the first green box. In this case, the compact fluorescent (CF) is the less expensive source, by $20.29/year.

11. The Payback Period is in the next green box. In this case, the CF's Payback Period is 0.25 years (3 months.)

12. The Net Present Value method requires that you enter a <u>discount rate</u>[1] for your money (%/year.) The higher the risk of your project, the higher the discount rate you should use. Lighting projects should usually not be very risky, so we recommend 7%/year. Enter your discount rate in cell B31. (The example uses 7%/year.)

13. Enter the rate of electricity price increases you expect in cell B32. This number must be less (at least 2 percentage points) than the discount rate just above it. If you believe electricity costs will rise faster than your discount rate, you don't really need this model– just buy the bulbs that use the least electricity because your future energy costs will dominate your decision. We recommend 3%/year electricity cost <u>escalation rate</u>[2] (roughly the rate of inflation,) unless you have specific knowledge of the future rates in your utility district. (The example uses 3%/year.)

14. If you want to cut off the cash flows after a certain number of years, enter that number in cell B39. The net present value of the difference in the 2 projects *with a 4-year cutoff* shows in cell F44. Using a 4-year cutoff, the CF bulb saves $69.75. The net present value of the difference in the cash flows using *infinite* cash flows is shown in F50. Using an infinite cash flow analysis, the CF project saves $469.42. Whichever project has the lowest total cost of lighting is the one you should choose, according to the NPV method.

A fine point: note that in the NPV analysis, each project is charged for the bulb at the beginning of the project, and also for depreciation (usage) of the bulb during the period of analysis. This means the result in cell F25 will be a bigger savings than the result in cell F44 using a 1-year cutoff.

In summary, in this example, however you look at it, Cost per Year, Payback Period or Net Present Value (with or without a cutoff,) the compact fluorescent is the winner. The various calculation methods don't always agree. If you're going to pick one method, we suggest using the NPV method, and cutting off the cash flows whenever you think the light system will be remodeled, demolished or sold to another owner who may not value the lower energy consumption.

Definitions:

1. **Discount Rate.** Net Present Value is the total discounted value of future cash flows. Future cash flows are worth less than current cash flows, so we discount them. We recommend a 7%/year discount rate. Let's say you expect to save $1/month with more efficient lighting. The $1 saved in the 12th month is only worth $1/(1.07) = $0.93 in today's dollars, assuming you pay the bill a year from today.

2. **Energy Cost Escalation Rate.** We expect energy costs to rise at about the rate of inflation, 3%/year. That means energy savings will rise 3%/year with better lighting. So, in our example, you'd really save closer to $1.03 in the 12th month. Discounted, that's worth $1.03/(1.07) = $0.96 in today's dollars. So all we do is subtract the inflation rate from the discount rate to get the effective discount rate for energy, which works out to 4%/year.