The Economics of Dimming

Technical white paper

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The economics of dimming

Executive Summary: Using assumptions outlined in the text— A residential dimmer can save $9 (or more) in electricity and bulb replacement costs per year, and can pay for itself in about two years. A commercial dimmer can save $85 (or more) in electricity costs per year, and pay for itself in about one year. Higher dimming use will result in shorter payback periods.

Residential dimming

The typical investment for a Lutron residential single-location 600 watt dimmer ranges from $9.97 for rotary dimmers to $29 for Maestro® dimmers, with the average retail price being $16. This investment can be easily recouped by substantial energy and bulb replacement savings that result from using the dimmer. Here's how:

1. Lighting electricity usage for a typical residential space that can use a dimmer = 294 kWh/year [i]
2. Average energy savings while dimmer is in use = 20% [ii]
3. Total electricity savings = decrease in energy consumption (294 kWh/year x 20%) = 59 kWh/year
4. Average cost of residential electricity = $0.1155 per kWh (2009 average) [iii]
5. Average annual cost savings = 59 kWh/year x $0.1155/kWh = $6.81/yr

Dimming not only saves electricity, but also extends lamp life. At a dimming level of 20%, using a typical 60W light bulb, the bulb life extension will be 4 times [iv]. A typical incandescent light bulb is rated for 750 hours [v].

We can now calculate how many light bulbs we would use at full compared to how many would be used if dimmed by 20%:

Energy consumed per bulb to end of life = rated life x rated power x running power factor x bulb life extension factor

Non-dim consumed energy per bulb to end of life = 750 x 60 x 1 x 1 = 45 kWh

Dimmed consumed energy per bulb to end of life = 750 x 60 x .8 x 4 = 144 kWh

Thus, the bulbs run much longer before failure in the dimmed case.

Therefore, we would require 6.5 bulbs (294/45) at full power to consume the 294 kWh/year compared to 1.63 bulbs [(294/59) / 144] for the 20% dimmed case. At a typical cost of $0.50 [vi] per bulb, the dimmed application would save $2.43 [(6.5 - 1.63) x .50] in bulb costs compared to the non-dimmed case.

We estimate a Lutron residential dimmer saves $9.24 ($6.22 + $2.43) per year in electricity and bulb savings.

An average residential dimmer (at $16) pays for itself in less than 2 years.

A rotary dimmer (at $9.97) pays for itself in approximately 1 year.

Energy savings over the life of the dimmer

A Lutron dimmer is designed to operate for at least 10 years, meaning that each dimmer will ultimately pay for itself several times over.

1. Minimum design life of dimmer = 10 years
2. Minimum lifetime cost savings = 10 years x $9.24/year = $92.40
3. Net savings = $92.40 - $16 = $76.40 per dimmer

The more you dim, the more you save

Dimmers operated for longer periods of time, at higher wattages, at dimming levels greater than 20%, save even more electricity and money. For example, here's what happens when you dim a light by 50% for 5 hours/day and assuming a 300W load:

1. Annual electricity savings = decrease in load (300 W x 50%) x hours used (5 hrs/day x 365 days) = 273.8 kWh/year
2. Annual cost savings = 273.8 kWh/yr x $0.1155/kWh = $31.62/year

In this case, a single residential dimmer saves $31.62 per year in electricity costs. This would reduce this payback period for an average dimmer (at $16) to about six months.

Commercial dimming

The typical investment for a Lutron commercial dimmer is $100. This investment is a little higher than the residential purchase because the dimmer is required to control larger loads. However, the running hours are much longer in a commercial installation and this results in larger savings. Here's how:

1. Average commercial dimmer load = 1200 W [vii]
2. Average energy savings while dimmer is in use = 20%[ii]
3. Average daily commercial dimmer use = 14 hours/day [ii]
4. Average number of days used for commercial operations = (50 weeks x 5 days) = 250 days
5. Average annual electricity savings = decrease in load (1200W x 20%) x annual use (14 hours/day x 250 days) = 840 kWh/yr
6. Average cost of commercial electricity = $0.102/kWh (2009 average) [iii]
7. Average annual cost savings = 840 kWh/yr x $0.102/kWh = $85.68/yr

A single Lutron commercial dimmer saves an average of $85.68 per year.

An average commercial dimmer (at $100) pays for itself in about 1 year and 2 months.

Energy savings over the life of the dimmer

A Lutron commercial dimmer is designed to operate for at least 10 years, meaning that each dimmer will ultimately pay for itself several times over.

1. Minimum design life of dimmer = 10 years
2. Minimum lifetime cost savings = 10 yrs x $85.68/year = $856.80
3. Net savings = $856.80 - $100 = $756.80 per dimmer

Conclusions

Residential dimming

1. We estimate, a residential dimmer can **save $9.24/yr in electricity and bulb replacement costs** compared to a switch.
2. An average residential dimmer pays for itself in less than 2 years. After that, the customer continues to save $9.24/year, every year.
3. If the dimming level is increased, the savings will be larger and the payback period will be shorter.

Commercial dimming

1. A commercial dimmer can **save $85.68 per year in electricity costs** compared to a switch.
2. An average commercial dimmer pays for itself in 1 year and 2 months. After that, the customer continues to save $85.68 per year, every year.
3. If the dimming level is increased, the savings will be larger and the payback will be shorter.

Endnotes

i US Department of Energy Lighting Market Characterization Study, Navigant Consulting, Sep 2002.

ii California Energy Study
http://www.energy.ca.gov/efficiency/lighting/VOLUME01.PDF

iii Energy Information Administration
http://www.eia.doe.gov/cneaf/electricity/epm/table5_3.html

iv IESNA handbook, 2000, p.6-13

v GE lighting
http://genet.gelighting.com/LightProducts/Dispatcher?REQUEST=RESULTPAGE&CHANNEL=Consumer&BREADCRUMP=General+Purpose_Standard%230

vi Lowes
http://www.lowes.com/ProductDisplay?partNumber=169088-3-10506&langId=-1&storeId=10151&productId=1207025&catalogId=10051&cmRelshp=sim&rel=nofollow

vii Lutron survey of commercial lighting designers, architects and field service engineers

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