All About LED Lighting – 2017 Update

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Focused on aggressive, cost effective, commercial energy cost reduction, particularly using:

- LED lighting and associated controls
- Utility incentives, economic analysis and depreciation accounting expertise
- Low cost, highly accurate real time energy and environmental conditions monitoring, including logging, measurement & verification
June 8, 2013

Cutting Your Energy Costs in Half – Ten Key Steps
(How to Join the ‘Half Way Club’)

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The Step 1 Dilemma

Buy some caulk / film? | Use Big Box Retail? | Use specialty store’s ideas? | Replace Tstats?

Add Insulation? | Radiant Barrier? | New Invention? | Replace Windows?

The Big Picture – Part 1

Energy Usage in the U.S. Residential Sector in 2015

- Space Heating: 27.3%
- Water Heating: 13.1%
- Space Cooling: 11.8%
- Lighting: 7.2%
- Refrigerators & Freezers: 6.3%
- Clothes Washers & Dishwashers: 5%
- Television: 4.2%
- Cooking: 2.7%
- Computers: 1.6%
- Other: 20.8%
Summary
Cutting Your Energy Costs in Half – 10 Key Steps

How to Join the Hallway Club!

1. Aggressively manage utility costs
2. Replace every lamp with LED technology
3. Change occupant / worker behavior style
4. Turn stuff off
5. Understand and measure actual energy consumptions
6. Research what governments and utilities are offering
7. Look very hard at heating & cooling the structure
8. Replace appliances w/ Energy Star / lower power versions
9. Put in automation controls / demand management
10. Put in solar PhotoVoltaic (PV) system to reduce grid power usage
Top Ten Steps to Cut Energy Costs in Half

1. Aggressively manage utility costs
2. Replace *every lamp* with LED technology
LED Lighting In the Home
Imperative
LED lighting details – residential focus
LED Technology: More Illumination per Watt
LED Pricing Going No Place But Down

60W Equ. LED Lamp Retail Price

<table>
<thead>
<tr>
<th>Month</th>
<th>Avg.</th>
<th>Low</th>
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<tbody>
<tr>
<td>J-11</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>A-11</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>O-11</td>
<td>40.0</td>
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<td>30.0</td>
<td>30.0</td>
</tr>
<tr>
<td>J-12</td>
<td>20.0</td>
<td>20.0</td>
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<tr>
<td>A-12</td>
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<td>10.0</td>
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<tr>
<td>O-12</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>D-12</td>
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<td></td>
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<tr>
<td>J-13</td>
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<td>F-14</td>
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<td>O-14</td>
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<td>D-14</td>
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<td></td>
</tr>
<tr>
<td>F-15</td>
<td></td>
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</table>
OMG!

Example - 400 KSF Warehouse, 1 story, no admin included (DFW area)

<table>
<thead>
<tr>
<th></th>
<th>Energy/Yr</th>
<th>Maint/Yr</th>
<th>Total/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Costs</strong></td>
<td>$171,371</td>
<td>$47,443</td>
<td>$218,814</td>
</tr>
<tr>
<td>1,555,074 kwh</td>
<td>$0.1000/kwh</td>
<td>$0.1000/kwh</td>
<td>932 fixtures</td>
</tr>
<tr>
<td><strong>New Costs</strong></td>
<td>$32,065</td>
<td>$0</td>
<td>$32,065</td>
</tr>
<tr>
<td>292,834 kwh</td>
<td>$0.1000/kwh</td>
<td>$0.1000/kwh</td>
<td>300 fixtures</td>
</tr>
<tr>
<td><strong>Annual Savings</strong></td>
<td>$139,307</td>
<td>$47,443</td>
<td>$186,750</td>
</tr>
<tr>
<td>(Maint assumes replacement work being performed by external contract - includes materials (replacement bulbs, ballasts), labor, special equip as needed, and proper disposal)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

85% reduction

**10 Yr Savings:** $1,867,497

**Monthly Savings:** $15,562

**NEW LED LIGHTING INVESTMENT**

- Price: $212,280
- Estimated Utility Cash Incentive: $93,293
- Subtotal: $118,997
- 1st yr Cash Flow - Inside Related Energy Depreciation (EPAct) (35% tax): $84,000
- 1st yr Cash Flow - Outside Related Energy Depreciation (Bonus) (55% tax): $0
- Abandonment Tax Benefit: ?
- Net 'Out of Pocket' Investment Cost After Tax Depreciation Benefit: $34,997

**Years to Recoup Investment (Simple Payback Period):** 0.2

**Annual Return on Investment (ROI):** 534%

**Savings Next 10 Yrs Less Investment Cost:** $1,832,500

**60 MONTH FINANCE OPTION**

- Financed Amount: $118,997
- Monthly Payment: $2,336
- Monthly Energy and Maint Savings (from above): $15,562
- Cash Positive or (Negative) Per Month for first 60 months: $13,228

**Savings Next 10 Yrs Less Monthly Payments:** $1,727,414

<table>
<thead>
<tr>
<th>Per Day</th>
<th>Per Month</th>
<th>Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$512</td>
<td>$15,562</td>
<td>$186,750</td>
</tr>
</tbody>
</table>
## Total U.S. LED Forecast

<table>
<thead>
<tr>
<th>LED market share (% of lm-hr)</th>
<th>2013</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3%</td>
<td>11%</td>
<td>48%</td>
<td>72%</td>
<td>84%</td>
</tr>
<tr>
<td>Residential</td>
<td>1%</td>
<td>3%</td>
<td>33%</td>
<td>71%</td>
<td>83%</td>
</tr>
<tr>
<td>Commercial</td>
<td>2%</td>
<td>8%</td>
<td>42%</td>
<td>69%</td>
<td>82%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1%</td>
<td>3%</td>
<td>26%</td>
<td>58%</td>
<td>87%</td>
</tr>
<tr>
<td>Outdoor Stationary</td>
<td>9%</td>
<td>22%</td>
<td>75%</td>
<td>97%</td>
<td>99%</td>
</tr>
</tbody>
</table>

LED Lighting – Where are We At Today (2017)?

- High quality / long lasting LED lamps/fixtures
- Extremely low energy use
  - And with controllability that creates additional energy savings opportunities (instant on/off, full-range dimming, light harvesting).
- No maintenance (re-lamping, re-ballasting)
  - Long lifespan
  - Durability
- High quality light (safety)
Incandescent Lighting in Today’s Homes

Five most used:

• 60 watt standard (A19 shape)
• 40 watt candelabra (B11)
• 60 watt vanity (G25)
• 65 watt indoor flood (BR30)
• 120 watt outdoor flood (PAR38)
Replacement List – Incandescent Lamps

60 w standard -> 9 w LED dimmable

40 w candelabra -> 4.7 w LED dimmable

60 w vanity -> 8 w LED dimmable

65 w indoor flood -> 8 w LED dimmable

120 w outdoor flood -> 17 w LED dimmable

These LED lamps -> energy savings greater than cost in less than 12 months

Bill Neukranz
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Energy Savings – Incandescent Lighting

If we assume:

1. average of 5 hours of ‘on’ (usage) time each day
2. based on electric rate of 11 cents/kWh (including transmission costs and all fees and taxes)

• 60 w standard -> 9 watt LED -> $10.24 per yr. savings

• 40 w candelabra -> 4.7 watt LED -> $7.09 per yr. savings

• 60 w vanity -> 8 watt LED -> $10.44 per yr. savings

• 65 w indoor flood -> 8 watt LED -> $11.44 per yr. savings

• 120 w outdoor flood (PAR38) -> 17 watt LED -> $20.68 per yr. savings

Avg Home Example = $11.98/yr/lamp avg annual savings * 40 incandescent lamps = $479/year avg savings
2017 Selling Prices

For commercial projects, AEEI uses Earthtronics manufacturer:

- Omni-directional
- Commercial grade
- UL Listed
- Utility incentive programs approved
- Energy Star certified
- Five year warranty
- Wholesale volume purchasing
- Earthtronics manufactures for Philips and Sylvania

Price? (before shipping/tax):

- 60 watt standard -> 9 watt LED -> $5.00 each
- 40 watt candelabra -> 4.7 watt LED -> $5.63 each
- 60 watt vanity -> 8 watt LED -> $8.00 each
- 65 watt indoor flood -> 8 watt LED -> $6.25 each
- 120 watt outdoor flood -> 17 watt LED -> $11.50 each
Payback Period (Based on Energy Savings Alone – No Maint Savings Considerations)

- Using Energy Savings and Selling Prices from previous slides
- Investment return is:

  - 60 w standard -> 9 w LED -> $10.24/yr svgs -> $5.00 ea -> $ back every 6 mos
  - 40 w candelabra -> 4.7 w LED -> $7.09/yr svgs -> $5.63 ea -> $ back every 10 mos
  - 60 w vanity -> 8 w LED -> $10.44/yr svgs -> $8.00 ea -> $ back every 9 mos
  - 65 w indoor flood -> 8 w LED -> $11.44/yr svgs -> $6.25 ea -> $ back every 7 mos
  - 120 w outdoor flood -> 17 w LED -> $20.68/yr svgs -> $11.50 ea -> $ back every 7 mos
A19-60 watt soft white
9.1 life expectancy
9.5 watt used
840 lumens
3 year warranty
$1.42 ea

A19-60 watt EnergyStar
2700K soft white
13 year life expectancy
Dimmable – omni-directional
8.5 watt used
800 lumens
5 year warranty
$15.97 (4pak)
$3.99ea

A19-60 watt EnergyStar
2700K (soft white)
22.8 year life expectancy
Dimmable – omni-directional
9.5 watt used
815 lumens
10 year warranty
$4.49 each

A19-60 watt
2700K (soft white)
13.7 year life expectancy
6.5 watt used
810 lumens
5 year warranty
$15.63 each
## Energy Star Requirements

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>ENERGY STAR Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compact Fluorescent</strong></td>
<td>Lamp shall have a rated life ≥ 10,000 hours. At 40% of rated life or 6,000 hours, whichever point occurs first, all tested units shall be operational (≥ 90% of the tested units if coincident). At the second point, ≥ 90% of the tested units shall be operational. ≥ 50% of the tested units shall be operational at rated life.</td>
</tr>
<tr>
<td><strong>Solid State</strong></td>
<td>Decorative lamps shall have a rated life ≥ 15,000 hours. All other lamps shall have a rated life of ≥ 25,000 hours. Lamps to be marketed as commercial grade shall have a rated life ≥ 35,000 hours. All tested units shall be operational at 3,000 hours. ≥ 90% of the tested units shall be operational at 6,000 hours.</td>
</tr>
</tbody>
</table>
# Perception – Color Temperature

## Choosing the Right Color

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm White, Soft White</td>
<td>The standard color of incandescent bulbs.</td>
<td>2700K</td>
</tr>
<tr>
<td>Cool White, Neutral, Bright White</td>
<td>Good for kitchens and work spaces.</td>
<td>3000K, 3500K</td>
</tr>
<tr>
<td>Natural or Daylight</td>
<td>Good for reading.</td>
<td>4100K, 5000K, 6500K</td>
</tr>
</tbody>
</table>
Step 2: Replace Every Incandescent Lamp with CFL

Example bulbs (first casualties (3) = 2012; none ‘ugly’):

installed 2007

**R30: GE FLE15/2/R30XL (80893) reflector**
- 10,000 hours – 7 years guaranteed
- 800 initial lumens
- 15 watts – replaces incandescent 65 W

**A19 Bulb Style: Philips 15700-8 soft white**
- 8000 hours
- Equivalent to 800 lumens
- 14 watts – replaces incandescent 60 W

**Candelabra: GE FLE7/2/CAC (16103) candle shape**
- 6,000 hours
- 370 initial lumens
- 7 watts – replaces incandescent 25 W

**PAR38: GE FLE26/2/PAR38XL (80895) reflector (outdoor rated)**
- 10,000 hours
- 1350 initial lumens
- 26 watts – replaces incandescent 90 W

All amalgam technology
Questions?

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