LED's – Possible Solution To Growing Consumption

Sometime we get stuck in what most call tunnel vision. The US alone, according to the most recent survey in 2011 by the US EIA, uses 461 billion kWh of electricity a year in lighting. I'm sure this number has increased over the last two years. While we wrack our brains to find the next breakthrough in power production, there are many solutions to reduce how wasteful we are at our own energy consumption. For now, lets look at lighting and run some numbers. For the sake of accuracy, I'll use the latest studies on energy consumption. I can't seem to find any study later than 2011.

For Starters, lets look at the EIA report for 2011 to validate the discussion. Not that I can vouch for the EIA but they are an official source. EIA estimates that in 2011, about 461 billion kilowatt-hours (kWh) of electricity were used for lighting by the residential and commercial sectors. This was equal to about 17% of the total electricity consumed by both of these sectors and **about 12% of total U.S. electricity consumption**. Residential lighting consumption was about 186 billion kWh or 13% of all residential electricity consumption. The commercial sector, which includes commercial and institutional buildings and public street and highway lighting, consumed about 275 billion kWh for lighting or 21% of commercial sector electricity consumption in 2011. EIA does not have an estimate for only public street and highway lighting. Our most recent data available indicates that in 2006, 63 billion kWh were consumed for lighting in manufacturing facilities, which was equal to about 2% of total U.S. electricity

consumption in 2006.

Estimated U.S. residential electricity consumption by end-use, 2011

End-use	Quadrillion Btu	Billion kilowatthours	Share of total
Space cooling	0.93	273	19%
Lighting	0.63	186	13%
Water heating	0.45	131	9%
Refrigeration	0.38	110	8%
Color televisions and set-top boxes	0.32	93	7%
Space heating	0.27	79	6%
Clothes dryers	0.20	57	4%
Personal computers and related equipment	0.16	46	3%
Furnace fans and boiler circulation pumps	0.13	39	3%
Cooking	0.11	32	2%
Dishwashers[1]	0.10	30	2%
Freezers	0.08	24	2%
Clothes washers[1]	0.03	10	1%
Other uses[2]	1.07	313	22%
Total consumption	4.86	1,424	

LED's are a solution to reducing the overall cost of residential energy. They are a solution in reducing the overall cost of commercial energy usage as well.

Light Emitting Diodes(LED) lamps are used for both general and special-purpose lighting. Compared to fluorescent bulbs, advantages[17] are that they contain no mercury, they turn on instantly at any temperature, their extremely long lifetime is unaffected by cycling on and off, they have no glass to break, they don't emit UV rays that fade,[18] they can emit unsaturated colored light without need of filters, and can shine uni-directionally without reflectors. Disadvantages include diminished color shades, supporting electronic circuitry failure and with traffic lights in snow prone areas they fail to melt the accumulated snow due to the low heat output.

So lets refer to the numbers highlighted in red above. 12% of the entire electrical usage in the US can be attributed to residential lighting and commercial lighting. LED's light fixtures today have progressed dramatically and you can outfit your whole house with

LED lamps at a cost slightly higher than the incandescent or fluorescent options. Even if you pay a few dollars more per bulb, you get 22 years of usage as opposed to sometimes less than 2 years with the other options.

Now lets do the math —

(note: current LED technology produces the equivalent BTU of light output for 1/10th the energy consumption on average)

Sorry if this seems elementary but our starting number is 12% the current energy usage at 461 Billion kWh.

12 * .1 = 1.2% at a reduction of 10.8% total usage.

Again with simple math you can conclude that switching to all LED's would reduce the overall kWh usage as well.

461000000(Wh) * 10^3(kWh) = 461000000000000 Wh (total watt hours)

(461000000(Wh) * 10^3) * .1 (or 1/10) = (461000000(Wh) * 10^2)

(basically 1/10th of 461 billion is 46.1 billion — don't forget kWh)

Now subtract 46.1 billion from 461 billion and you get 414900000000000 kWh or 414.9 billion kWh of total energy savings for the year.

Sorry if all the numbers are confusing but lets look at what 414.9 billion kWh of raw power can do for us. For starters lets look at a major cold sore (pun intended) we have peppering our landscape in the form of Nuclear power. In the same year as this study (2011), the US produced 801 billion kWh of energy via the lovely 104 nuclear reactors in the US. LED's would save the US 414.9 Billion kWh of energy a year. Subtract that from the the 801 billion kWh being produced and we can see how shutting down 52 nuclear plants would not seem to inconceivable.

Update: Mark E has posted some more accurate numbers as to the energy savings we could see if we switched to LED lighting. Thanks Mark for the update. I focused on watt hours average and may have left out many other important factors.

(Posted by Mark E)

Most LED lamps that are sold in stores are only producing 60 – 80 lumens per Watt, when they could be producing 120 lumens per Watt or more by simply using slightly more expensive LEDs. Incandescent bulbs range from around 11 lumens per Watt for

10W bulbs to about 17 lumens per Watt for 100W bulbs. (Yes, it is ironic that the incandescent prohibitions have started with the most efficient incandescent bulbs instead of the worst.) So a typical LED replacement saves roughly 75% – 80% versus incandescent bulbs. So, let's assume for sake of argument that incandescent bulbs make up 75% of household lighting today, and that LEDs save 80%, ie are 5x the efficiency of incandescents:

For residential:
Savings = 75%(consumption that is incandescent) * 186 E9 kWh(residential lighting energy/year) * (5x – 1x)/5x = 0.6 * 186 E9 kWh/year ~= 112 E9 kWh/year ~= 12.7E9W, or the equivalent of almost 13 big power plants, and $11 billion / year pumped back into people's pocket books once the LED cost amortizes out. ($0.10/kWh)

If people would buy the better LED bulbs that put out 120 lumens / W then the savings increases by about 9%

75% * 186E9 * (7.5X – 1X)/7.5X = 0.65 * 186E9 kWh/year ~= 120.9 E9 kWh/year ~= 13.8E9W.

The average cost / W for an LED bulb right now is about $0.50. The break even on an LED purchase versus $0.10/kWh power when used 8 hours per day is:

BreakEvenYears = CapitalCostPerWatt * 1000 W/kW * (NewEfficiency/(NewEfficiency – OldEfficiency)/ (HoursPerDayUse * 365 d/year * Electricity$/kWh)

$0.50/W * 1000 * (5X – 4X)/5X / (8 * 365 * $0.10) ~= 2.1 years.

So, switching to LED lighting pays off quickly, and after about 2.1 years will shave about 8% off an average electric bill until they wear out. They will also save the replacement cost of the incandescent bulbs over their life.

Source: http://revolution-green.com/leds-possible-solution-growing-consumption/