The Basics of Digital Signage and Energy Consumption

by Gregory Young

In the world of outdoor advertising, successive technological and stylistic advancements have prompted cities and states to rethink their signage regulation and policy. There has been much controversy regarding the potential safety hazard posed by digital signage. Many studies show that such signage can lead to driver distraction and traffic delays (Wachtel, 2009). This research, and the resultant outcry from activists and concerned citizens, has led some policymakers to regulate distracting, electronic signage displays. There has been relatively little research, however, regarding the environmental and energy-consumption issues raised by this new technology.

First, *what exactly is digital signage*? Digital signage packages consist of three key pieces: player, extender(s), and display. The player is essentially a computer, equipped with software to generate the displayed content. Players are typically mounted behind the screen, and must be kept cool (via internal or accessory fan) and must be easily accessible for repairs or rebooting. These player/fan arrangements typically consume between 200 and 300 Watts[1] while running, slightly more than a home dishwasher. Depending on the relative location of the player to the screen, there may be a need for a video extender, essentially a cable which connects the player to the screen. This brings us to the most important component of any digital sign: the screen, or, in industry parlance, "the display." There are three main categories of digital display: LCD, plasma, and LED.

LED is the name used for Light Emitting Diode (aka LED) boards, commonly used in small to medium sized on-premise electronic advertising[2]. They are the overwhelming preference for large off-premise[3] digital billboards; designed for long-distance impact, they are often up to 1200 sq. ft. in size (20'x60'). According to the U.S. Department of Energy, LEDs produce more light (in lumens per watt) than incandescent bulbs, and their efficiency is not affected by shape and size, unlike traditional fluorescent light bulbs or tubes.

3051 Front St., Philadelphia
Off-premise LED sign

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[1] **Watt—**a unit of power which measures the rate of energy conversion. It is defined as one joule per second. The kilowatt (kW) is equal to one thousand watts. For a sense of perspective, one kilowatt of power is approximately equal to 1.34 horsepower. A small electric heater with one heating element can use 1.0 kilowatt. If that heater is used for one hour, it will have used one kilowatt hour.

[2] **On-premise** or **accessory** signage is defined as a business establishment's on-site advertisements.

[3] **Off-premise** or **non-accessory** billboards/signs are those which advertise a business or product not sold at the signs' location. Roadside billboards are a popular form of off-premise advertising.

Proponents of digital signage tout the "greenness" of LEDs; lower wattage and greater luminance[4] than the more traditional fluorescent, incandescent, or halogen bulbs.

These claims overlook one key bit of common sense: whereas traditional, static signage is illuminated by two or three "inefficient" lamps at nighttime, digital signs are comprised of hundreds, if not thousands, of "green" LED bulbs, each using between 2-10 watts, lit twenty-four hours a day. For instance, a 14'x48' LED billboard can have between 900 and 10,000 diodes.

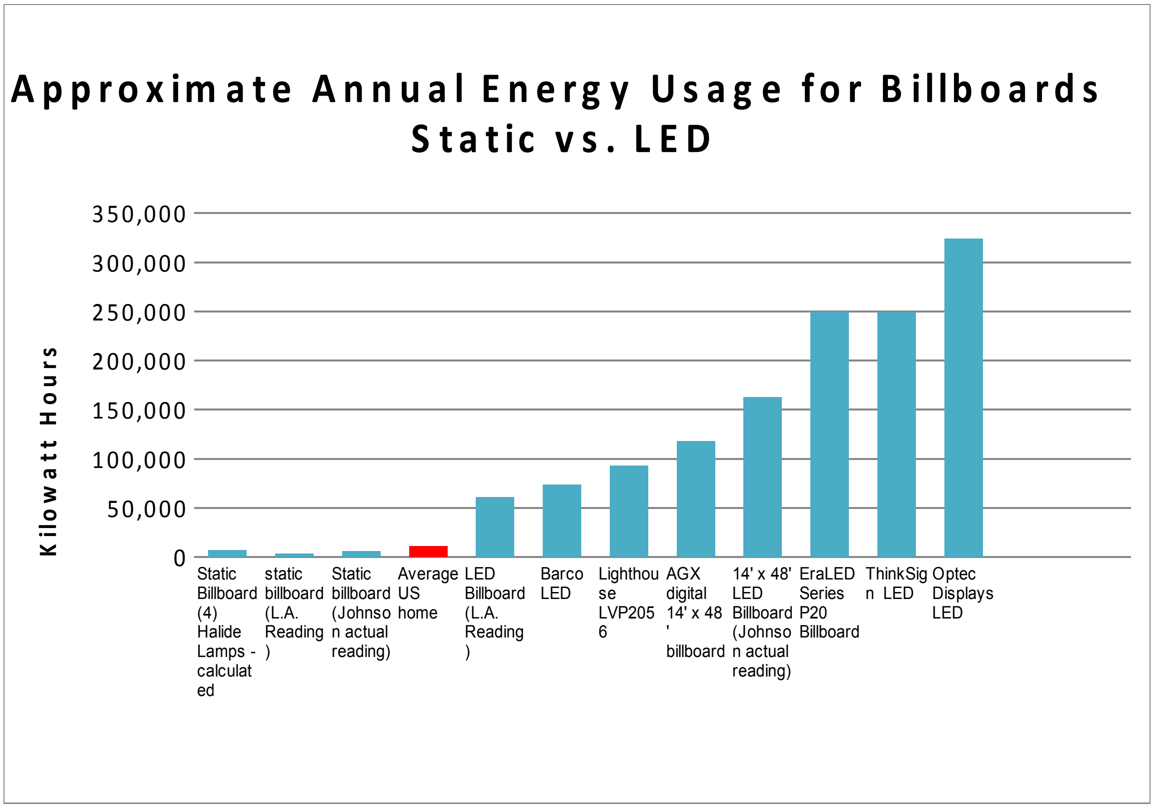
Considering this simple fact, intrinsic to digital billboard design, it is no surprise that overall energy consumption of digital signage exceeds that of static signage, and makes bulb-to-bulb comparisons irrelevant in this context.

Additionally, with all digital display types, the players which control the changeable images and the fans required to cool them must be taken into account, as they too increase energy consumption. Adding auxiliary equipment, such as extenders, further increases the power demand.

Determining the exact power consumption for a digital billboard is difficult; usage is dependent upon many variables, including size, resolution (how close pixels are spaced, aka diode density), how many LEDs are in each pixel, the color capabilities of the board (tri-color or full color), the image being displayed and time of day (daytime operation requires more power than nighttime operation, as the lit image must compete with the brightness of the sun).

Despite these difficulties, we have compiled an objective chart of consumption rates. Our information was provided by a variety of sources, ranging from manufacturers, fellow researchers, advocacy groups, and independent meter readings.

[4] **Luminance** is a measure of the perceived brightness of a light-emitting surface, such as a digital sign. Its unit of measure is candela per square meter (c/m^2), informally referred to as "nits."



LED units generate heat, and cannot function well in heat, which reduces the unit's life expectancy. As a result of the tremendous amount of heat generated in LEDs , and the additional impact of hot weather on the signs, an air conditioning unit is incorporated to cool the components. The energy drawn from the grid is highest during the summer months when the heat from the sun coupled with the heat generated by the higher brightness of the LED unit requires increased demand on the air conditioning system installed for cooling the LED unit.

This energy use corresponds directly with maximum peak demands from businesses and residences. Utility companies now provide a discount for homeowners if they can disconnect their air conditioners from the grid during the peak load demands. There is no discussion or plan that we are aware of to disconnect

LED air conditioners or darken signs during periods of high demand. If traditional billboards continue to be replaced by LED signs, the growing draw of energy during peak hours could negate the efforts of Utility companies to reduce demand during peak times.

Rates of Energy Consumption		
Product type	**Annual Usage, kWh***	**Annual cost****
Unillumintated Static Sign	0	$0
Noventri "green" player	35	$4.80
Noventri PC based player	1,752	$240
Corn Digital 42" LCD Display	2,103	$288
Hewlett-Packard 47" LCD Display	2,737	$375
Salescaster Corp. 76"x12" LED sign (8-color)	4,380	$600
Static Billboard (4) Halide Lamps - calculated	**7,008**	**$960**
LED Authority 36"x60" LED sign (full color)	8,760	$1,200
Average US home	**11,040**	**$1,512**
LED Billboard (L.A. Reading)	61,032	$8,361
Barco LED	73,584	$10,081
Lighthouse LVP2056	92,715	$12,792
AGX digital 14' x 48 ' billboard	117,866	$16,148
14' x 48' LED Billboard (Florida actual reading)	**162,902**	**$22,318**
EraLED Series P20 Billboard	249,690	$34,208
ThinkSign LED	248,993	$34,112
Optec Displays LED	323,773	$44,357
* Energy Usage (((24))((365))/1000		
** Average costs per kWh=$.137 (Metro Area)		

In many applications---such as television/computer display, general lighting, and small electronics---LCD, plasma screen, and LED technological advancements have proven more energy efficient than their predecessors, but research indicates that out-of-home advertising is simply not an appropriate or responsible application for digital technology.