

Light Outputs of Internally Illuminated Signs

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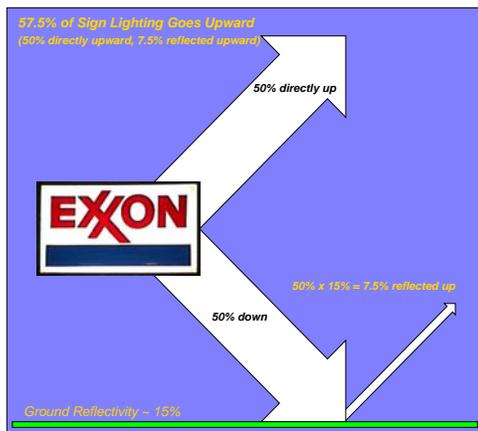
Presented at the International Dark-Sky Association Annual Meeting, Tucson Arizona, 17-19 March 2002
Revised from paper presented March 2001

Summary

Internally illuminated signs produce light that is by nature unshielded; about 50% escapes directly into the night sky. Different styles of signs produce substantially different outputs, however. White-background signs are found to emit 7 times the output of a typical colored-background sign, and about 30 times the output of a typical opaque-background sign. The brighter sign styles are also a source of glare in high-traffic and pedestrian areas, and are considered less legible by many persons, particularly those with ageing eyes.

Lighting or sign codes that restrict the styles of internally illuminated signage to the lower-output styles can substantially reduce light pollution while maintaining or even improving the visibility and legibility of signs.

Most Light From Signs Ends Up In The Sky



Sign Styles

There are three general types of internally illuminated signs:

White Background

colored copy
black copy



Colored Background

white copy
colored copy



Opaque Background

white copy
colored copy



Measuring Sign Light Output

To convey information at night, signs must be illuminated. But there are choices about how signs are illuminated that can make big differences in both how effective they are in conveying information, and how much light is needed.

In this study, the light output of internally illuminated signs is estimated through a three-step process:

1. We first measure the brightness of signs, including various colors in background and copy.
2. We next measure signs to determine how much is typically background, how much is "copy"
3. Finally, we use these two sets of numbers to model the light output of three groups of sign styles: white-background, colored-background, and opaque background.

1. How Bright Are Sign Colors?

Over 160 measures of 7 colors on 58 internally-illuminated signs were made. The following summarize the results:

Color	Average Luminance (candela/sq.meter)	Number of Measures
White	412	61
Yellow	201	12
Red	30	42
Green	17	9
Blue	7.0	26

2. Signs Are Background and Copy – How Much of Each?

A selection of 14 signs was measured to determine the "Copy Area Ratio" (CAR), the ratio between area devoted to "copy" and the area of the entire sign. The CAR was found to vary from 0.14 to 0.63, with an average of 0.32.

3. With These Brightnesses and Copy Fraction, How Bright Are Signs?

Sign Model	Light Output (lumens/sq.meter)
White Background	
Red Copy on White Background	911
Blue Copy on White Background	887
Black Copy on White Background	880
Typical	887
Colored Background	
White Copy on Red Background	479
Yellow Copy on Blue Background	217
Red Copy on Blue Background	45
Typical	130
Opaque Background	
White Copy on Black Background	414
Red Copy on Black Background	30
Blue Copy on Black Background	7
Typical	30

Comparing Light Pollution Impacts from Signs and Other Sources

Here we compare the amount of uplight produced by various internally-illuminated sign styles with uplight generated by other lighting. Light pollution has many other dimensions, including glare, aesthetics, clutter and confusion, and trespass, and differing sign styles could be compared along these lines as well.

Estimating Total Light Output of Signs and Other Lighting Uses

The total light output from signs and other lighting in a community depends on:

1. The amount of commercial land - signs are used on commercial properties (mostly), and not on residential property!
2. The allowed size and number of signs - sign area
3. How well shielded other lighting is
4. How much other lighting is used (lumens)

Any comparison or sign uplight to other uplight sources is strongly affected by these factors, and no general conclusions are applicable in detail to all communities.

As one set of examples, we compare uplight amounts from signs and other lighting under the following sets of conditions:

1. Sign size: 100 square feet (9.3 square meters)
2. Commercial parcel size: one acre (one sign per one acre)
3. Other lighting: four different scenarios.
 - 50,000 lumens/acre, including 5,500 lumens/acre unshielded (Flagstaff Zone II Standards)
 - 100,000 lumens/acre, including 5,500 lumens/acre unshielded (Flagstaff Zone III Standards)
 - 100,000 lumens/acre and 10% uplight (Garstang model)
 - 200,000 lumens/acre and 10% uplight (Garstang model)

Other Lighting Can Dominate If Not Well Controlled

Some development projects in communities with no lumens per acre or illumination caps exceed the highest levels shown here by large margins. Typical convenience store / service station combinations in recent years can exceed 1,000,000 lumens/acre; lighting in other situations can often exceed 500,000 lumens/acre. The last two examples of lighting shown under 3 above may be representative of typical lighting practices in the commercial districts of most communities where rational amounts of lighting with a typical mix (w/o lighting code) of shielded and unshielded fixtures is used. As can be seen from the comparison below, sign lighting can be a large relative contributor to upward-directed light only when other lighting is under tight control.

The figure below compares the uplight produced by signs and area lighting. To determine these figures, we assume 57.5% of all unshielded lighting (signs and unshielded lighting) goes upward. Further, we assume that 65% of the lumen totals for area lighting escapes the fixture.

Individual Signs Will Vary!

It is important to note that this analysis does not predict the output of individual signs; it does predict the average for large numbers of signs. If a lighting code requires colored (or opaque) background signs, for example, it will reduce light output from signs, on average, by about 85% (or 95%) compared to a community where only white-background signs are used. The fractional reduction for an entire community, including not only commercial but also roadway, sports, and residential lighting, will be smaller, and will depend very strongly on the community, its size and lighting practices.

