

Illinois Statewide Residential LED Hours of Use Study Additional Results

To: Ameren Illinois Company and Commonwealth Edison
From: Opinion Dynamics Evaluation Team
Date: April 17, 2018
Re: Illinois Statewide Residential LED Hours of Use Study – Exterior and Specialty Bulb HOU

On April 3, staff from AIC, ComEd, their evaluation teams, and the ICC had a call to discuss the results of the 2017 Illinois Residential LED Hours of Use (HOU) Study and consider recommendations for updates to the IL-TRM V7.0. The group agreed:

- To use statewide study results rather than utility-specific results for TRM updates;
- The statewide HOU estimate of 2.98 daily hours or 1,089 annual hours was appropriate for standard LEDs installed in interior locations.

In this memorandum, we provide additional information for the following outstanding items:

Exterior HOU. Opinion Dynamics was unable to produce an estimate of exterior LED HOU due to small sample sizes. Opinion Dynamics suggested considering results from other jurisdictions and agreed to come back to the group with study results and a recommendation.

Specialty LEDs. Due to small study sample sizes, Opinion Dynamics recommended using a single specialty LED HOU estimate that combined results across all specialty bulb types (e.g. reflectors, globes, candelabras, etc.) rather than separate values for different bulbs as the current TRM provides. There is a great deal of variation across specialty bulb HOU in the current TRM that group members were interested in preserving, if possible, to potentially use in program design. Opinion Dynamics was concerned that the variation in HOU was not real variation in bulb use but was due to sampling error. The 2013 Navigant/Itron CFL study conducted as part of the PY5/PY6 evaluation (hereafter referred to as “2013 CFL Study”) had small sample sizes for some of the specialty categories, and the TRM does not provide estimates of confidence and precision. Opinion Dynamics agreed to examine the previous study and report back on the uncertainty associated with the different specialty bulb HOU estimates in the current TRM.

Exterior HOU

Opinion Dynamics could not identify any recent publicly available LED studies that provide an exterior HOU estimate. Moreover, due to the challenges of exterior light logging, very few HOU studies, regardless of technology, provide an exterior estimate based on robust sample sizes. The most recent study with larger samples sizes is a study conducted in 2013 of four Northeast states (Massachusetts, Connecticut, Rhode

Island, and New York) that had a combined exterior sample size of 71 loggers.¹ The study logged both CFLs and LEDs, but given the low LED saturation at the time of the study, a large majority of the logged bulbs were CFLs.

In Table 1, we provide the exterior HOU results from this Northeast Study and the values in the IL-TRM V6.0 that come from the 2013 CFL Study. The Northeast Study has a slightly lower HOU, but the difference between the two studies is not statistically significant. Moreover, because exterior bulbs comprise only 5 percent of all residential bulbs in use in Illinois, there would be little difference in a combined interior/exterior HOU if we were to use the exterior HOU estimate from Northeast Study instead of continuing to use the estimate from the 2013 CFL Study (2.84 using the Northeast Study vs 2.88 2013 CFL Study). This combined HOU is used for bulbs installed in unknown locations, which is most upstream lighting program sales. Given the similar results of the larger non-Illinois study and the smaller Illinois-specific study, we recommend continued use of the Illinois exterior HOU estimate from the 2013 CFL Study. In the rest of this memo, we use the exterior results from the 2013 CFL Study to estimate HOU for installations in unknown locations (i.e. the weighted average of interior and exterior HOU).

Table 1. Comparison of Exterior Annual and Daily HOU Estimates

Metric	Northeast Study	2013 CFL Study (IL-TRM V6.0)
Number of loggers	71	17
Exterior HOU	2,190/6.0	2,475/6.78
Lower confidence level	2,044/5.6	1,646/4.5
Upper confidence level	2,300/6.3	3,307/9.1

Note: Annual hours are the first set of numbers, daily hours are second set.

Recommendation for IL-TRM V7.0: Continue to use the exterior HOU estimate from the 2013 CFL Study of 2,475 annual hours.

Specialty LEDs

Opinion Dynamics conducted a thorough review of the study methodology and results from the 2013 CFL Study to determine the level of uncertainty associated with various specialty bulb HOU estimates in the current TRM. From this review, we learned that the different specialty bulb HOU estimates are based on a weighted average of room-type HOU results across all logged bulbs and not restricted to the logging of a specific specialty bulb type. For example, rather than basing the decorative bulb HOU estimate on the 33 bulbs logged as part of the study, Itron used room level HOU results from all logged bulbs, regardless of type, but weighted the HOU by the prevalence of decorative bulbs in different room types. The HOU of rooms that had a high percentage of decorative bulbs would be weighted more heavily than rooms with a low percentage. If a room did not have any decorative bulbs, the HOU estimate from that room type would not contribute to the decorative estimate.

The benefit of this method is that it uses all the data collected rather than relying on a small number of logged bulbs. However, this method requires an underlying assumption about customer use of light bulbs, which may not be true. It assumes that light bulb use within a room type is the same across all bulb types. That is,

¹ See “Northeast Residential Lighting Hours-of-Use Study”, May 5, 2014 by NMR Group: <http://www.neep.org/sites/default/files/resources/Northeast-Residential-Lighting-Hours-of-Use-Study-Final-Report1.pdf>

customers use reflector bulbs in their kitchens in the same way that they use standard bulbs in their kitchens. We tested this assumption by combining data from five light logger studies that Opinion Dynamics has conducted over the past five years. The results include both CFLs and LEDs.

The results suggest that the assumption holds for some room types but not others (see Table 2). Kitchens, bathrooms, dining rooms, and basements have relatively consistent HOU across bulb types, but bulb use in living rooms and bedrooms is more varied. As might be expected, HOU across bulb types in “other” rooms, which contains a variety of rooms, such as laundry rooms, hallways, offices, and closets is more varied.

Table 2. Daily HOU by Room Type and Bulb Type from Five Light Logger Studies

Room Type	Standard ^A	Specialty ^B	Reflector ^C
Bedroom	2.18 ^B (361)	0.93 ^{AC} (56)	1.53 ^{AB} (20)
Bathroom	1.59 (415)	1.55 (136)	1.71 (29)
Living Room	3.99 ^{BC} (421)	2.40 ^A (44)	2.45 ^A (61)
Kitchen	4.46 (272)	4.57 (76)	4.35 (114)
Dining Room	2.35 (181)	2.15 (43)	0.35 (3)
Basement	1.69 (121)	1.54 (11)	1.52 (108)
Other	1.66 ^B (282)	4.06 ^C (84)	1.12 ^B (30)

Note: Numbers in parentheses are number of loggers. Superscript letters indicate statistically significant differences at the 90% confidence level.

We estimated HOU using the room type weighting approach that uses the results from all loggers. Table 3 compares the weighted estimates to logged estimates of specific bulb types. We also include the estimates in the IL-TRM V6.0 from the 2013 CFL study. With the weighted approach, HOU are lower for standard bulbs but higher for all specialty bulbs combined and reflector bulbs. Weighted results are also lower for a combined specialty bulb estimate that excludes reflectors. We are unable to compare weighted results for globes and decorative bulbs with actual logged results due to small sample sizes of the logged results. The weighted results provide a relatively high HOU value for decorative bulbs and a low one for globes. Compared to the values from the 2013 CFL study, the weighted LED results are higher for all bulb categories except globes.

The precision for the weighted HOU result installed in unknown locations is 7% at the 90% confidence level and is the same across all bulb types because each makes use of the entire sample of loggers. The precision estimate only considers the uncertainty associated with the logger data and not the uncertainty associated with the lighting audit data, which gives us the distribution of the different bulb types across rooms. It also does not take into account the bias that might result from the assumption that light bulb use within a room type is the same across all bulb types. The precision for the logged estimates varies due to differences in sample sizes and estimate variability. The 2013 CFL Study did not report the precision of the weighted specialty estimates.

Table 3. Logged HOU Estimates of Individual Bulb Types Compared to Weighed HOU of all Rooms

Bulb Type	Actual Logged Results	Estimated Results from Room Type Weighting	2013 CFL Study (IL-TRM V6.0)
Standard LEDs			
Interior	2.98	2.60	2.08
Exterior	6.78	6.78	6.78
Unknown	3.18 (9%)	2.95 (7%)	2.32 (10%)
All Specialty LEDs (Reflectors and All Other Specialty Bulbs)			
Interior	2.09	2.65	*
Exterior	6.78	6.78	*
Unknown	2.32 (14%)	2.98 (7%)	*
Reflector LEDs Only			
Interior	1.71	2.85	2.36
Exterior	6.78	6.78	6.78
Unknown	1.84 (19%)	3.02 (7%)	2.44
Specialty LEDs Combined (Excludes Reflectors)			
Interior	2.68	2.02	*
Exterior	6.78	6.78	*
Unknown	3.17 (20%)	2.83 (7%)	*
Specialty LED by Type			
Globe – Unknown Location	**	1.53 (7%)	1.75
Decorative – Unknown Location	**	3.64 (7%)	3.26

Note: Numbers in parentheses are precision at 90% confidence.

* This value is not available from the 2013 CFL study and is not in the IL-TRM V6.0.

**Sample sizes are too small to produce logger-based estimates.

Most TRMs do not attempt to provide separate estimates for standard versus specialty bulbs given the high level of uncertainty associated with most HOU studies. The only study that provides HOU by different specialty bulb types was a California study that logged CFLs in 1,200 homes. The question is whether the value of these weighted specialty bulb type estimates is outweighed by the assumptions that are required and the potential bias these assumptions introduce.

A benefit of having HOU estimates by bulb shape in the TRM is that program administrators can target bulbs with the greatest HOU and achieve higher savings. Using results from the 2013 CFL Study, the programs should have been focusing on decorative bulbs to maximize savings from HOU. Past program sales data suggest that neither the AIC nor ComEd program has used this type of targeting as reflectors are the most frequently discounted specialty bulb.

An alternative bulb targeting strategy would be to focus on the specialty bulbs with the greatest market share. Based on results from our in-home lighting audits, reflector bulbs make up 76% of specialty bulbs installed in Illinois homes, decorative bulbs make up 15%, and globes 9%. Reflectors comprise the majority of past program specialty sales, suggesting that the market drives sales. If the programs were to dramatically increase their discounts on decorative bulbs and reduce discounts on reflector bulbs, it may be possible to shift sales, but this strategy would ignore the sizable remaining potential in the reflector market.

If programs do not attempt to drive sales towards specialty bulbs with the greatest estimated HOU (i.e. decorative bulbs), market share for different specialty bulbs will likely continue to drive sales. Because our combined specialty bulb HOU estimate is weighted by the prevalence of different bulbs in homes, the savings should be the same whether we use a combined specialty bulb HOU estimate or different estimates by specialty bulb type. Therefore, program targeting of high HOU LEDs would be the only reason to continue to have separate specialty bulb HOU estimates in the TRM.

If Illinois utilities desire to target specialty bulb types based on their HOU, we will not object to using with weighted HOU results for the IL-TRM V7.0. In that case, we believe that the weighted method should be used across all bulb types, including standard bulbs. However, our preferred HOU estimate is one based on actual logging of bulbs and combines all specialty bulbs into a single estimate.

Recommendation for IL-TRM V7.0: Use actual logged estimates for both standard and specialty LEDs. Use a combined statewide specialty HOU estimate.

Table 4. Recommended LED HOU

Bulb Type	Logged HOU
Standard LEDs	
Interior	2.98
Exterior	6.78
Unknown	3.18
All Specialty LEDs	
Interior	2.09
Exterior	6.78
Unknown	2.32