DISPOSITION FOR WORKPAPER PGECOLTG178-REV3 COVERING HIGH AND LOW BAY LED FIXTURES
California Public Utilities Commission, Energy Division
September 29, 2017

1. Review Scope and Summary of Direction

This disposition includes a detailed review of PG&E's workpaper PGECOLTG178, revision 3, covering high- and low-bay interior LED fixtures. The workpaper is not approved. Additional analysis and revisions are required to address standard practice baseline and to ensure that programs are providing incentives for the most efficient products in the market. PAs are directed to:

- Develop a standard practice baseline that reflects the typical mixture of efficiency levels that are currently selected in normal replacement situations.
- Define measure tiers in a way that assigns greater savings for higher performance products and place an efficacy floor on eligible products.
- Due to the rapid changes in the marketplace, update the measures at least annually.
- Revise measure definitions so that baseline and measure zonal lumen output levels represent similar levels of service.


2. Develop a Standard Practice Baseline for Normal Replacement Measures

All measures covered by the workpaper are defined as "Replace-on-Burnout" or "ROB." Moving forward, ROB measures will be referred to "Normal Replacement" or "NR" measures. CPUC police requires the baseline for NR measures to be based on standard practice. The workpaper savings are based on a specific technology as the baseline for each measure. That is, each measure assumes a baseline of a specific combination of lamp type, lamp quantity, ballast type and ballast quantity. For example, measure code LT109 for LED fixtures in the range of 122 to 142 watts assumes a baseline of a specific fixture using a 200 watt pulse start metal halide (PSMH) lamp and total fixture power of 222 watts. Since this workpaper covers NR measures only, the baselines must represent the typical standard practice for the normal replacement choices that would occur outside of an IOU efficiency program. The workpaper's baseline performance is, or is near, the oldest and least efficient technology available in the current market. The baseline technologies do not consider that newer, more efficient technologies, including LEDs, likely make up some portion of the standard practice. The current standard practice for measures covered by this workpaper will vary from the least efficient technology such as T8 or PSMH fixtures to technologies that are very similar to those offered within an efficiency program. PAs shall revise the workpaper to include a baseline performance that represents expected behavior of participants in a normal replacement application without incentives.

Recent NEMA lamp index data[1] shows that linear fluorescent (Figure 1) and HID (Figure 2) lamp shipments are rapidly decreasing, which is likely an indication that LED technologies are moving to a standard practice choice for many normal replacement projects, which supports the inclusion of these products in the NR baseline mix along with older, less efficient technologies.
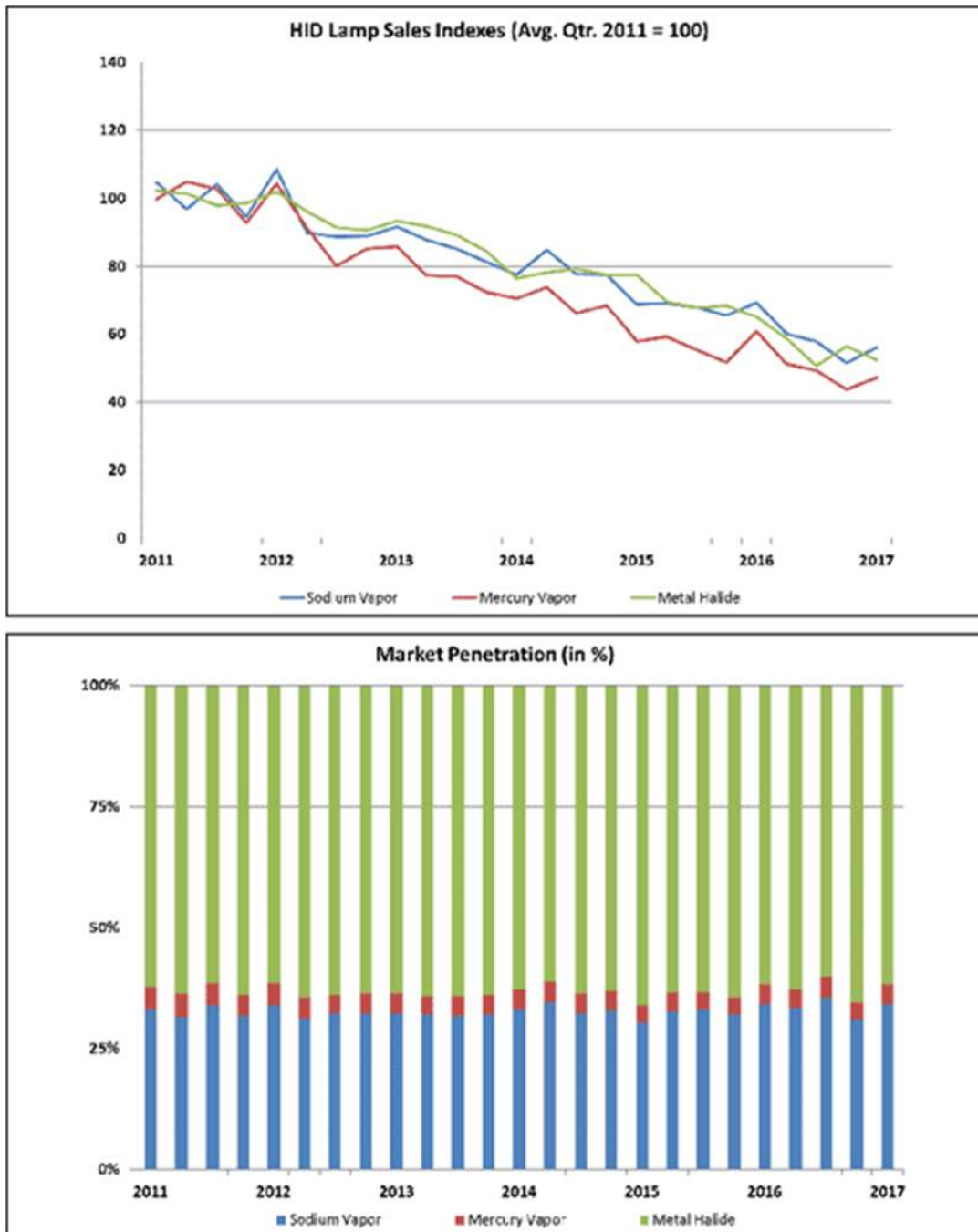
Figure 1 - NEMA Linear Fluorescent Lamp Sales

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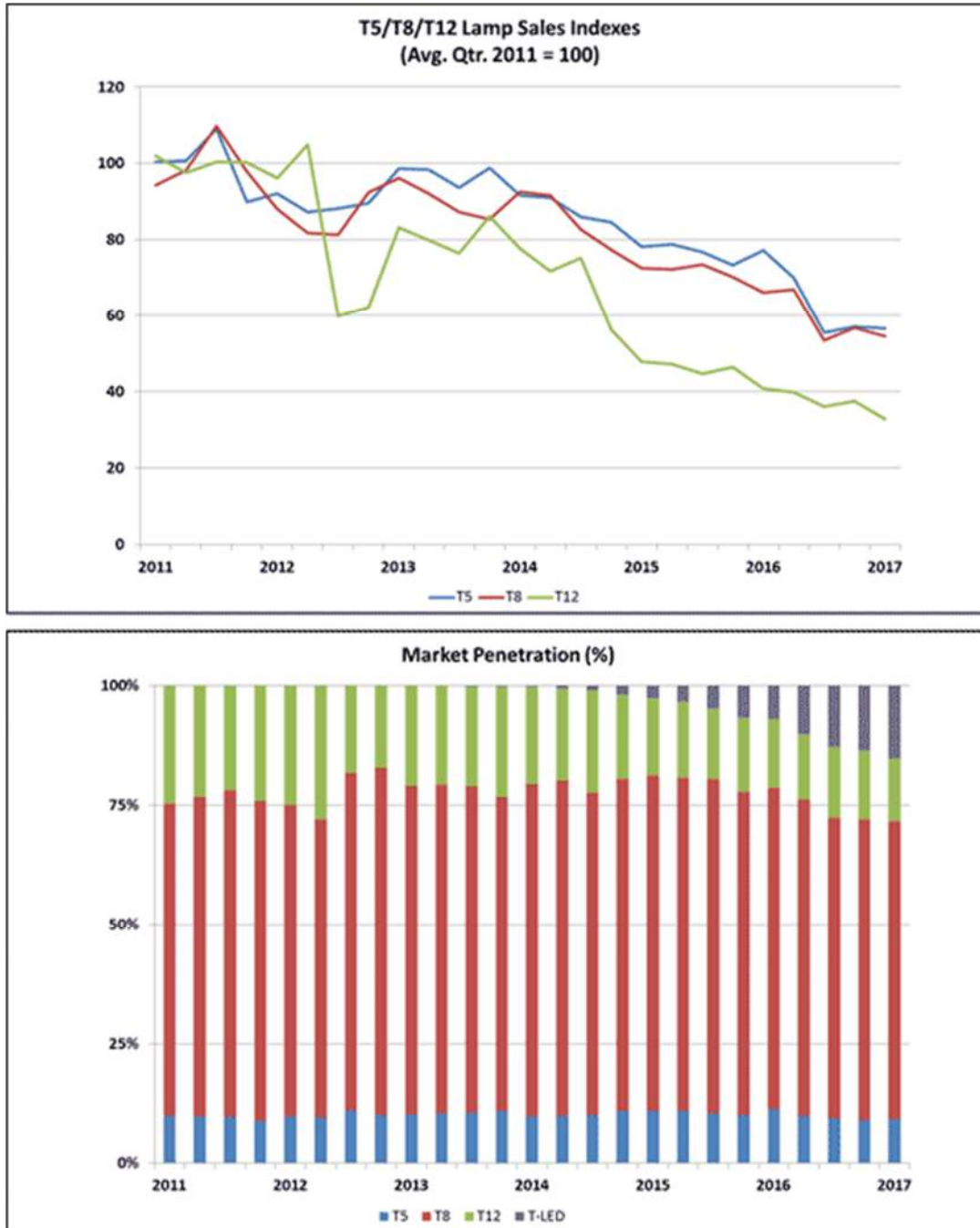
[1] NEMA Lamp Indices Report: http://www.nema.org/Intelligence/Pages/Lamp-Indices.aspx

Figure 2 - NEMA HID Lamp Sales

3. Revise Measure Definitions to Ensure Similar Service Levels, Remove Lower Performing Products, and Encourage Adoption of Higher Efficacy Products,

The workpaper cites the recent Navigant LED study[2] which stated "Navigant's analysis suggests that the typical installed LED wattage for bay and exterior lighting applications falls near the mean of the existing LED wattage ranges." Navigant then concludes that the direction in the 2013-2014 lighting disposition, which requires savings to be calculated assuming the highest wattage of the wattage range for any particular measure, underestimates savings by the difference of the highest wattage in the range and the median value, and also discourages adoption of higher efficacy fixtures.

To address this concern from the Navigant report, the workpaper analysis classifies all qualifying fixtures into bins based on the "zonal lumens"[3] and groups each bin with specific a baseline technology that has similar output, so that each qualifying LED fixture is assigned to a specific baseline technology. Then, the mean wattage for each group of LED fixtures is set as the measure wattage, while the baseline is the wattage of the specific baseline fixture. This approach is an improvement over past workpapers as it helps to eliminate potential overlap of fixture performance across measures.

The revised approach does not address CPUC staff's concern and direction that savings and incentives should be higher for higher efficacy lighting products. Additionally, staff has previously directed that analysis should consider the variation in technology efficacy and strive to provide incentive support for the higher performance products. Staff has also directed that PAs should offer higher incentives for higher performance products and remove support for the lowest performing products. In 2016, PG&E followed this direction inthe LED ambient lighting fixtures and retrofit kits workpaper (PGECOLTG179). In that workpaper, savings are calculated using units of installed kilolumen rather than per fixture, with higher savings per kilolumen assigned to products with higher efficacy. Similarly, the 2017 screw-in LED lamp disposition differentiates savings based on efficacy and places a floor on product efficacy so that lower performing products are not eligible for incentives.

In this workpaper, savings are the same for all fixtures within a particular bin, but the performance of those fixtures varies widely. Figure 3 shows the distribution of qualifying hi-bay fixtures that are categorized in the HIS measures. In the nine lowest wattage measures, there is 200%-400% variation in LED fixture output but only 10%-20% variation in LED fixture input wattage. Staff is disappointed that this new submission does not build on the approaches developed for either the ambient fixtures or screw-in A-lamps disposition. Additional analysis is presented below and our direction is provided on page 8.

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[2] California LED Workpaper Update Study, Final Report, Prepared for: Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric by Navigant Consulting, Inc., Reference No.: 169396, August 28, 2015
[3] "Zonal Lumens" refers to the effective light output at the work surface which will be lower than the total output of the fixture.

Figure 3 – HID Measures: Output and Power, Categorized by Baseline Fixture Wattage
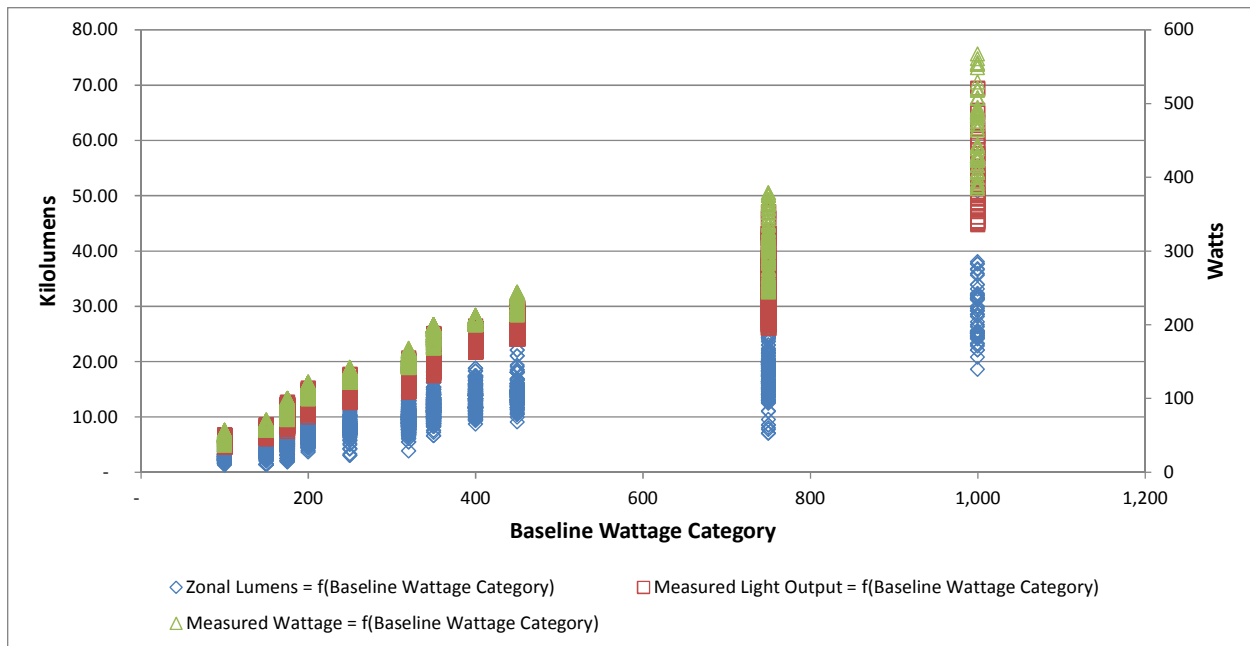
Notes to Figure 3: This chart shows the fixtures that qualify for each PG&E measure, which is why the graph is in columns. Each column represents the group of qualifying fixtures that aligns with a particular baseline fixture.
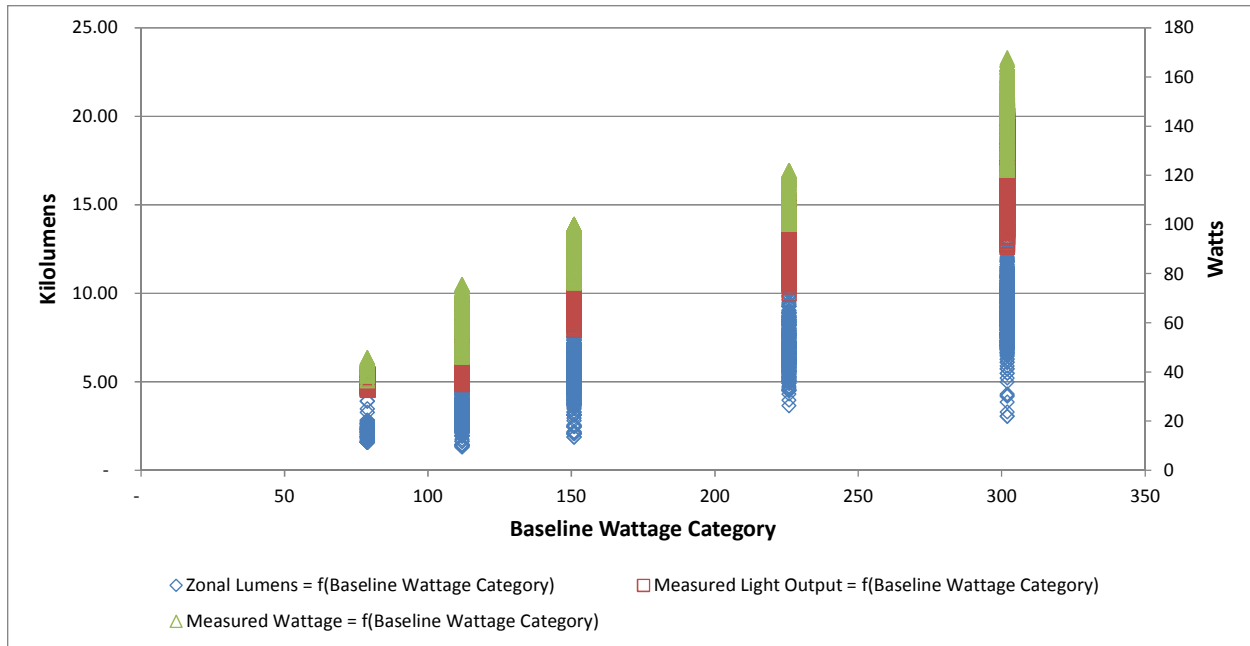
Figure 4 and Figure 5 provide additional analysis examples of how fixture performance varies greatly within the workpaper's measures. Figure 6 and Figure 7 show examples of how adding minimum efficacy requirements in units of zonal lumens per watt (zlm/w) reduce the variation in performance within measures. In particular, Figures 4, 6, and 7 may be directly compared to understand how adding an efficacy floor would affect the measures as they are currently defined.

Figure 4 - HID Measures: Efficacy and Power, Categorized by Baseline Fixture Wattage
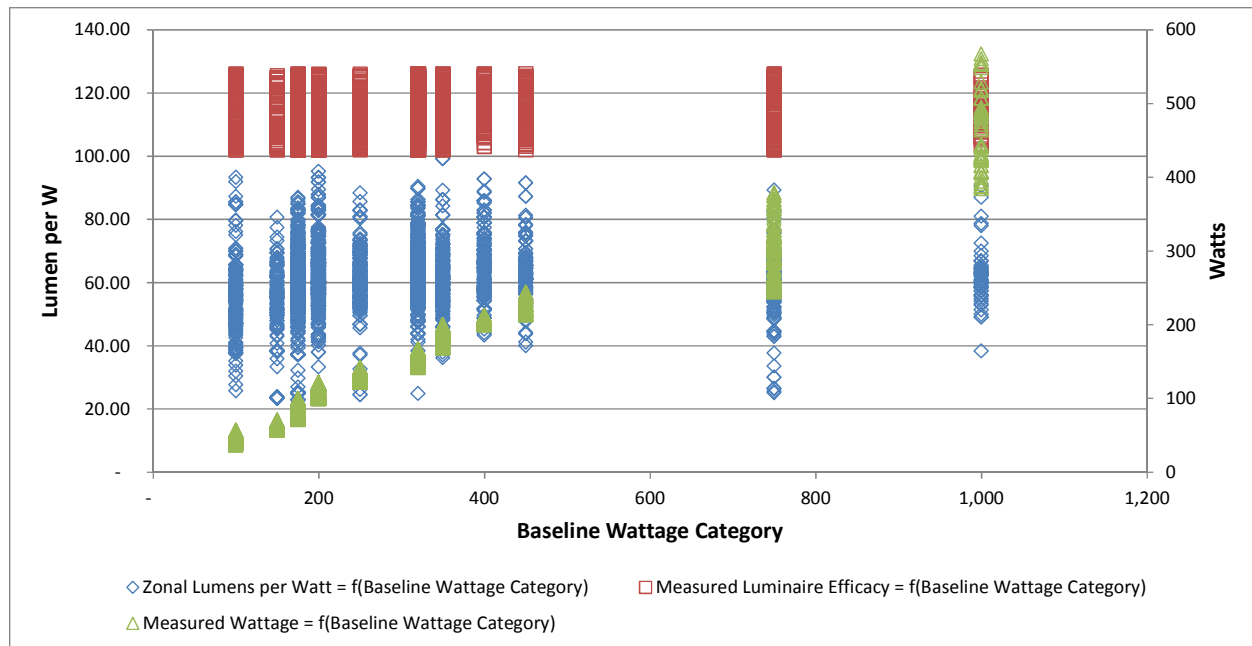
Notes to Figure 4: In the nine lowest HID measures, there is very large variation in zonal lm/w, but only a small variation in input power which leads to large variations in efficacy although all fixtures in any one column are assigned the same savings.

Figure 5 - LF Measures: Output and Power, Categorized by Baseline Fixture Wattage

◇ Zonal Lumens = f(Baseline Wattage Category)   □ Measured Light Output = f(Baseline Wattage Category)
△ Measured Wattage = f(Baseline Wattage Category)

Notes to Figure 5: In the 3 highest LF measures, there is a 2X-3X variation in zonal lumens, but only 10-20% variation in input power. It is not reasonable to group these fixtures into a single measure with the same deemed savings since they don't represent a similar level of service. All measures are classified as normal replacement which means the baseline must be a standard practice that includes a mix of varying technologies of different levels of efficiency.
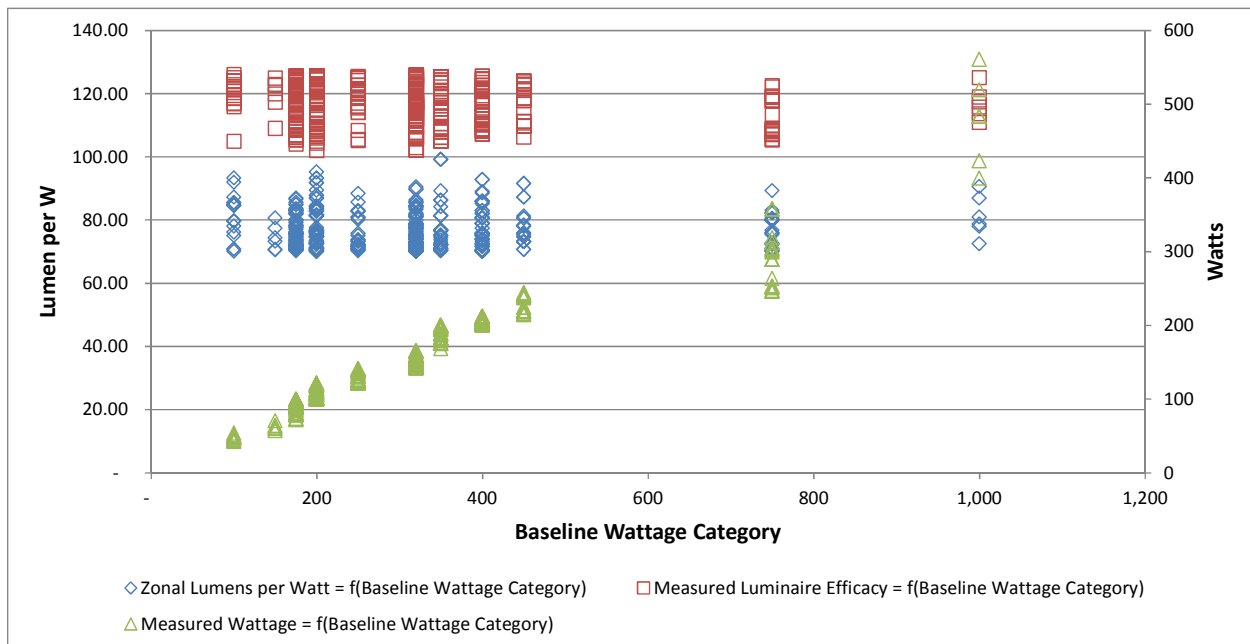
Figure 6 - HID Measure: Efficacy and Power for Fixtures $\geq$ 60 zlm/w, Categorized by Baseline Fixture Wattage
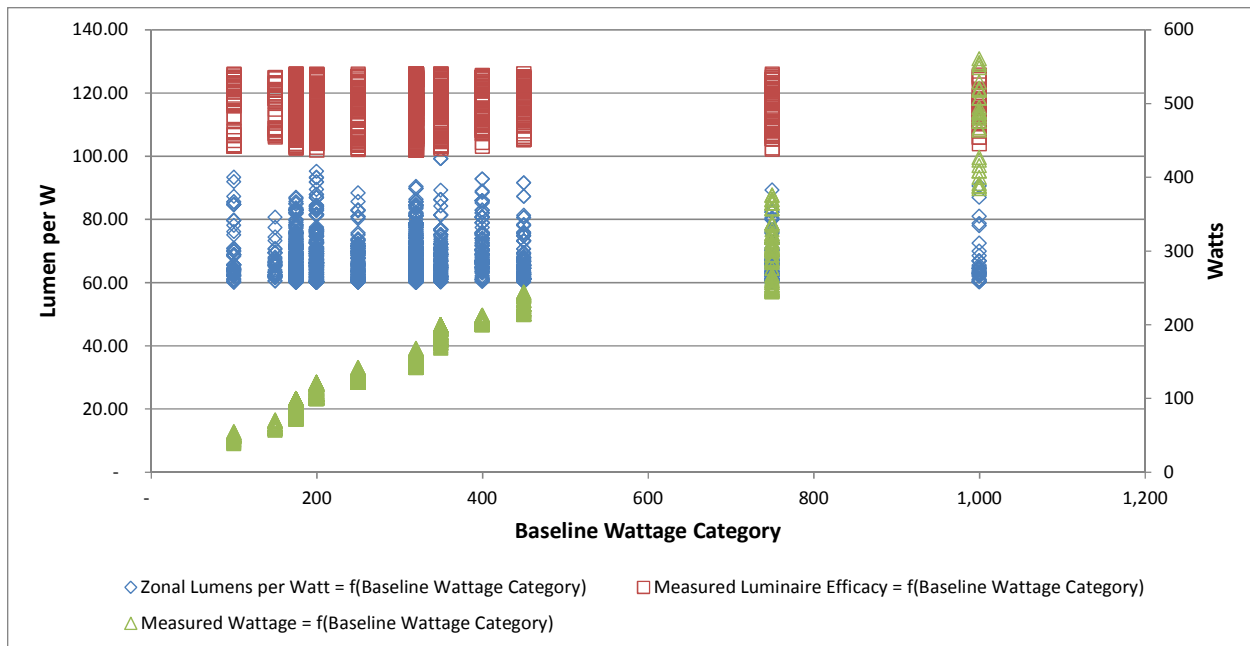
Notes to Figure 6: Setting a floor of 60 zlm/w as one of the program criteria appears to reduce the scatter but still allow a significant number of fixtures

Figure 7 - HID Measure: Efficacy and Power for Fixtures $\geq$ 70 zlm/w, Categorized by Baseline Fixture Wattage

Notes to Figure 7: 70 zlm/w greatly reduces the number of qualifying high-wattage fixtures, but may not be too restrictive since this program will not start for another 3 months.

These figures were developed using the enclosed workbook, PGECOLTG178-R3-PerfAnal-29Sep2017-final2.xlsm. This workbook can be used to examine range of performance of the workpaper measures and also to examine the effects of setting minimum efficacy requirements.

CPUC staff directs PAs to define measure tiers in a way that assigns greater savings for higher performance products and to place an efficacy floor on eligible products. Due to the rapid changes in the marketplace, update the measures at least annually. Furthermore, the baseline shall be revised to ensure equivalent performance, in units of "zonal lumens" (zlm), for both the measure and baseline definitions.