CFL ORIGINAL EQUIPMENT MANUFACTURER PERFORMANCE ASSESSMENT: 2017

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ASSESSMENT HIGHLIGHTS

VERIFICATION TESTING SAMPLE

- Verification testing of CFLs was established to verify, on an ongoing basis, whether ENERGY STAR CFLs sold after initial qualification meet ENERGY STAR requirements. ENERGY STAR verification testing programs have tested 656 CFL models from 2010 to 2016.

- The 656 tested products included in this assessment were manufactured by 39 different original equipment manufacturers (OEMs); 21 of these OEMs had five or more products tested. OEMs with five or more products tested account for approximately 95% of the total number of tested products. Among these OEMs, disqualification rates ranged from 0% to 86%.

- Products manufactured by the 21 OEMs with five or more products tested represent a large number of products labeled under different brand names. These OEMs manufactured approximately 85% of the products listed on the ENERGY STAR certified products list as of December 31, 2016.

DISQUALIFICATION RATES

- Disqualification rates for ENERGY STAR certified CFLs have decreased over time. Overall disqualification rates decreased by nearly half between the CFL Testing Program (2010-2014) and 2015 and 2016 verification testing.

- Of OEMs with five or more products tested, disqualification rates ranged from 0% - 43% in 2015 and 0% - 57% in 2016 (compared to 0% - 86% from 2010-2014).

- Overall CFL program disqualification rates improved in 2015 and 2016, but the improvement has not been consistent among OEMs. In 2015, one OEM accounted for 30% of total disqualifications and in 2016, two OEMs accounted for 50% of total disqualifications.

ENHANCED COMPLIANCE EFFORTS

- The Environmental Protection Agency (EPA) has undertaken targeted actions to help drive improved quality control in the production of ENERGY STAR CFLS. Since 2013, EPA has issued 122 individual notices to approximately 30 OEMs providing a recap of their testing performance in the CFL Testing Program. EPA has provided greater oversight of products associated with OEMs with high failure rates and sought additional quality assurance information for 24 private labelers using products from those sources.

- After initiation of the EPA enhanced compliance oversight efforts in 2013, disqualification rates for CFLs that underwent verification testing fell from 30% in 2013 to 17% in 2014.

- Private labelers of CFLs can play an important role in addressing quality control issues by inquiring about their OEM's testing record and plans for improving it, as needed.

PROGRAM OVERVIEW

ENERGY STAR THIRD PARTY CERTIFICATION AND VERIFICATION TESTING

CFLs have defined energy efficient residential lighting since the 1980s and been a critical component of utility energy efficiency program portfolios since the 1990s. In 1999, the first ENERGY STAR specification was developed and released by the U.S. Department of Energy (DOE) to provide manufacturers with a national standard and to help consumers more easily identify higher quality products with greater energy savings. The ENERGY STAR specification and label also made it easier for utilities to identify and promote specific products to their customers.

Due to concerns that the CFLs promoted through utility programs were underperforming, a number of utilities and energy efficiency stakeholders created the Program for the Evaluation and Analysis of Residential Lighting (PEARL) in 2000.[1] Under the PEARL program, CFL products available in the marketplace were procured and tested to ensure they still met the requirements they were qualified to under ENERGY STAR. In nine test cycles from 2000 to 2009, PEARL tested 185 CFL models from 35 manufacturers. Test results were shared with the PEARL sponsors, DOE, EPA, and manufacturers of the products tested.

PEARL was replaced in 2009 by the CFL Third Party Testing and Verification Program (CFL Testing Program). The CFL Testing Program, established by DOE, was designed to test all off-the-shelf ENERGY STAR qualified CFLs at least once every five years. A third-party administrator managed the program on behalf of DOE and coordinated testing of 20% of ENERGY STAR qualified CFLs on an annual basis. In 2010, management of the CFL Testing Program transitioned from DOE to EPA.

In 2011, EPA restructured its approach to ENERGY STAR qualification and verification testing and created the ENERGY STAR Third Party Certification Program (3PC). EPA then established disqualification procedures to provide a more consistent structure for managing failed products and their association with the ENERGY STAR mark.

Under the 3PC Program, ENERGY STAR products are third-party certified and subject to off-the-shelf verification testing, administered by a EPA-recognized certification body (CB). From 2010 to 2014, verification testing continued to be administered under the CFL Testing Program, and in 2015 transitioned to CB-administered verification testing.

Each year, 20% of all ENERGY STAR certified CFLs are tested. Half of the products tested are selected through a nomination process, and half are chosen randomly from the Qualified Products List.[2] EPA reviews and approves the final list of product nominations each year, based on nominations by EPA, ENERGY STAR partners, and industry stakeholders. Once the final list of nominations and random selections is compiled,

[1] http://www.lrc.rpi.edu/programs/pearl/index.asp

[2] http://www.energystar.gov/products

partners with products selected for testing are informed and the certification body initiates procurement and testing.

Products that are subject to verification testing under the 3PC Program undergo the same 14 tests performed for purposes of ENERGY STAR product certification (see Table 1), except that products are tested through 40% of their rated lifetimes (for certification, products must be tested through the entire rated lifetime).

Table 1: Tests Required for ENERGY STAR Certification and Verification

Photometric Performance	Lumen Maintenance and Rated Life	Operational and Electrical Performance
Luminous Efficacy	1000-Hour Lumen Maintenance	Power Factor
Light Output*	Lumen Maintenance at 40% of rated life	Start Time
Elevated Light Output Ratio	Rated Life	Run-Up Time
Center Beam Intensity*	Rapid Cycle Stress Test	Transient Protection*
Correlated Color Temperature (CCT)		
Color Rendering Index (CRI)		

*Not required for CFL Version 4.3

PRODUCT DISQUALIFICATION

Product performance is assessed at three stages of testing: 100 hours, 1000 hours, and 40% of rated life. A product failure can be observed at any of these three stages. If a product fails, EPA notifies the tested partner, the OEM, and any other affected private labelers, that EPA intends to disqualify the product from the ENERGY STAR program. Tested and affected labelers have the opportunity to dispute the pending disqualification, in which case EPA conducts a technical review of all information the partner(s) submits before making a final determination on the product's status.

For any CFL that warrants disqualification from the ENERGY STAR Program, EPA requires a corporate certification detailing product control measures undertaken to manage the sale, distribution, and marketing of the disqualified model, such that ENERGY STAR is no longer associated with the product. CFL products that are disqualified appear on the Lighting Products Disqualified from the ENERGY STAR Program list on the ENERGY STAR Program Integrity webpage.

From May 1, 2009 through June 30, 2017, 656 models were evaluated through post-market ENERGY STAR verification testing programs. During that period, 178 (27%) failed to meet program requirements and were subsequently disqualified from the ENERGY STAR program. Annual CFL product disqualification rates ranged from 17% to 38% (see Table 2).

Table 2: Summary Performance Results of All CFL Products Tested May 2009 – June 2017

Verification Testing Program	Testing Year	Disqualified	Total Tested	Disqualification Rate
CFL Testing Program	2010	14	61	23%
	2011	48	128	38%
	2012	33	114	29%
	2013	41	138	30%
	2014	2	12*	17%
3PC	2015	18	97	19%
	2016	22	106	21%
	Total	**178**	**656**	**27%**

*The limited number of models tested in 2014 is due to the transition from the CFL Version 4.3 Specification to the Lamps Version 1.0 specification, which went into effect on September 30, 2014 and resulted in fewer certified models in 2014.

LAMPS SPECIFICATIONS

The ENERGY STAR Lamps Version 1.0 Specification became effective September 30, 2014 and combined performance requirements for CFLs and LED lamps into one specification. Before the new specification took effect, nearly 5,000 CFLs were ENERGY STAR certified (to CFL Version 4.3 requirements). Before the ENERGY STAR Lamps Version 2.0 Specification became effective January 3, 2017, approximately 1,500 CFL products were certified to the Lamps Version 1.0 Specification.

Only 22 CFLs are certified to the new specification. Although CFLs are decreasing in market share, many CFL OEMs have pivoted to developing and manufacturing LED lamps and are certifying LED lamps to ENERGY STAR Lamps Specification Version 2.0.

CFL OEMS AND PRIVATE LABELERS

In the United States, CFLs are sold under a variety of brand names. These branded products, or private labels, are manufactured by OEMs who then sell their products to the private label brand owners. In some cases, an OEM will sell the product under its own brand name, as well as selling it to other private labelers. Other times, a brand owner and an OEM will enter into an exclusive relationship whereby the brand owner will label only products produced by that OEM. Most commonly, an OEM sells the same model to multiple private labelers and each private labeler sells the model under its own brand name.

From 2010 to 2016, CFLs from 39 different OEMs underwent verification testing and of those, 21 have had five or more CFLs tested. The CFLs from the 21 OEMs that have had five or more products tested represent nearly 95% of all CFLs tested to date. See Table 3 for additional detail.

Table 3: Verification Testing Sample, by Testing Period

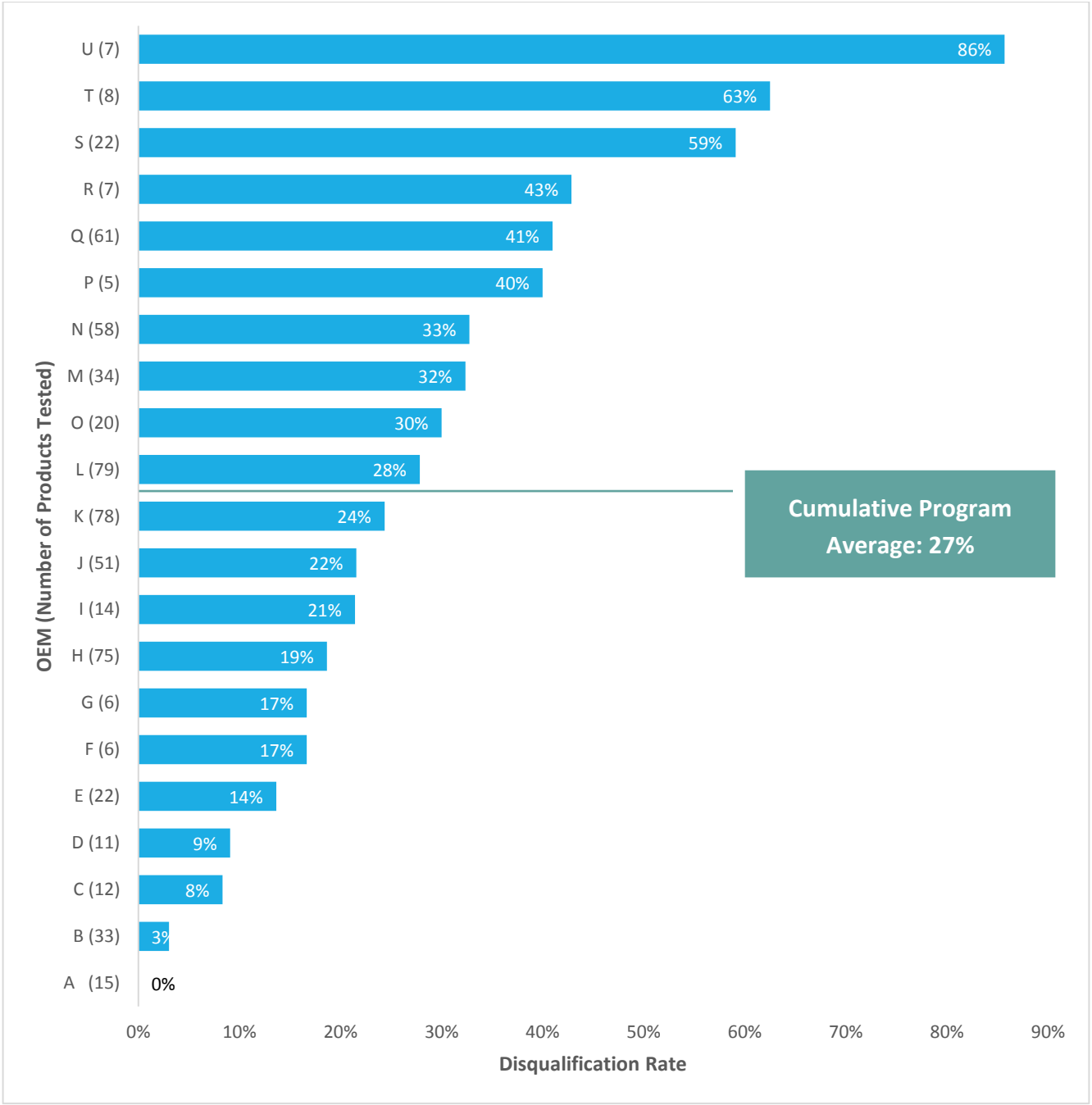
	All OEMs		OEMs with 5 or more products tested	
Testing Period	# Products Tested	# Unique OEMs Tested	# Unique OEMs Tested	% of Total Products Tested
2010 - 2014 (CFL Testing Program)	453	31	19	96%
2015 (Third Party Certification and Testing)	97	16	10	88%
2016 (Third Party Certification and Testing)	106	21	8	73%
Overall (2010 - 2016)	**656**	**39**	**21**	**95%**

The ENERGY STAR Program has monitored the performance of CFL OEMs as a result of high disqualification rates observed during the CFL Testing Program. EPA began to educate CFL private labelers about the performance of CFL OEMs and their direct and indirect market effects, and encouraged private labelers with failed models to examine and correct the root causes of failure among their products. To raise attention to quality issues, EPA conducted outreach to private labelers to further encourage increased quality control and subjected poor performing OEMS, and private labelers associated with them, to heightened oversight for failed products, including increased verification testing.

OEM PERFORMANCE

Verification testing performance varied among OEMs with five or more products tested. Cumulative (2010 to 2016) disqualification rates range from 0% to 86% across all testing years (see Figure 1). The overall CFL cumulative program disqualification rate is 27%.

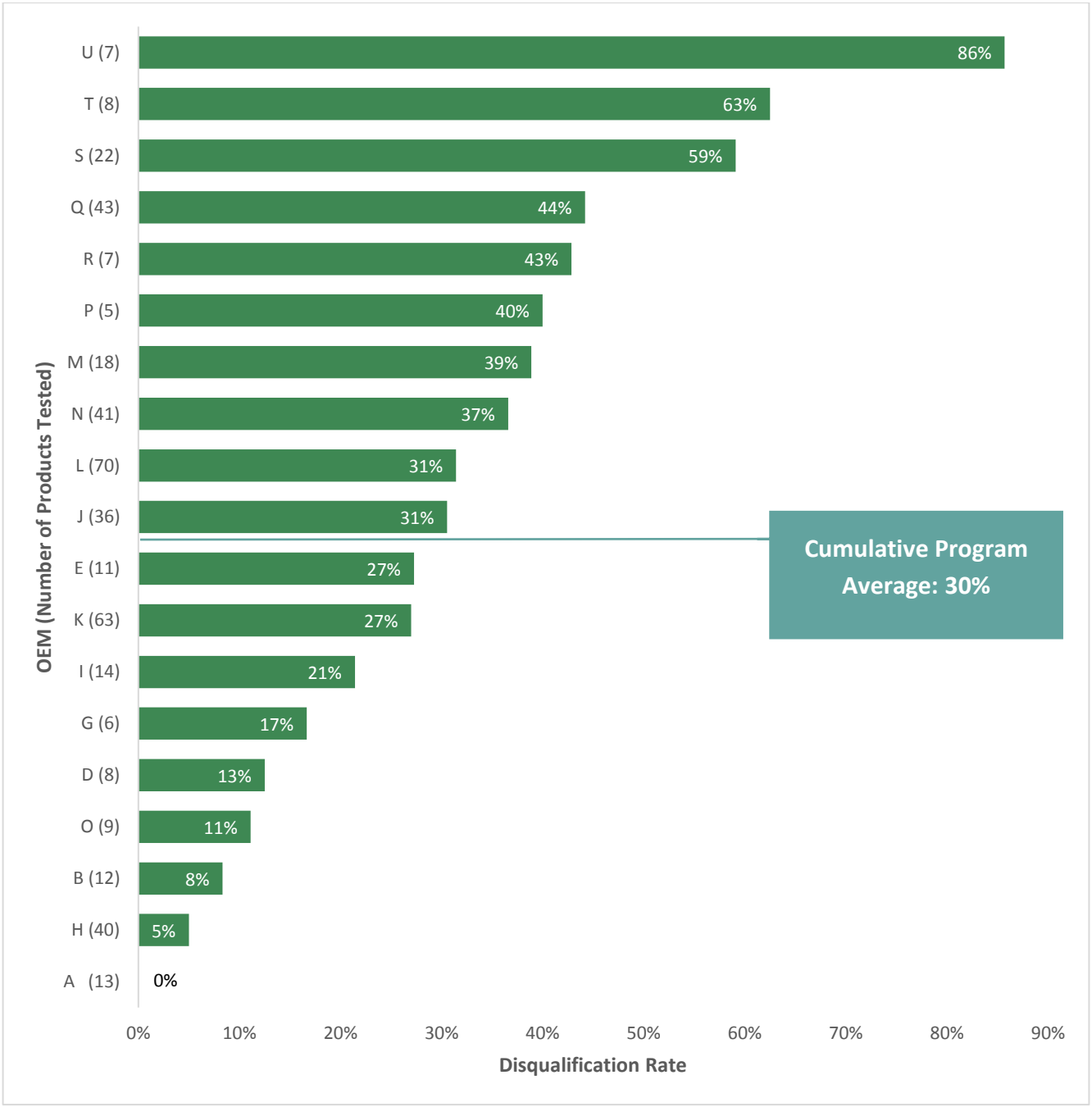
Figure 1: 2010 - 2016 Disqualification Rates, by OEM (Five or more products tested)



2010 – 2014 TESTING

During the CFL Testing Program (2010 to 2014), 19 OEMs were tested and had cumulative disqualification rates ranging from 0% to 86%. The overall CFL program disqualification rate during the CFL Testing Program was 30% (see Figure 2). After 2014, the CFL program disqualification rate decreased, and many OEMS improved their performance. Most notably, the program disqualification rated dropped from 30% in 2013 to 17% in 2014.

Figure 2: 2010 - 2014 Disqualification Rates, by OEM (Five or more products tested)



IMPROVED QUALITY CONTROL

In 2013, EPA began issuing each CFL OEM a letter that provided its verification testing performance for the year, including the overall CFL disqualification rate for those tested models. These letters served to ensure that every CFL OEM that supplied products associated with the ENERGY STAR label was aware of its overall performance against program requirements, and to provide a somewhat standardized basis of comparison for interested parties. At the same time, EPA made CFL private labelers aware of the distribution of OEM disqualification rates, encouraging them to review their OEM's performance and institute improved quality control as warranted.

In addition, private labelers of ENERGY STAR certified CFLs that failed verification testing were subject to heightened control measures if the OEM of the failed model was among those with poor performance records (i.e., with a failure rate greater than the program average). These private labelers were required, as part of corrective measures, to establish and submit additional quality control assurances covering all models from that source.

Models from sources with failure rates greater than the overall CFL program average (based on five or more product tests) were considered for verification testing nominations. In addition, to obtain more information about sources with limited historical testing, EPA sought additional testing on products from OEMs that had few products tested in the CFL Testing Program. The focus on testing provided greater oversight of those OEMs with a demonstrated history of below-average performance and allowed EPA to better assess the quality of products from sources with limited verification exposure.

2015 AND 2016 TESTING

In 2015, disqualification rates decreased. OEMs with five or more products tested had disqualification rates ranging from 0% to 43% (averaging 19%). The number of tested OEMs also decreased, with 16 total OEMs tested in 2015 compared to 31 during the CFL Testing Program. Of the 16 OEMs tested, 10 OEMs had five or more products tested. In addition, four out of five of the worst performing OEMs during the CFL Testing Program exited the ENERGY STAR market in 2015.

The 2016 verification testing period saw another decrease in the number of OEMs with five or more products tested (8 OEMs), while disqualification rates ranged from 0% to 57% (averaging 21%, a slight increase from 2015). See Figure 3 and Figure 4.

Figure 3: 2015 Disqualification Rates, by OEM (5 or more products tested)

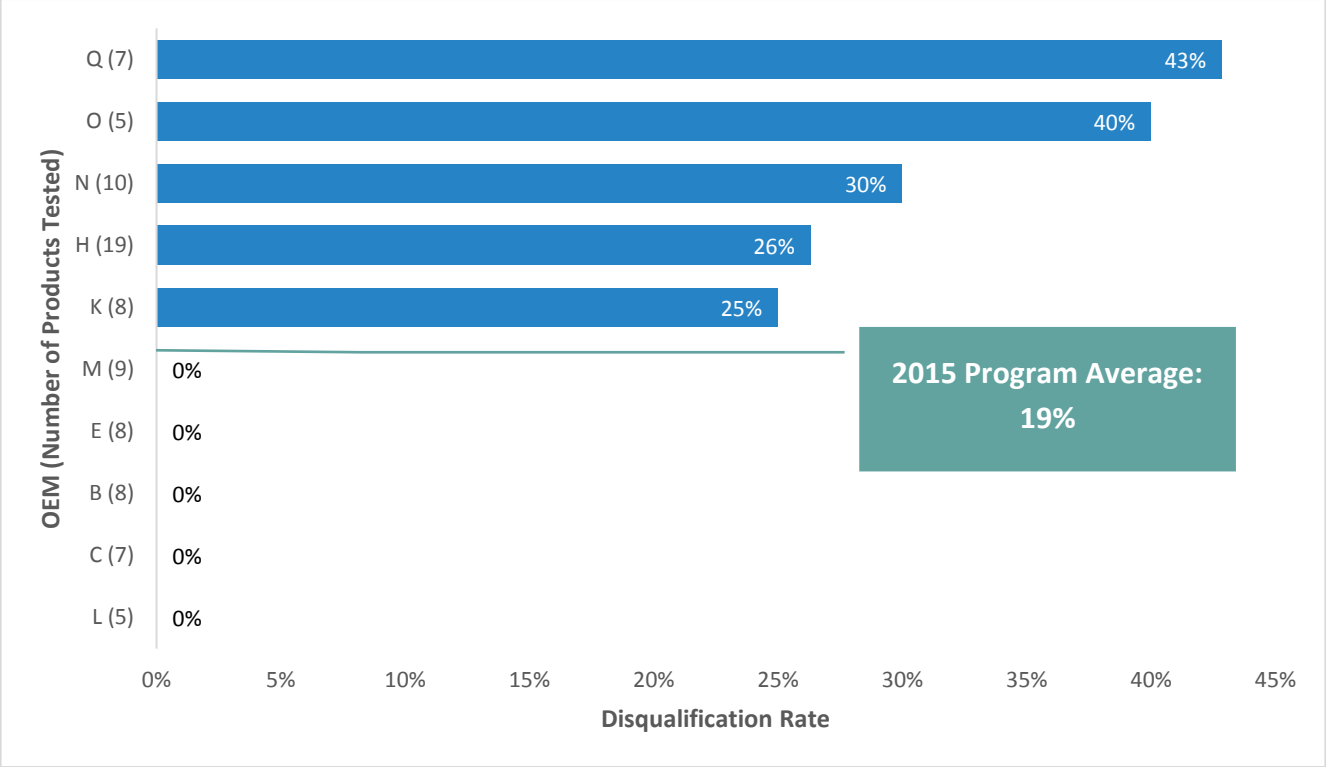
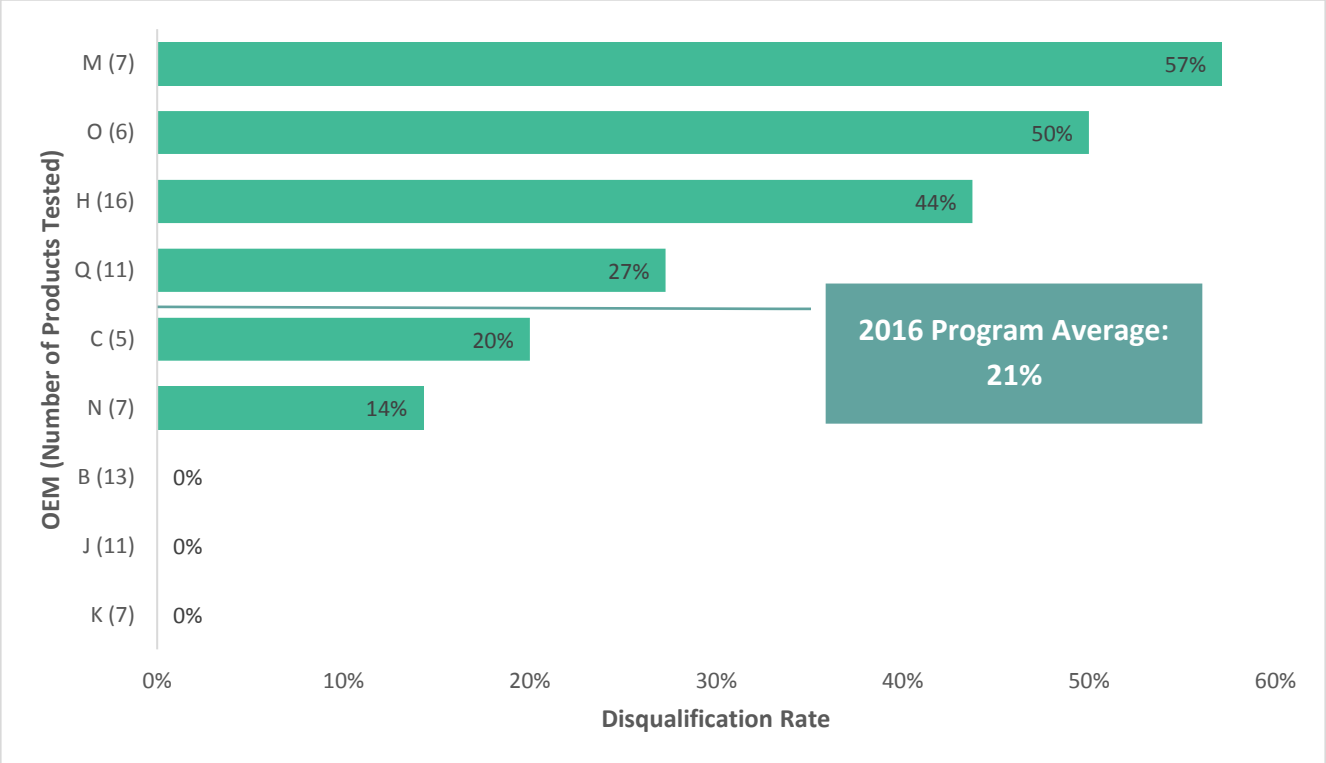


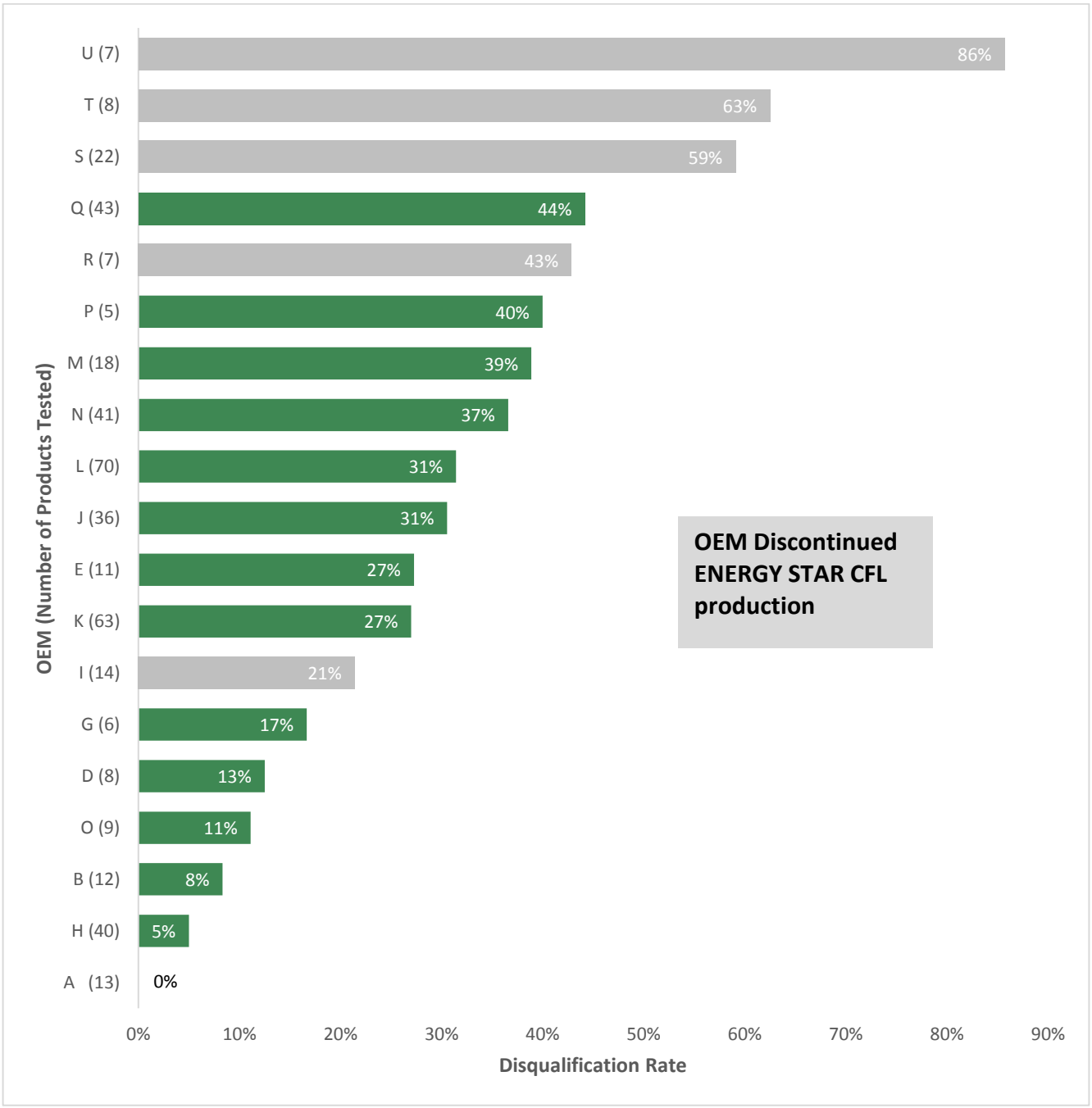
Figure 4: 2016 Disqualification Rates, by OEM (5 or more products tested)



PERFORMANCE COMPARISON

In 2015, two years after EPA initiated its quality improvement efforts, four of the five worst performing OEMs did not certify any CFLs to the new Lamps Version 1.0 Specification (see Figure 5).

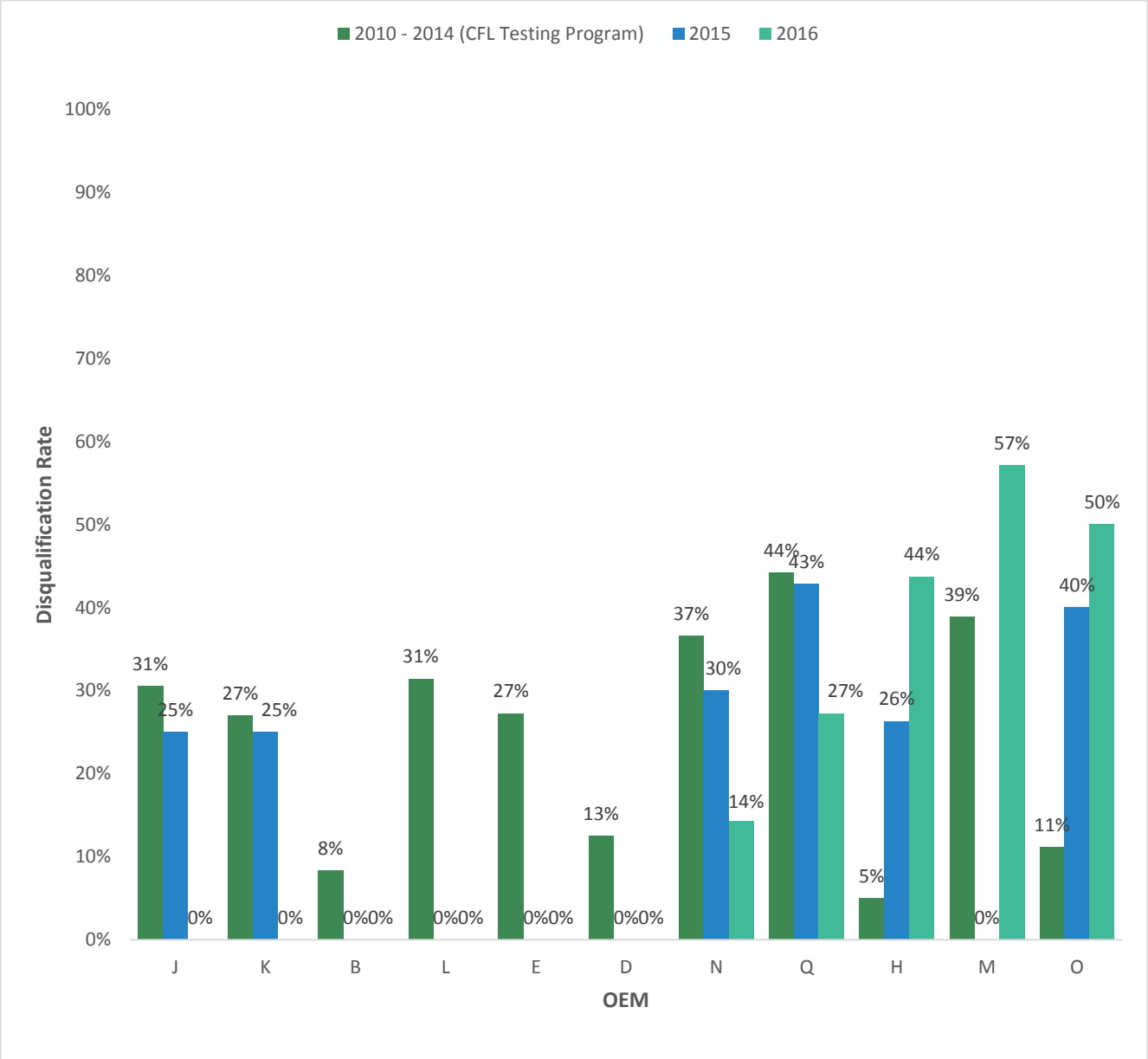
Figure 5: 2010 - 2014 Cumulative CFL Testing Program Disqualification Rates, by OEM



For most OEMs, disqualification rates decreased in 2015 and 2016 compared to the CFL Testing Program testing period (2010 to 2014). Of the 11 OEMs that were tested in all three testing periods, eight improved their testing performance (see Figure 6):

- Four OEMs had disqualification rates ranging from 27% to 31% in the CFL Testing Program testing period, and all four had disqualification rates of 0% in 2015 and 2016.
- Two OEMs had disqualification rates decrease from 25% in 2015 to 0% in 2016.
- Two OEMs have steadily improved their performance over time; disqualification rates for both of these OEMs have decreased in 2015 and 2016.

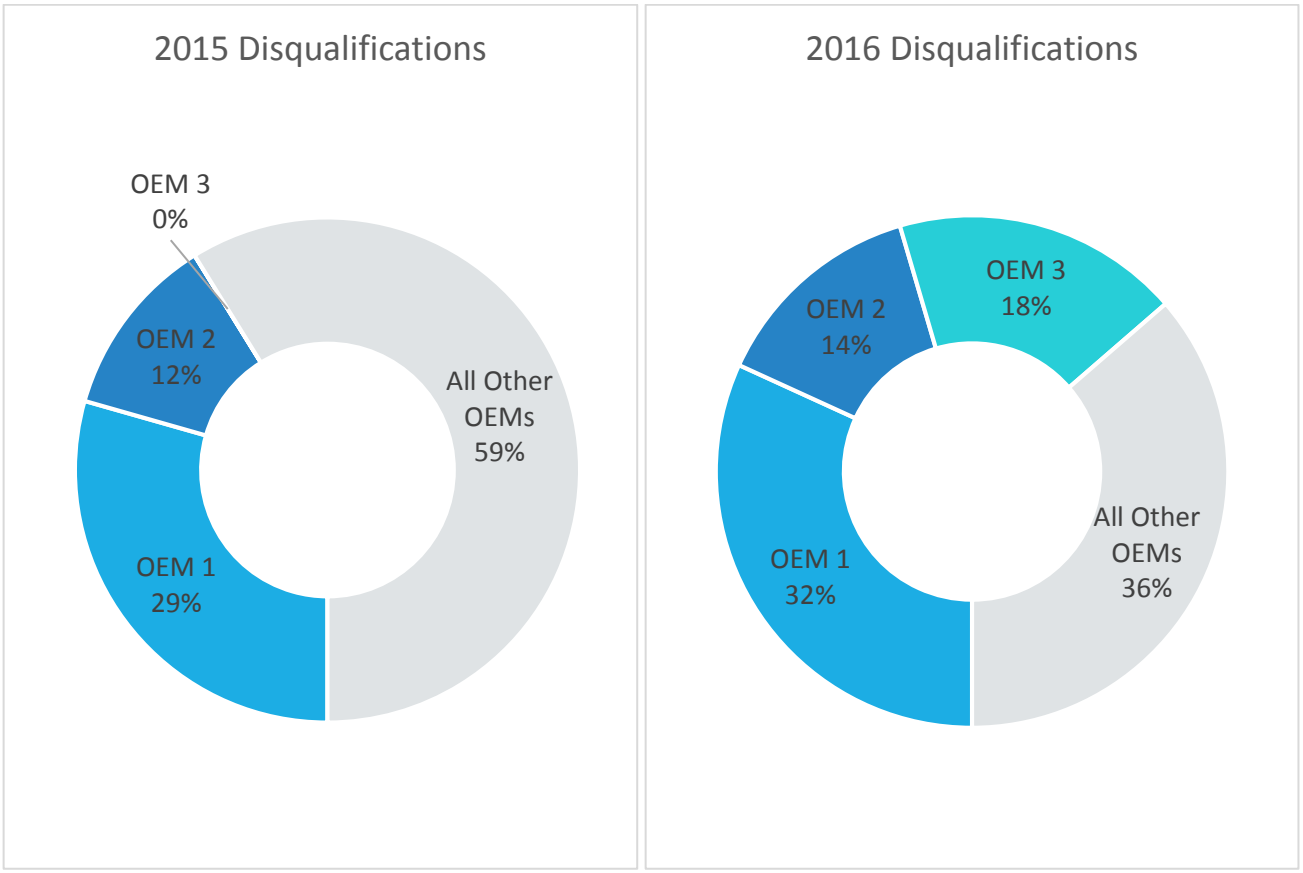
Figure 6: Disqualification Rates by Testing Period, by OEM



Three OEMs saw significant increases in their disqualification rates in 2015 and 2016. These three OEMs were responsible for 41% of total disqualifications in 2015 and 64% of total disqualifications in 2016:

- One OEM, which had a 5% cumulative disqualification rate in the CFL Testing Program, had a 2015 disqualification rate of 26%, representing 29% of the total disqualifications for that year. In 2016, this OEM's disqualification rate increased to 44%.
- One OEM had an 11% cumulative disqualification rate in the CFL Testing Program, but increased to 40% in 2015 and 50% in 2016.
- One OEM with a 39% cumulative disqualification rate in the CFL Testing Program decreased its disqualification rate to 0% in 2015 but then experienced a significant increase in 2016 to 57%.

Figure 7: 2015 and 2016 Disqualifications, by OEM



ENHANCED COMPLIANCE EFFORTS

From 2013 to 2016, EPA issued 122 letters to approximately 30 unique OEMs to notify them of their testing performance. The CFL program disqualification rate decreased starting in 2013, and has maintained a disqualification rate of about 20% from 2014 to 2016. Twenty-four private labelers have been required to submit additional control measures due to the poor performance of their OEM. In addition, EPA continues to

consider models from sources with failure rates of greater than the overall CFL verification testing program average (based on 5 or more product tests) for future verification testing nominations. See Table 4 for additional detail.

Table 4: EPA Enhanced Compliance Efforts

Testing Year	# OEM Letters Sent	# Unique Private Labelers Subject to Enhanced Oversight	Program Disqualification Rate
2013	31	0	30%
2014	28	5	17%
2015	30	6	19%
2016	33	13	21%
Overall	**122**	**24**	**27%**

CONCLUSION

Overall disqualification rates decreased between the CFL Testing Program, and the 2015 and 2016 3PC Programs, by nearly half. Disqualification rates among OEMs vary widely, but more narrowly in successive years of testing. While overall CFL disqualification rates decreased in 2015 and 2016, quality improvement has not been consistent among OEMs. In 2015, one OEM accounted for 30% of total disqualifications and in 2016, two OEMs accounted for 50% of disqualifications.

EPA has undertaken targeted actions to help drive improved quality control in the production of ENERGY STAR CFLs. Subsequent to EPA's enhanced compliance efforts, disqualification rates fell from 30% in 2013 to 17% in 2014, and four out of five of the worst performing OEMs exited the ENERGY STAR market. Given the success of EPA's enhanced compliance efforts in affecting the quality of ENERGY STAR suppliers and improving the rate of product disqualification, EPA will continue to apply this approach to ENERGY STAR LED private labelers and suppliers to ensure product quality.

LOOKING FORWARD

As CFL market share decreases, many CFL OEMS are investing in LED technology and transitioning production to LED lamps and fixtures. Sixteen of the 21 CFL OEMs that are the focus of this assessment now manufacture ENERGY STAR certified LED lamps (see Figure 8 below). Given the success of EPA's enhanced compliance efforts in affecting the quality of ENERGY STAR suppliers and improving the rate of product disqualification, EPA will seek to continue applying this approach to ENERGY STAR certified LED lamp private labelers and suppliers to ensure product quality.

Figure 8: 2010 - 2016 CFL Disqualification Rates of OEMs that Manufacture ENERGY STAR certified LED lamps, by OEM