

LED LAMPS ORIGINAL EQUIPMENT MANUFACTURER PERFORMANCE ASSESSMENT

2018 Report



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NONCOMPLIANT PRODUCTS

VERIFICATION TESTING

The ENERGY STAR Third Party Certification Program (3PC) is designed to provide a consistent structure for ENERGY STAR product certification and subsequent off-the-shelf (“verification”) testing. Under 3PC, all ENERGY STAR products are third-party certified and after introduced to the market may be subject to verification testing, administered by each of the EPA-recognized certification bodies. Each year, 20% of all ENERGY STAR certified LED lamps are verified. Up to half of the tested products are selected through an Agency-led nomination process, and the other half of tested products are selected from the ENERGY STAR Qualified Products List (QPL)¹ by the certification body (CB). EPA’s selection list is comprised of products nominated by ENERGY STAR stakeholders, such as utilities and industry and by EPA. Some factors that may increase the likelihood of product nominations include: prior product failures by the same manufacturer; products that are broadly rebated; manufacturers with limited verification testing data; and products from sources with repeated program compliance issues. Once a final product list for testing is compiled, responsible brand owner partners are informed, and the CBs initiate testing.

LED lamps subject to verification testing under 3PC undergo some variation of the same tests required for purposes of ENERGY STAR product certification (see Table 1), except that products are tested at 0 hours, 3,000 hours and 6,000 hours.

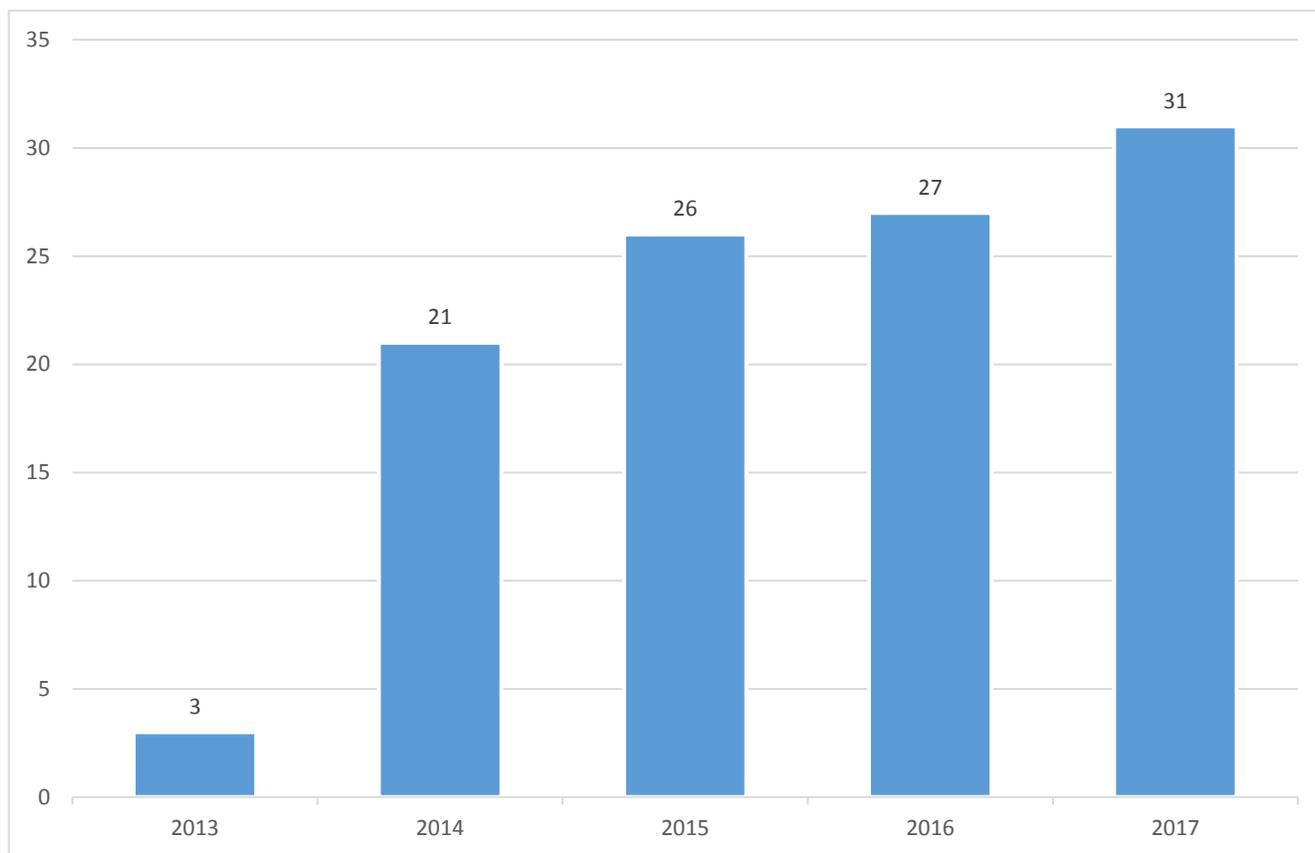
Table 1: Tests Required for ENERGY STAR Certification and Verification

Photometric Performance	Lumen Maintenance and Rated Life	Operational and Electrical Performance
Luminous Efficacy	3000-Hour Lumen Maintenance	Power Factor
Light Output	6000-Hour Lumen Maintenance	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)		

Each year, the number of ENERGY STAR certified LED bulb OEMs whose products are subject to verification testing for the first time increases (see Figure 1). The significance of that expansion is that it provides a better understanding of quality among a broader universe of sources, as well as comparisons between sources and across the industry.

¹ <http://www.energystar.gov/products>

Figure 1: Number of OEMs with ENERGY STAR LED Lamps Verification Tested for the First Time (by year)



PRODUCT DISQUALIFICATION

During verification testing, LED lamp performance is assessed at three stages of testing: 0 hours, 3,000 hours and 6,000 hours. A product failure can occur at any of these three stages. EPA addresses failed products and their association with the ENERGY STAR mark pursuant to the ENERGY STAR [disqualification procedures](#). If a product fails, then EPA sends notification that it intends to disqualify the product from ENERGY STAR to the brand owner of the tested product and all other labelers who sold that base product under another brand (“affected private labelers”). Those parties may or may not include the original equipment manufacturer (OEM), depending upon whether the OEM labels and sells its own branded version of the bulb, or only sells the product to other labelers for market distribution. All parties notified have the opportunity to dispute the pending disqualification. If applicable, EPA conducts a technical review of all information the partner(s) submits in order to make a final determination on the product’s status.

For any product 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 the ENERGY STAR name and label is no longer associated with the product. LED lamps that are disqualified appear on the [Lighting Products Disqualified from the ENERGY STAR Program](#) list on the [ENERGY STAR Program Integrity](#) webpage.

The first LED lamps became eligible for the ENERGY STAR label in 2013 and the first verification tests were completed in 2015. As of December 31, 2017, 440 LED lamps have been evaluated and completed lifetime testing through ENERGY STAR verification testing programs. During that period, 80 LED lamps failed to meet

program requirements and were subsequently disqualified from the ENERGY STAR program, representing 18% of all tested LED lamps. (See Table 2 for breakdown of annual product disqualification rates.) Annual LED lamp disqualification rates for individual OEMs ranged from 0% to 100%.

Table 2: Summary Performance Results of All LED Lamps Products Tested 2015 – 2017

Year Testing Completed	# Products Tested	# Products Disqualified	Disqualification Rate
2017	195	36	18%
2016	153	26	17%
All Years (Cumulative)	440	80	18%

EARLY CERTIFICATION FAILURES

Life testing for LED lamps seeking ENERGY STAR certification requires a duration of 6,000 hours (approximately nine months). Recognizing this partner commitment, EPA offers Early Interim (provisional) Certification for products that meet minimum light output requirements after life testing has reached the 3,000-hour mark, and all other relevant performance requirements. Full Certification depends on successful completion of the full 6,000-hour lumen maintenance life test.

Early certified products represent a small fraction of the over 20,000 LED lamps that have been certified. Because early-certified LED lamps are certified consistent with specification allowances, products that fail long-term performance are removed from the QPL but are not “disqualified products”. EPA requires the same actions to control the sale, distribution, and marketing of LED lamps for early certification failures as for disqualified products.

Erratic receipt of full-life testing failures data from 2012-2016 caused EPA to consider whether early certifications were being properly submitted by CBs to EPA. (See Table 3 for breakdown of annual early certification failures.) After a preliminary review of early certification failures to date, in 2018, EPA established improved data quality checks for CBs. This emphasis will provide greater opportunity for marketplace control of products that fail to meet full certification requirements.

Table 3: Early Certification Failures (2012-2016)

Year	Number of Incidents
2012	13
2013	2
2014	2
2016	8
2016	11
All Years (Cumulative)	36

OEM PERFORMANCE

In 2013, to better understand manufacturing and market vulnerabilities, EPA began to track, and more openly communicate, annual disqualification rates associated with each OEM for CFLs. Based on its demonstrated value in assessing and affecting the CFL market, EPA applied that approach to LED bulb OEMs as the ENERGY STAR market transitioned to LED bulbs.

When determining OEM disqualification rates, EPA considers only those OEMs who have had five or more products tested to date to ensure that average rates are not distorted comparisons (for example, disqualification

of one of two products yields a 50% disqualification rate for a minor examination of the party's product).² Each year as verification testing nominations are prepared, EPA strives to increase the number of OEMs that have had five or more products tested so that comparisons of individual OEMs are more comprehensive.

Between 2015 and 2017, a total of 81 LED bulb OEMs had products that completed verification testing. Of those 81 OEMs, 22 have had five or more LED lamps tested, representing 77% of all LED lamps tested to date. Figure 1 illustrates that the majority of products tested were manufactured by OEMs with a higher number of completed lifetime tests.

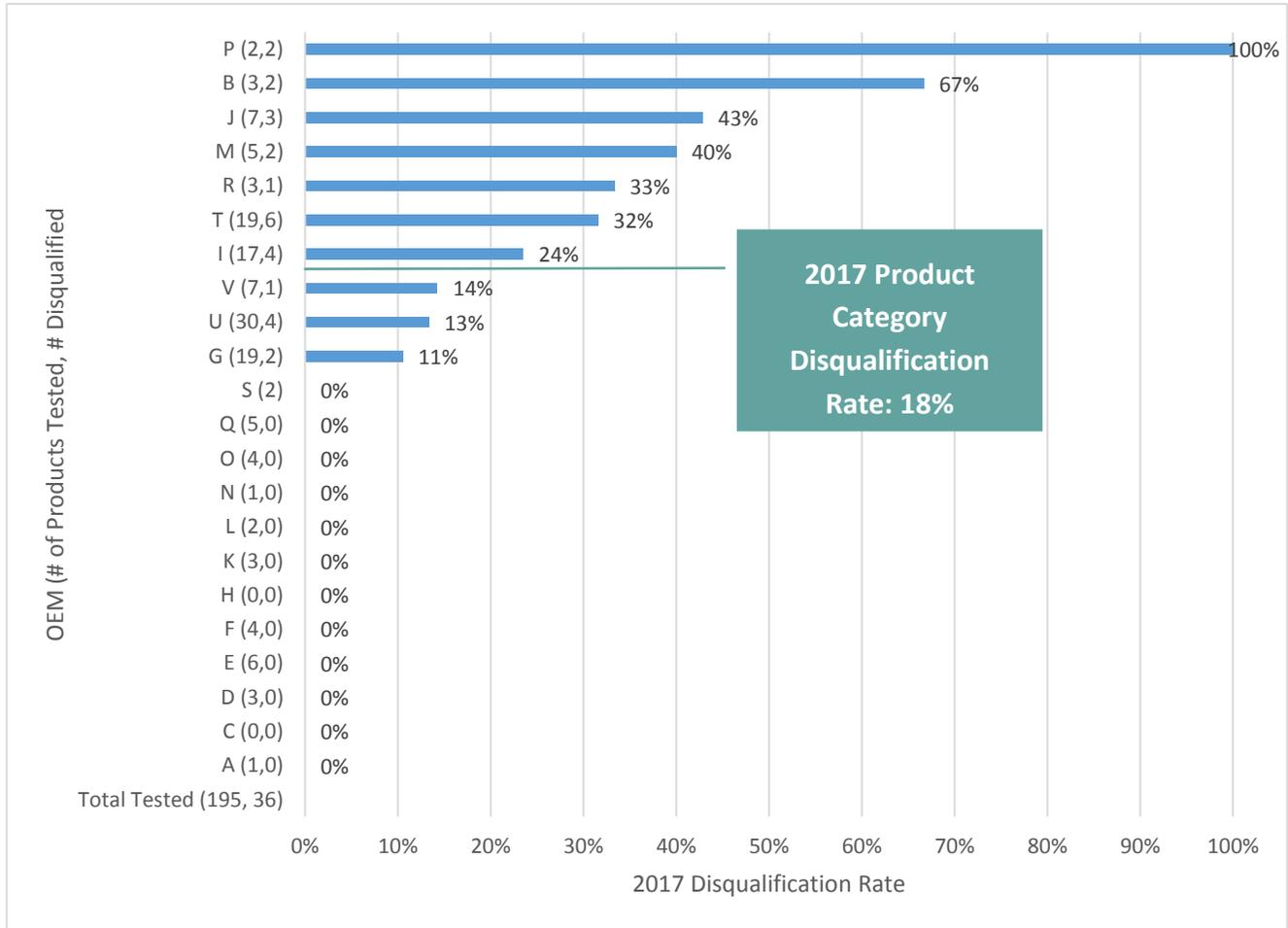
Figure 2: Products Tested by Year



Among the 20 OEMs with five or more products tested in 2017, annual disqualification rates varied widely, from 0% to 100% (see Figure 3). Out of those OEMs, ten had zero disqualifications. Including the 10 OEMs with zero disqualifications, 13 of the 20 OEMs had disqualification rates lower than the 2017 overall product disqualification rate of 18%.

² Overall annual product disqualification rates include all products tested, not solely those manufactured by OEMs with five or more tested products.

Figure 3: 2017 Disqualification Rates, by OEM (5 or more products tested)



In a cumulative assessment (2015 to 2017), the overall LED lamp disqualification rate is 18%. Individual OEM disqualification rates during that period range from 0% to 60% (see Figure 4). Of the 22 OEMs tested from 2015-2017, four had zero disqualifications. The four OEMs with perfect testing records had between five and 21 products tested. Of those OEMs most heavily tested, disqualifications ranged from 4% to 31%. The poorest performing OEM has a disqualification rate double the next poorest performer (see Figure 4, OEMs “S” and “T”). As more data becomes available regarding OEMs with five or more products tested, the full range of OEM performance will be clearer and it will provide more insight into the range of source quality.

Figure 5 displays a breakdown of individual 2016 OEM product performance. The overall product disqualification rate for 2016 was 17%, slightly lower than 2017. Note that 2017 testing included a significant increase in the number of LED lamps tested (195), compared to 2016 (153).

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

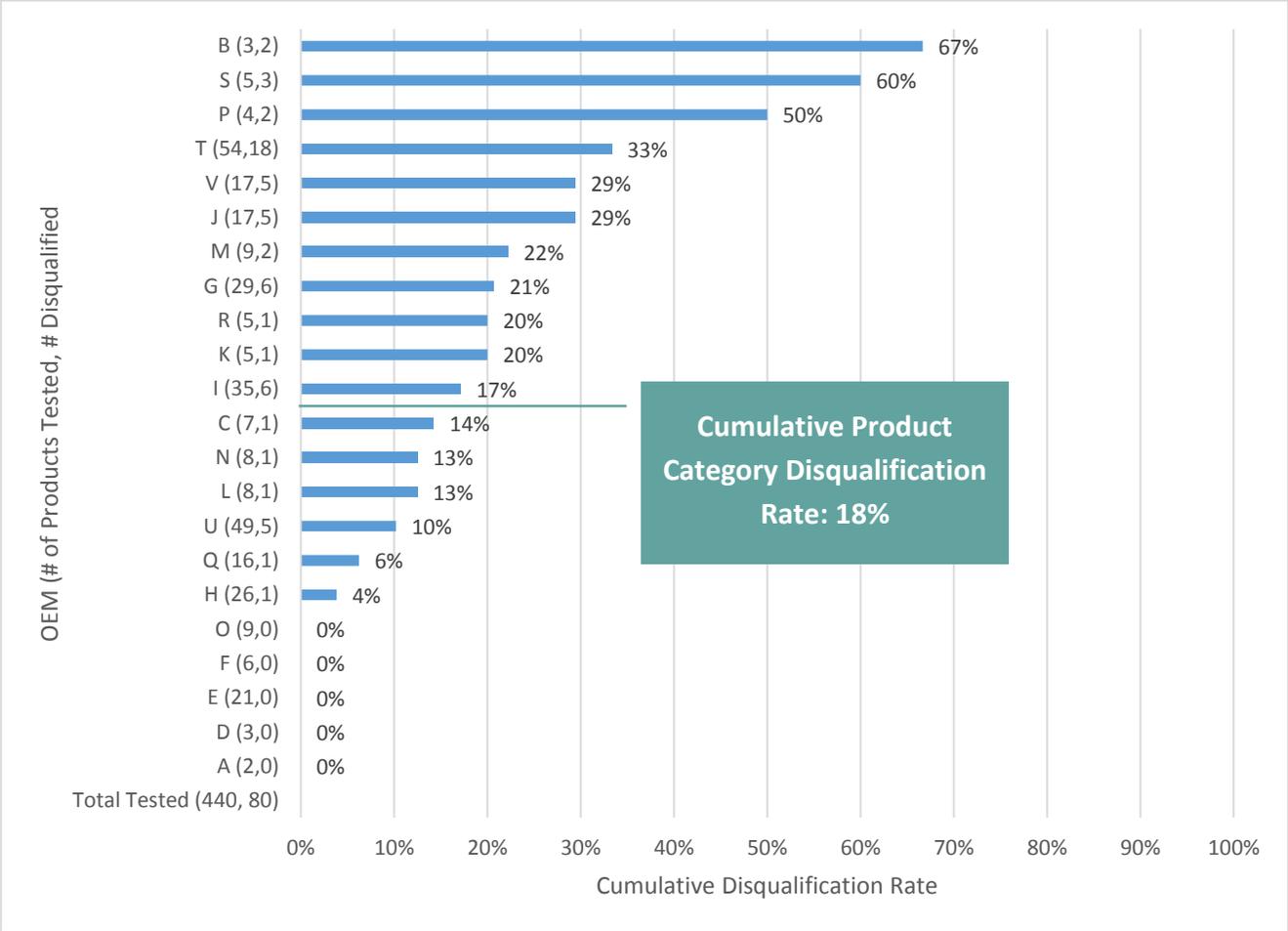
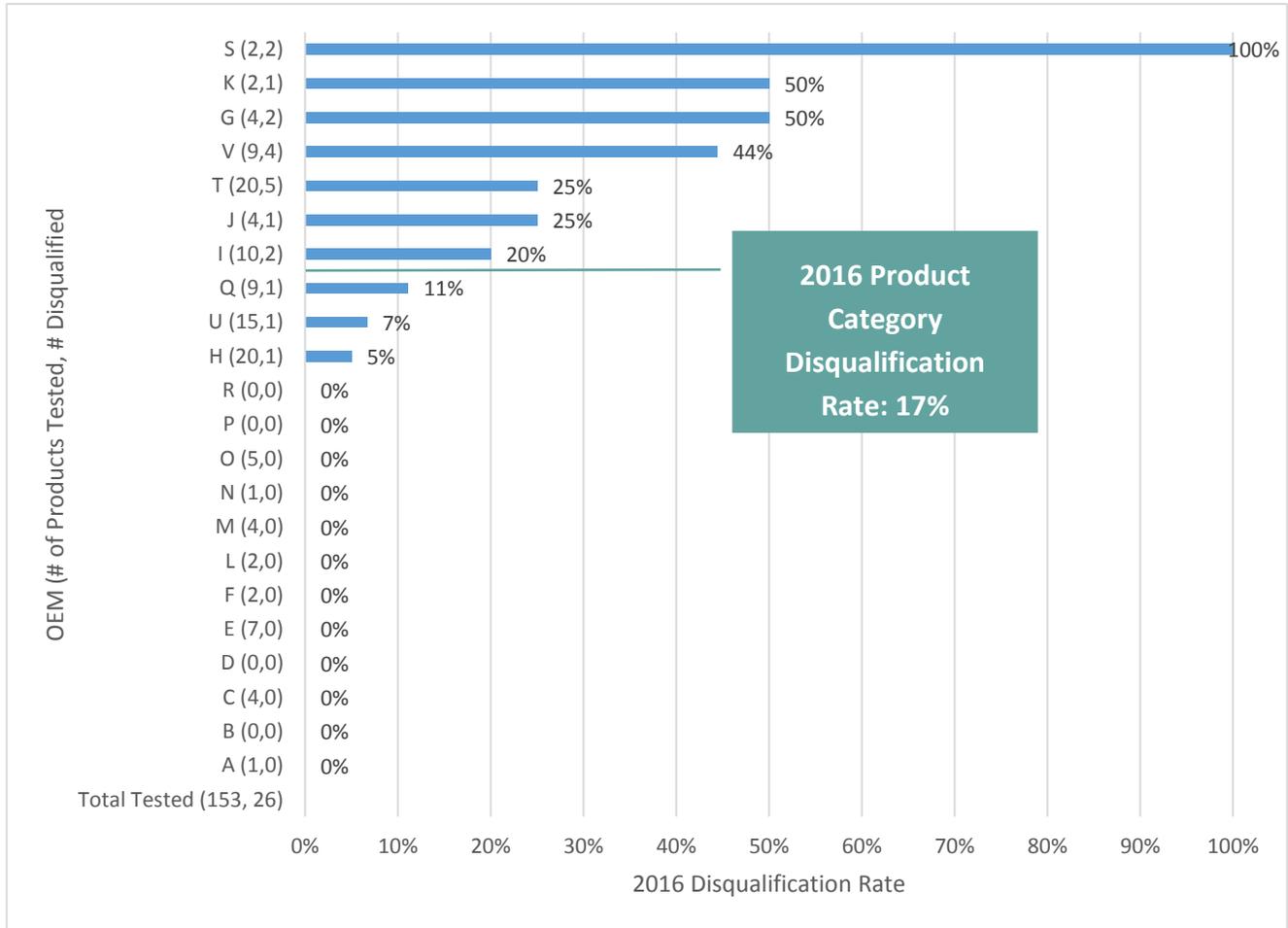


Figure 5: 2016 Disqualification Rates, by OEM (5 or more products tested)



OEM INFLUENCE IN THE MARKET

In the United States, LED lamps are sold under a variety of brand names. These branded products, or private labels, are manufactured by OEMs who 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 OEM sells a product to one labeler only. Most commonly, an OEM sells the same model to multiple private labelers and each private labeler sells the model under its own brand name. This underscores the importance and broad impact of an OEM product’s quality as it moves through the market.

The number of LED lamps OEMs entering the market has steadily increased since 2010, when the product was first introduced into the ENERGY STAR Program.

LED BULB FACTORIES

EPA continues to learn more about ENERGY STAR product sourcing and issues affecting product performance. In 2016 and 2017, ENERGY STAR visited CFL and LED factories in China. This provided the opportunity for

EPA to meet with OEMs that do not have an ENERGY STAR partnership (they do not own an ENERGY STAR brand and do not directly label product for distribution), but are significant sources of ENERGY STAR products. During those meetings, EPA provided technical guidance regarding ENERGY STAR specifications, and reviewed with OEMs their verification testing compliance rates in the context of competitor performance overall. EPA was able to educate OEMs regarding the reach of product disqualifications, and the implications for their buyers, as well as increased exposure to additional product testing.

Factory visits also allowed EPA to learn about common production practices and challenges, quality control within the factory (e.g., management of products manufactured for different brands), issues surrounding OEM and brand owner relationships, sales practices (including the assertion from one major source that lesser performing products are directed toward the European market), and in many instances how OEMs were positioning themselves for future roles in the market.

Tracking OEM performance has been complicated in the past by inconsistent uses of the term “OEM.” EPA uses this term to refer to a factory in which product was manufactured. Others may use this term to describe an entity that sells the product to a brand owner, but does not own the factory where the product is produced. This distinction is important in affecting the extent to which EPA can control a failed product in the marketplace. After examining how this distinction relates to historic data, EPA has begun efforts to underscore the importance of and better identify factory sources at the time of product certification.

HEIGHTENED OVERSIGHT

EXPERIENCE WITH 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, as well as associated direct and indirect market effects, and encouraged private labelers with failed CFLs to examine and correct the root causes of failure among their products. EPA conducted outreach to private labelers to further encourage increased quality control and subjected poor performing OEMs, and the private labelers associated with them, to heightened oversight for failed CFL lamps products, including increased verification testing. Models from sources with failure rates of 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. These testing focuses 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. Private labelers were required, as part of corrective measures, to establish and submit additional quality control assurances covering all models they carry from that source.

From 2013 to 2017, EPA issued 122 letters to approximately 30 unique CFL OEMs to notify them of their verification testing performance, including the overall CFL disqualification rate for those tested models. These letters served to ensure that every CFL OEM that supplies products associated with the ENERGY STAR label is aware of its overall performance against program requirements, and to provide a somewhat standardized basis of comparison for interested parties.

As a result of these heightened oversight efforts, the CFL program disqualification rate decreased starting in 2013, from 30%, to 19% in 2014 to 2016. Twenty-four private labelers were required to submit additional control measures due to the poor performance of their OEM. Additionally, four of the five worst performing

OEMs with CFLs tested during the CFL Testing Program did not certify any CFLs to the new Lamps Version 1.0 Specification, which went into effect in 2015.

APPLICATION TO LED BULB OEMS

Because of the success of the heightened oversight efforts with CFL OEMs and private labelers, in 2017, EPA began to implement a similar approach for LED lamps OEMs. Similar to CFL OEMs, LED lamps OEMs and the labelers associated with them are subject to heightened future oversight for failed LED lamps products, including increased verification testing under the provisions of the ENERGY STAR Partnership Commitments.

In 2016, EPA issued letters to 37 LED lamps OEMs to notify them of their verification testing performance, including the overall product disqualification rate. In 2017, EPA issued letters to 43 OEMs to notify them of their annual verification testing performance, including the overall product disqualification rate. OEMs with disqualification rates higher than the product average are subject heightened future oversight for failed products, including increased verification testing. EPA is optimistic that the improvements to CFL quality resulting from heightened oversight may be replicated for LED lamp production.