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Analysis of Lamp Availability and Sales in California

Final White Paper

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TABLE OF CONTENTS

TABLE OF FIGURES

1. INTRODUCTION AND METHODOLOGY

1.1 Introduction and Background

Pacific Gas and Electric Company (PG&E) requested that TRC Energy Services (TRC) develop a white paper regarding the availability of lamps in the winter 2015/16 California retail shelf survey (i.e. the 2015/16 shelf survey", conducted by DNV-GL). Specifically, PG&E requested that TRC analyze availability by lamp technology (i.e., the prevalence of incandescent, halogen, CFL, and LED lamps); and for LEDs – the availability of products that are ENERGY STAR labeled, that meet the California Energy Commission specification (commonly known as the "CEC-spec"), or both ("co-labeled[1]"). The purpose of this white paper was to compare the availability of high efficacy and low efficacy lamps; compare the availability of ENERGY STAR and CEC-spec LEDs; and explore how availability varies by market channel. In addition, TRC developed estimates of the percent of lamp sales by technology, and by LED specification. The sales estimates were provided because lamp availability is an indicator of (but not equal to) lamps purchased. As shown in the analysis, TRC found some alignment but also some key differences between lamp availability and lamp sales.

1.2 Methodology

1.2.1 Analysis of Availability in the California winter 2015/16 shelf survey

The DNV-GL California shelf surveys capture the number of lamps available for purchase on retailers' shelves over a given timeframe – typically over a two to three month period. DNV-GL periodically conducts these shelf surveys as part of impact evaluations of the Investor Owned Utilities' residential upstream lighting programs. The results reflect a "snapshot in time" of lamp availability.

For this analysis, TRC used the most recent shelf survey – the winter 2015/16 survey conducted from November 2015 to January 2016 – for the majority of our analysis. For the section, Shelf Survey Trends over Time, TRC used results from previous surveys as well as the winter 2015/16 survey. For all analysis, TRC used the shelf survey results weighted by DNV-GL to account for their sampling of store channels.

DNV-GL provides its shelf survey results and their methodology for conducting the shelf surveys here: https://webtools.dnvgl.com/projects62/crlss/Home.aspx.

1.2.2 TRC Lamp Sales Estimates Methodology

While this white paper is primarily intended to show lamp availability, TRC also provides sales estimates for select analysis. As noted above, the shelf surveys present a snapshot of availability at one point in time. Shelf surveys cannot capture sell through rates[2], which may vary by various market channel.

As an overview of our methodology to calculating lamp sales:

1. TRC assumed that consumers purchased lamps by channel according to the results of a consumer telephone survey (DNV-GL 2016), in which respondents were asked where they had most recently purchased lamps. TRC developed a sales multiplier for each channel by dividing the percent of lamps purchased in each channel (based on the DNV-GL consumer phone survey, 2016) by the percent of

[1] Although the CEC-specification does not carry a label, for brevity, this analysis refers to LEDs that are both ENERGY-STAR labeled and meet the CEC-spec as "co-labeled".

[2] The sell through rate refers to the amount of inventory a retailer receives from a manufacturer or supplier compared to the amount that is sold to the customer, over a given timeframe.

lamps found in that channel in the shelf survey (generally the winter 2015/16 shelf survey[1]). As examples, for the Discount channel, TRC developed the sales multiplier 2% / 6% = 0.3; and for the Membership Club, TRC developed the multiplier 12% / 3% = 4, as shown in Table 1. Note that these values are rounded so as not to imply greater precision than is appropriate. TRC used the full values for the calculations: 0.291 for Discount and 4.25 for Membership Club.

2. Within each channel, TRC assumed that consumers purchased lamp technologies according to lamp availability, as found in the shelf survey (typically the winter 2015/16 shelf survey). For example, (see Figure 13 in Appendix A for the source of these values):
   - Within the Discount channel, the shelf survey found the following lamps available: 748,156 incandescent, 69,086 halogen, 203,733 CFL, and 11,530 LED lamps. TRC multiplied each lamp technology by 0.291 to estimate the following sales in Discount stores: 217,592 incandescent, 20,093 halogen, 59,253 CFL, and 3,353 LED lamps.
   - Within the Membership Club channel, the following lamps were available: 1,421 incandescent, 812 halogen, 141,264 CFL, and 347,894 LED lamps. TRC multiplied each lamp technology by 4.25 to estimate the following sales in Membership Club stores: 6,033 incandescent, 3,446 halogen, 599,832 CFL, and 1,477,217 LED lamps.
3. TRC used the same approach for all channels and summed the results. The total number of lamps found in the shelf survey (17.7 million lamps for the winter 2015/16 survey) remained the same, but our analysis shifted the number of lamps among the channels. Because these channels had different percentages of lamps by technology, the analysis also shifted the number of lamps for each technology. Similarly, the fraction of LEDs that were CEC-spec or ENERGY STAR labeled shifted, because channels had different availability of LEDs by label.

Overall, compared to the lamp availability numbers, the sales multipliers increased the number of lamps in the membership club and home improvement channels; and decreased the number of lamps in the discount, drug store, grocery, and mass merchandise stores. (The number of lamps in hardware stores remained approximately the same.) As shown in Figure 13 in Appendix A, membership club and home improvement stores had higher availability of LEDs, while discount, grocery, and mass merchandise stores had higher availability of incandescent sales. Consequently, compared to availability, LED sales increased, while incandescent sales decreased. Halogen and CFL sales also decreased slightly compared to availability. ENERGY STAR and CEC-spec LED sales were higher than availability, because home improvement and membership clubs offer more of these LEDs.

The motivation for the multipliers is illustrated in Table 1, which compares the percent of lamps in the winter 2015/16 shelf survey by channel, with where consumers reported they recently purchased lamps in the phone survey (DNV-GL 2016).

[1] For the section, Shelf Survey Trends over Time, TRC used results for each shelf survey to develop a multiplier specific to that shelf survey, because the total number of lamps varied among shelf surveys.

Table 1. Lamps by Channel in Winter 2015/16 Shelf Survey Compared with Consumer Purchasing Preferences

	Disc.	Drug	Grocery	Hard-ware	Home Impr.	Mass Merch.	Memb. Club	Total
Lamps in shelf survey (%) (DNV-GL winter 2015/16 shelf survey)	6%	5%	21%	12%	18%	35%	3%	100%
Lamps purchased in channel (%) based on consumer phone survey (DNV-GL 2016)	2%	2%	2%	9%	57%	16%	12%	100%
Sales Multipliers (rounded)	0.3	0.4	0.1	0.8	3	0.5	4	N/A

Table 1 shows that the influence of each market channel varies when comparing lamp availability in the shelf survey (first row) with where lamps are purchased according to the consumer phone survey (second row). For example, if we treated the shelf survey results as a proxy for sales:

- Grocery stores would be over-represented since 21% of the lamps available on the shelves are in this channel, but the consumer survey indicates only 2% of lamps were purchased in this channel. Similarly, 35% of all lamps in the shelf survey were in the mass merchandise channel, but the consumer survey indicates that only 16% of purchases are in that channel.
- Conversely, the home improvement and membership club channels would be under-represented, since these channels have lower availability in the shelf survey (18% and 3%, respectively) compared with the consumer survey (57% and 12%, respectively).

Appendix A provides a full description of TRC's methodology for calculating lamp sales, results of the sales multiplier for each channel for all lamps in each shelf survey, and possible reasons for the discrepancy between lamp availability and lamp sales.

2. SUMMARY OF RESULTS

This analysis identified the following trends:

- **In terms of availability, shelf surveys show that incandescent lamps are declining but are still the most available technology, and LEDs are increasing but still the least available. But sales estimates indicate that LEDs had the highest sales in the most recent shelf survey, despite having the lowest availability.** Lamp availability results in shelf surveys conducted from the spring 2009 to winter 2015/16 indicate that incandescent lamps have declined, CFLs have declined but plateaued recently, halogens have increased but plateaued recently, and that LEDs continue to increase. The winter 2015/16 survey indicates that incandescent lamps are still the most available (34%), followed by CFLs (25%) and halogens (23%), and then LEDs (17%). However, sales estimates based on the winter 2015/16 survey found that LEDs had the highest sales (33%), followed by incandescent sales (27%), and then CFLs and halogens (20% each).
- **The four lamp technologies (incandescent, halogen, CFL, and LED) all comprise significant fractions of lamp availability and lamp sales.** In the most recent shelf survey (winter 2015/16), high efficacy lamps (CFLs and LEDs) were slightly less prevalent (42%) than low efficacy lamps (halogen and incandescent) in terms of availability, but high efficacy lamps comprised the slight majority (52%) of lamp sales. For high efficacy lamps, CFLs were more available (25%) than LEDs (17%), but LEDs had higher sales (33%) than CFLs (20%). For low efficacy lamps, incandescent lamps were both more available and had higher sales than halogens, although halogens are more predominant (for availability and sales) among A-lamps.
- **ENERGY STAR labeled LEDs and unlabeled LEDs have significant availability and sales, but CEC-spec LEDs are generally unavailable and have low sales.** Based on the winter 2015/16 shelf survey, ENERGY STAR LEDs have a significant presence among available lamps (8%) and sales (16%). Most market channels do not carry a significant number of CEC-spec LEDs: they comprise only 2% of all lamps available, and 5% of lamp sales estimates (primarily in membership clubs). CEC-spec LEDs increased only slightly from the winter 2014/15 shelf survey to the winter 2015/16 shelf survey, whereas ENERGY STAR LEDs increased significantly during the same timeframe. Almost all (99%) of CEC-spec LEDs are ENERGY STAR labeled. "Unlabeled LEDs" (i.e., neither ENERGY STAR labeled nor CEC-spec) are also significant, comprising 10% of available lamps and 16% of sales in the winter 2015/16 shelf survey.
- **The market channels vary widely in terms of lamp availability by technology and (for LEDs) by label, with membership clubs representing an outlier.** As an outlier, membership clubs offer almost exclusively high efficacy lamps, and the majority of these are LEDs that are ENERGY STAR labeled, or are co-labeled (ENERGY STAR and CEC-spec). The other market channels are fairly similar to the "Overall Availability" results (aggregated across all channels). In the winter 2015/16 shelf survey, home improvement stores – the most important channel for consumer purchases[1] – offer more high efficacy lamps (51%), have a higher availability of LEDs than CFLs, and have a strong availability of ENERGY STAR LEDs (16%) compared with Overall Availability. The mass merchandise, hardware, grocery, and drug store channels offer more CFLs than LEDs, and have fairly low availability of ENERGY STAR LEDs (≤8%).

Overall, the results indicate that the residential lamp market has made progress in moving towards high efficacy lamps, but that there are still huge opportunities for increasing availability and sales of high efficacy lamps, particularly high quality (i.e., ENERGY STAR labeled or CEC-spec) LED products.

[1] Based on a telephone survey of consumers (DNV-GL 2016) asking respondents where they most recently purchased lamps, over half (57%) of consumers reported they purchased lamps in home improvement stores (after normalizing survey results to 100%). For the raw survey results, see Figure 11 in Appendix A.

3. SHELF SURVEY TRENDS OVER TIME

This section provides a comparison of lamp availability for shelf survey results over time. The remainder of this white paper focuses on the most recent shelf survey: winter 2015/16.

3.1 Lamp Technology Trends

As shown in Figure 1, in terms of lamp availability:

- Incandescent lamps were almost half of lamps available from 2009 until 2013, but have decreased since. However, the winter 2015/16 shelf survey indicates that incandescent lamps still comprise approximately one-third (34%) of available lamps.
- Halogen lamp availability generally increased until the winter 2014/15 shelf survey, but has since plateaued at approximately one-quarter (23%) of available lamps.
- CFL availability has decreased, from almost one half of lamps (45-46%) in 2009-2012 to approximately one-quarter of lamps in the winter 2014/15 (24%) and winter 2015/16 (25%) surveys. Similar to the halogen lamp *increase*, the CFL *decrease* has also plateaued in the two most recent shelf surveys.
- LED availability has generally increased, from 2-4% from 2009 to 2013 to 17% in the winter 2015/16 survey.

Figure 1. Lamp Availability by Technology over Time

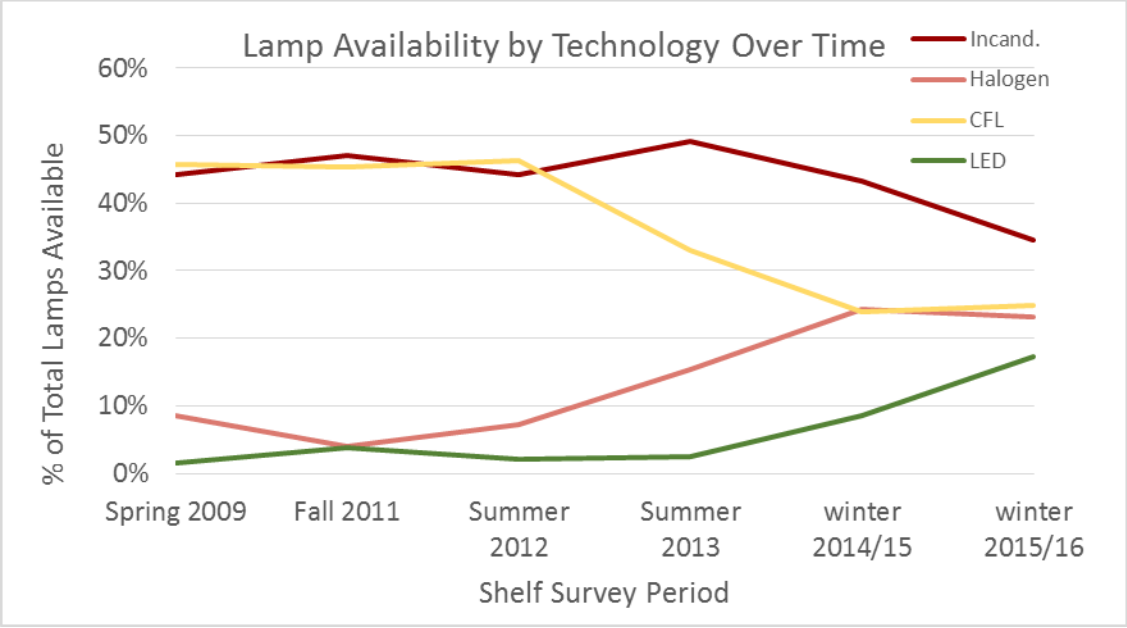
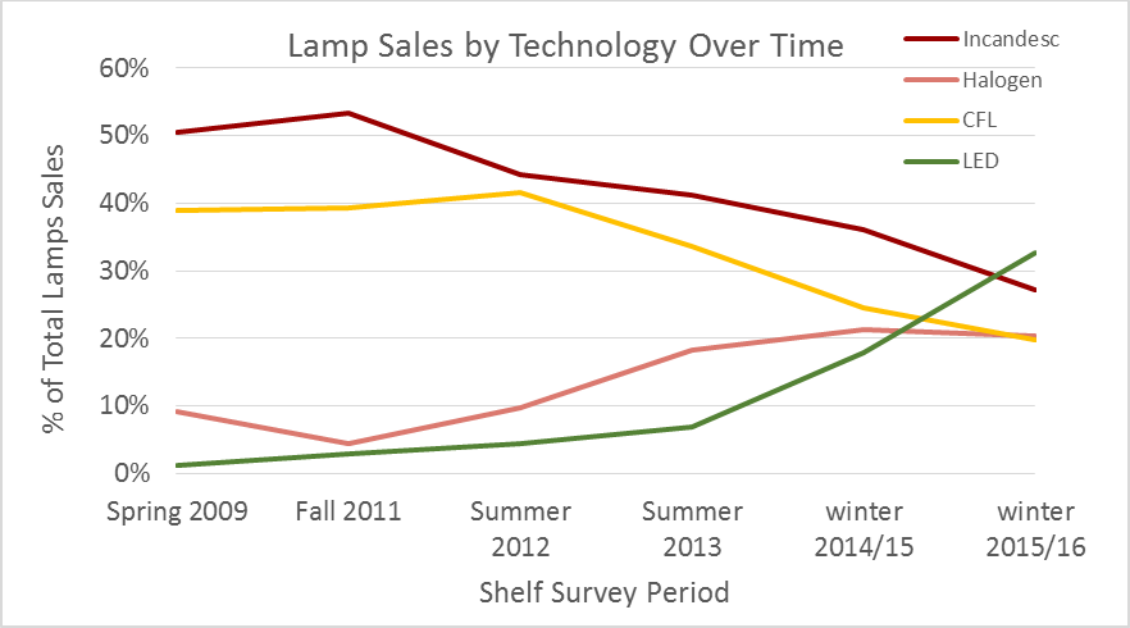


Figure 2 presents similar information, but for lamp sales estimates. As shown in Figure 2,

- **The overall trends within each technology are similar for lamp sales and availability**. Incandescent lamp sales have declined, although the sales decline (Figure 2) started earlier and has been more dramatic than the availability trend (Figure 1). Halogen sales have increased but generally plateaued. CFL sales have declined, and the sales estimate shows a continuing slight decline. LED sales have increased, although the increase has been more dramatic for sales (Figure 2) than availability (Figure 1).

- **The relative changes among technologies are more pronounced among the technologies, particularly for LEDs.** LEDs were the most prevalent lamp sold, comprising 33% of all lamp sales (Figure 2), while LEDs were the least prevalent lamp available, comprising 17% of lamps available (Figure 1).

Figure 2. Lamp Sales by Technology over Time



3.2 ENERGY STAR and CEC-Spec LED Trends

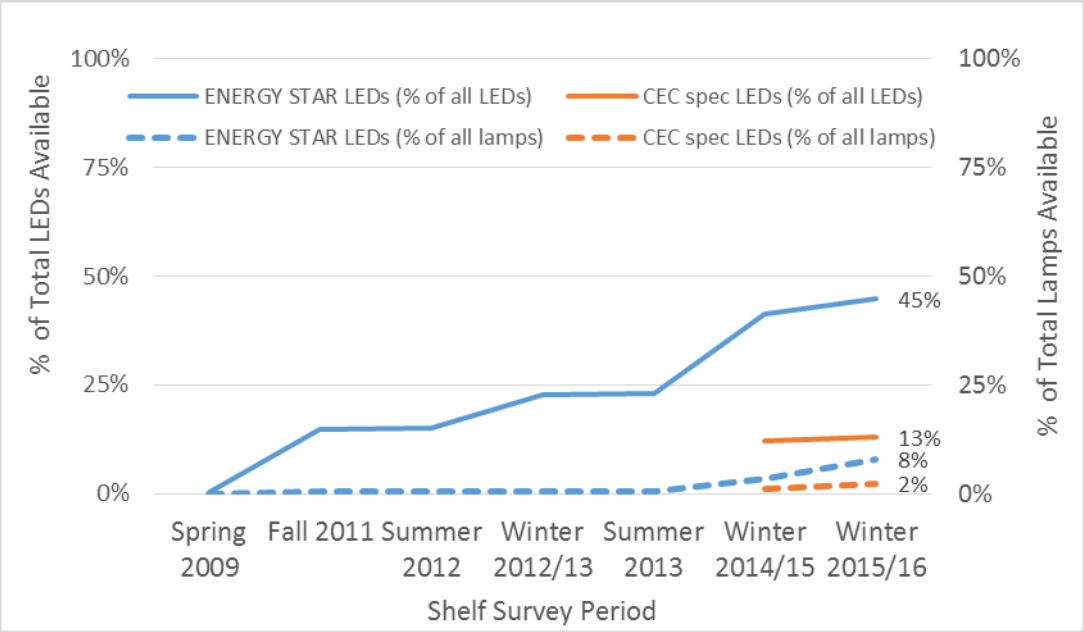
Figure 3 presents the availability of ENERGY STAR LEDs and CEC-spec LEDs over time. Note that DNV-GL only started tracking CEC-spec LEDs in the winter 2014/15 survey[1].

As shown:

- ENERGY STAR LED availability has climbed to almost half (45%) of all LEDs, and represents a significant fraction of total lamps (8%). For the two most recent surveys (from the winter 2014/15 to the winter 2015/16), the trajectory for ENERGY STAR LEDs is generally upwards.
- CEC-spec LEDs represent only 13% of all LEDs and 2% of all lamps. There was also little increase in CEC-spec LEDs from the winter 2014/15 survey (12% of all lamps) to the winter 2015/16 survey (13%).

[1] DNV-GL may not have tracked CEC-spec availability in previous shelf surveys because the CEC-spec was finalized in December 2012, and there may have been a lag time for manufacturers to develop products to meet this specification and then for these products to appear on shelves. http://www.energy.ca.gov/appliances/led_lamp_spec/documents/

Figure 3. ENERGY STAR and CEC-Spec LED Availability over Time



Section 4 presents sales estimates for ENERGY STAR and CEC-spec LEDs.

4. Results by Market Channel and Lamp Type

The following sections present results by market channel and for each major style of lamps: A-lamps, reflectors, and globe lamps. In reviewing the results, note that:

Legislation has phased out incandescent lamps in several lamp categories: The Energy Independence and Security Act (EISA) phased out traditional incandescent A-lamps in common lumen bins, with an effective start date of 2011-2013 in California under Assembly Bill 1109 (AB 1109). Specifically, EISA placed requirements on medium screw-based lamps between 310 and 2600 lumens (approximately 40-100W incandescent equivalent lamps). Lamps < 310 lumens and > 2600 lumens are not under the purview of these laws[6]. In addition, the federal Incandescent Reflector Lamp (IRL) regulation placed restrictions on reflector (e.g., R and PAR) lamps beginning in 2012.

Market channels vary in their significance for lamp availability and lamps sales.

As an overview, in terms of lamp availability in the winter 2015/16 shelf survey, for all lamp types:

1. The greatest number of lamps was found in the mass merchandise channel (35%),
2. Grocery (21%), home improvement stores (18%), and hardware (12%) stores were secondary in terms of the number of lamps available,
3. The fewest lamps were found in the discount (6%), drug (5%), and membership club (3%) channels.

The telephone survey of customers (DNV-GL 2016) found that lamp purchases were distributed as follows:

1. The home improvement channel was the most important,
2. Mass merchandise, membership clubs, and hardware stores were of secondary importance,
3. Grocery, discount, and drug stores were the least important.

The full results of the telephone survey are provided in Appendix A, in Figure 11.

As illustrated in this white paper, the percent of lamps available by market channel differ from the consumer purchasing preferences.

A-lamps are the most prevalent lamp type in California homes, followed by reflectors, and then globes. Table 2 shows the fraction of lamps that this style represented of total lamps found in California homes, based on the California Lighting and Appliance Saturation Study (CLASS 2012[7]).

Table 2. Percent of Lamp Styles in California Homes

Lamp Style	Lamps in average California home in 2012 (%)
A-lamps (including spiral CFLs)	48%
Reflector	14%
Globe	8%
Other (e.g., linear tube, decorative)	30%

[6] Non-medium screw based lamps, such as candelabra based lamps, are also not under the purview of EISA or AB 1109. However, due to scope limitations, TRC did not separately analyze candelabra-based lamps.

[7] As found in the CLASS survey and published in the DNV-GL Residential Lighting Market Status Report (DNV-GL 2014), Table 28.

4.1 Results by Market Channel

This section presents lamp availability by market channel by technology and (for LEDs) by label.

Figure 4 shows lamp availability for all lamp types identified in the 2015/16 shelf survey by technology and LED label. Lamp availability for each market channel is then presented from left to right, based on residential customers' responses to survey questions regarding the channels where they recently purchased lamps (DNV-GL 2016). TRC then calculated:

- "Overall Availability", by aggregating availability results across all market channels.
- "Overall Sales", by estimating sales in each market channel and aggregating results across all channels.

The percent of lamps that are high efficacy (CFL and LED) is shown in a green text box. Because almost all (99%) of LEDs that met the CEC-spec LED were also ENERGY STAR labeled, the ENERGY STAR fraction is comprised of both the dark green bar (ENERGY STAR labeled only) and the hashed bar (CEC-spec and ENERGY STAR), as designated by brackets.

As shown in Figure 4, In terms of availability by technology:

- The Overall Availability results indicate that a minority of lamps (42%) are high efficacy, with CFLs comprising 25% of total lamps and LEDs comprising 17%. Despite EISA and IRL, incandescent lamps are the most prevalent of all lamp technologies (34%). CFLs and halogens are the second most prevalent technology (25% and 23% respectively), and LEDs are the least at 17% of all lamps.
- The home improvement channel – the most important channel for consumer purchasing – has a higher fraction of high efficacy lamps (51%) than the Overall Availability result (42%). Of the four lamp technologies, LEDs are the most available in home improvement stores (36%), followed by incandescent (27%) and halogen (22%). CFLs are significant, but the least prevalent lamp technology (15%).
- For the channels with moderate significance for consumer purchasing (mass merchandise, membership club, and hardware):
  - The mass merchandise and the hardware channels results are similar to the Overall Availability result (42% high efficacy), although both channels have slightly less high efficacy lamps (38%).
  - The membership club channel stands out as an outlier, because almost all (99%) of lamps available in this channel are high efficacy, with the majority comprised of LEDs (71%).
- For the less significant channels (grocery, drug, and discount):
  - The availability of high efficacy lamps for grocery (44%) and drug stores (41%) are similar to the Overall Availability result (42%). Discount stores have significantly fewer high efficacy lamps (21%) and almost no LEDs (1%); the majority of lamps available in discount stores are incandescent (72%).
  - Grocery, drug, and discount stores all have high availability of CFLs (36%, 37%, and 20% respectively), but low availability of LEDs (5%, 4%, and 1% respectively).

In terms of availability of LEDs that are ENERGY STAR labeled or that meet the CEC-spec:

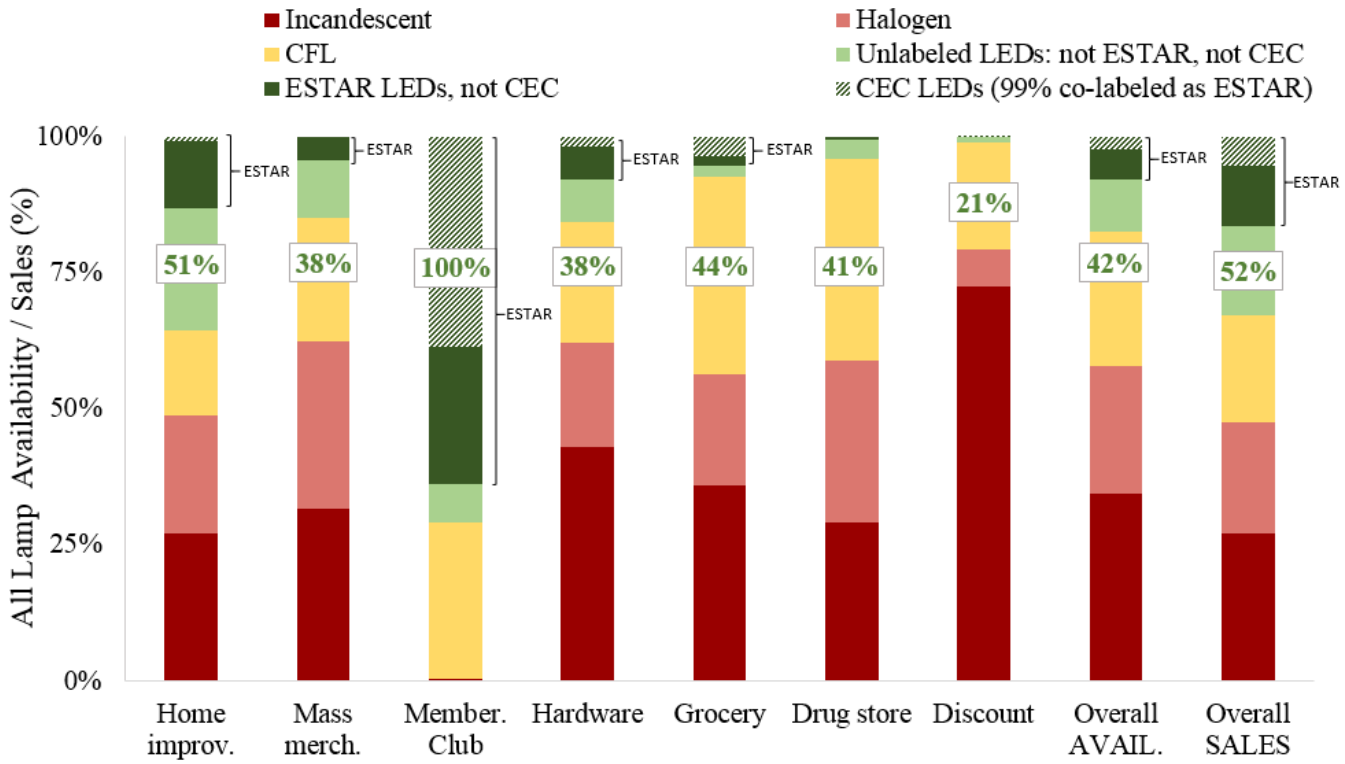
- The majority of LEDs available are unlabeled (10% of total lamps), followed closely by ENERGY STAR LEDs (8% of total lamps available). CEC-spec LEDs comprise only 2% of available lamps.
- In the home improvement channel, unlabeled LEDs comprise almost one-quarter (23%) of all lamps, although ENERGY STAR LEDs comprise a significant fraction (13%). Only 1% of lamps are CEC-spec LEDs.
- For the channels with moderate significance for consumer purchasing:

- Mass merchandise stores offer primarily unlabeled LEDs (10%), a small amount of ENERGY STAR LEDs (4%), and no CEC-spec LEDs.
- The membership club channel again stands out as an outlier. The majority of lamps in this channel are either co-labeled as CEC-spec and ENERGY STAR (39%), or are ENERGY STAR labeled (25%), meaning that almost two-thirds (64%) of lamps in this channel are ENERGY STAR LEDs. The vast majority of all CEC-spec lamps found in the shelf survey are in the membership club channel.
- LED availability in hardware stores is similar to the Overall Availability result: unlabeled LEDs and ENERGY STAR LEDs each comprise 8% of lamps, and CEC-spec LED availability is low (2%).

Based on the sales estimates:

- Overall Sales have a higher fraction of high efficacy lamps (52%) than Overall Availability (42%). This is because the sales multipliers generally increased sales in channels with high availability of efficient lamps – the membership club and home improvement channels; and decreased sales in channels with low availability of efficient lamps – discount, drug store, grocery, and mass merchandise stores.
- Overall Sales estimates for ENERGY STAR and CEC-spec LEDs are higher compared with Overall Availability: 5% for CEC-spec LED sales, and 16% for ENERGY STAR LED sales, compared with 2% availability of CEC-spec LEDs and 8% availability of ENERGY STAR LEDs. This is because multipliers increased sales in membership clubs, which primarily provide CEC-spec and ENERGY STAR LEDs; and increased sales in home improvement stores, which primarily offer ENERGY STAR LEDs. However, sales estimates of CEC-spec LEDs are still a relatively small fraction of the market.

Figure 4. Availability by Market Channel, and Overall Sales Estimates



4.2 A-lamps Results

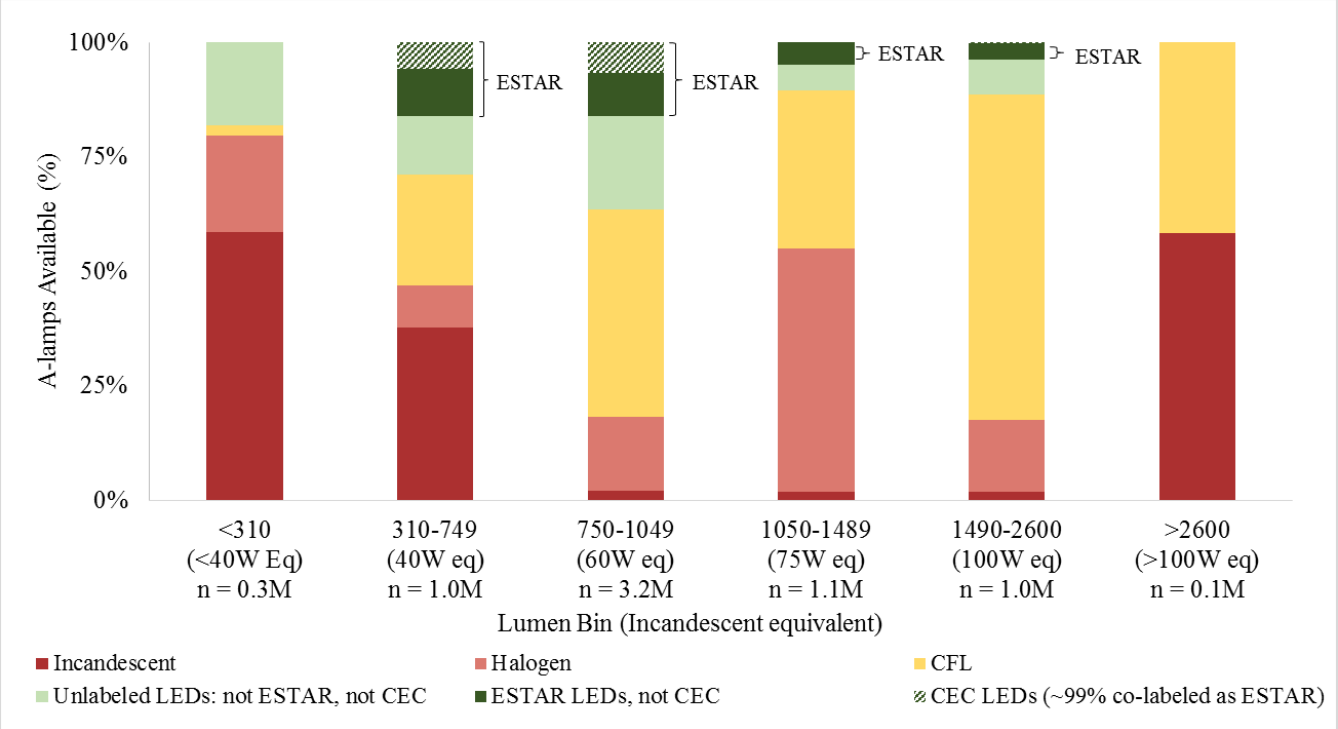
This section provides results for A-lamps. As shown in Table 2, A-lamps are the most prevalent lamp type in California homes. In reviewing the results, note that:

- 60W equivalent lamps comprised 44% of A-lamps in the 2015/16 shelf survey, indicating that this is the most significant lamp class;
- The 40W, 75W, and 100W equivalent classes comprised 16%, 17%, and 13% of A-lamps in the shelf survey respectively, indicating these are of secondary significance; and
- The <40W and >100W equivalent classes comprised only 5% and 2% of A-lamps respectively, indicating these are the least significant lamp classes.

As shown in Figure 5:

- Except for lamps in the lowest lumen bin (< 40W equivalent), CFLs have a strong presence in all A-lamp classes, and have a higher availability than LEDs.
- Halogens are the majority of lamps available in the 75W equivalent lamp class, and comprise a significant portion of lamps in the <40W, 60W, and 100W equivalent lamp classes.
- LEDs have a significant presence for A-lamps, particularly for the lower lumen range lamps (from <40W through 60W equivalent).
- Incandescent lamps comprise the majority of lamps in the lowest lumen bin (<40W equivalent), probably because this lamp class it not regulated by EISA.
- The most prevalent LEDs are unlabeled (13% for 40W and 20% for 60W equivalent), although ENERGY STAR LEDs comprise a significant portion for 40W equivalent (9%) and for 60W equivalent (10%). CEC-spec LEDs have low availability in the 40W and 60W equivalent classes (6% and 7% respectively), and no availability in the other lamp classes. As described below, the CEC-spec LED availability is primarily in the membership club channel.

Figure 5. A-lamp Availability by Technology, and (for LEDs) by Label



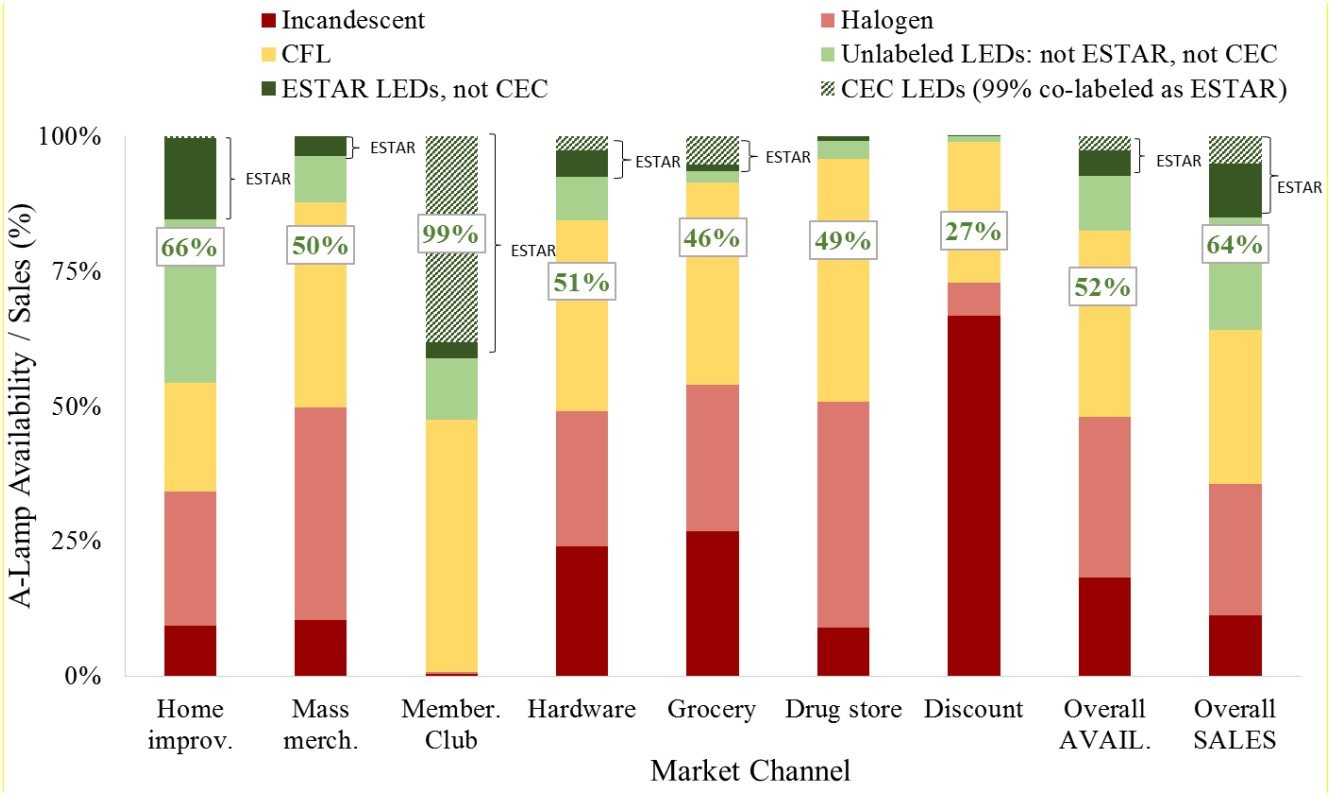
TRC did not develop sales estimates at the lumen bin level, because many channels had no (or very few) lamps available in some bins. However, TRC aggregated results across all lumen bins for A-lamps to show Overall

Availability, and applied sales multipliers to the aggregated A-lamp results to estimate Overall Sales. Figure 6 shows result of the A-lamp availability by market channel, Overall Availability, and Overall Sales.

As shown in Figure 6:

- Overall Sales have a higher fraction of high efficacy A-lamps (64%) compared with Overall Availability (52%). In addition, LEDs comprise a higher portion (36%) than CFLs (28%) for lamp sales, because of the increased weighting of the home improvement and membership club channels by the sales multipliers. Halogens have greater sales and availability compared with incandescent lamps, because of the high significance of the 60W and 75W equivalent lamp classes.
- The majority of LEDs sold are unlabeled (21%), although ENERGY STAR lamps comprise a significant portion (10%). CEC-spec LEDs comprise 5% of A-lamp sales, primarily because of sales in the membership club channel.
- The membership club channel is an outlier, because almost all A-lamps (>99%) are high efficacy, and because a significant fraction (38%) are CEC-spec LEDs.

Figure 6. A-lamp Availability by Market Channel, and Overall Sales



For the availability of CEC-spec and ENERGY STAR A-lamp LEDs by lumen bin for each market channel, please see Table 3 in Appendix B.

4.3 Reflector Lamp Results

Figure 7 presents availability of reflectors by technology, and by LED label. As with the previous figures, because almost all (~100%) of CEC-spec LEDs are also ENERGY STAR labeled, ENERGY STAR LEDs are represented by the dark green and hashed bars, as designated by the brackets.

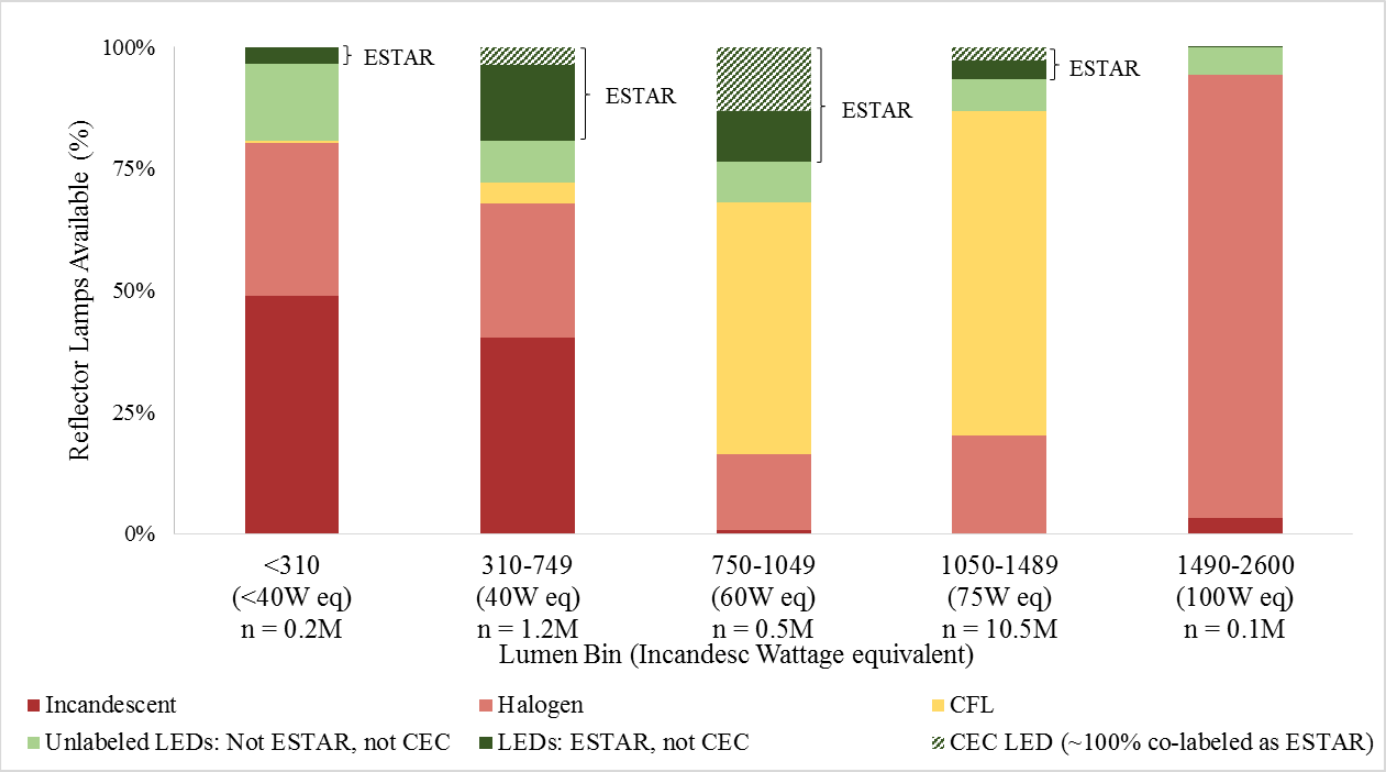
In reviewing the results, note that:

- 40W equivalent lamps comprised 49% of reflectors in the 2015/16 shelf survey, indicating that this is the most significant lamp class for reflectors;
- The 60W and 75W equivalent classes comprised 21% and 20% of reflectors in the shelf survey respectively, indicating these are of secondary significance;
- The <40W and 100W equivalent classes comprised only 7% and 5% of reflectors respectively, indicating these are the least significant lamp classes. There were almost no reflectors > 100W equivalent.

As shown in Figure 7:

- High efficacy lamps (CFLs or LEDs) comprised only 32% of lamps available for the most significant reflector class (40W equivalent). The majority of the high efficacy lamps available in this lumen bin were ENERGY STAR LEDs.
- CFLs comprised the majority of lamps in the lamp classes of secondary significance (60W and 75W equivalent).
- Incandescent lamps comprised approximately half of lamps in the lowest lumen bin (<40W equivalent lamps), probably because this lamp class is not regulated by EISA or the IRL.
- It appears from Figure 4 that CEC-spec LEDs had significant availability – particularly in the 60W equivalent lamp class. However, as shown in Figure 8, the vast majority of CEC-spec LED reflectors were available only in the membership club channel. ENERGY STAR LEDs are much more available than CEC-spec LEDs, and are more prevalent than unlabeled LEDs.

Figure 7. Reflector Lamp Availability by Technology and (for LEDs) by Label

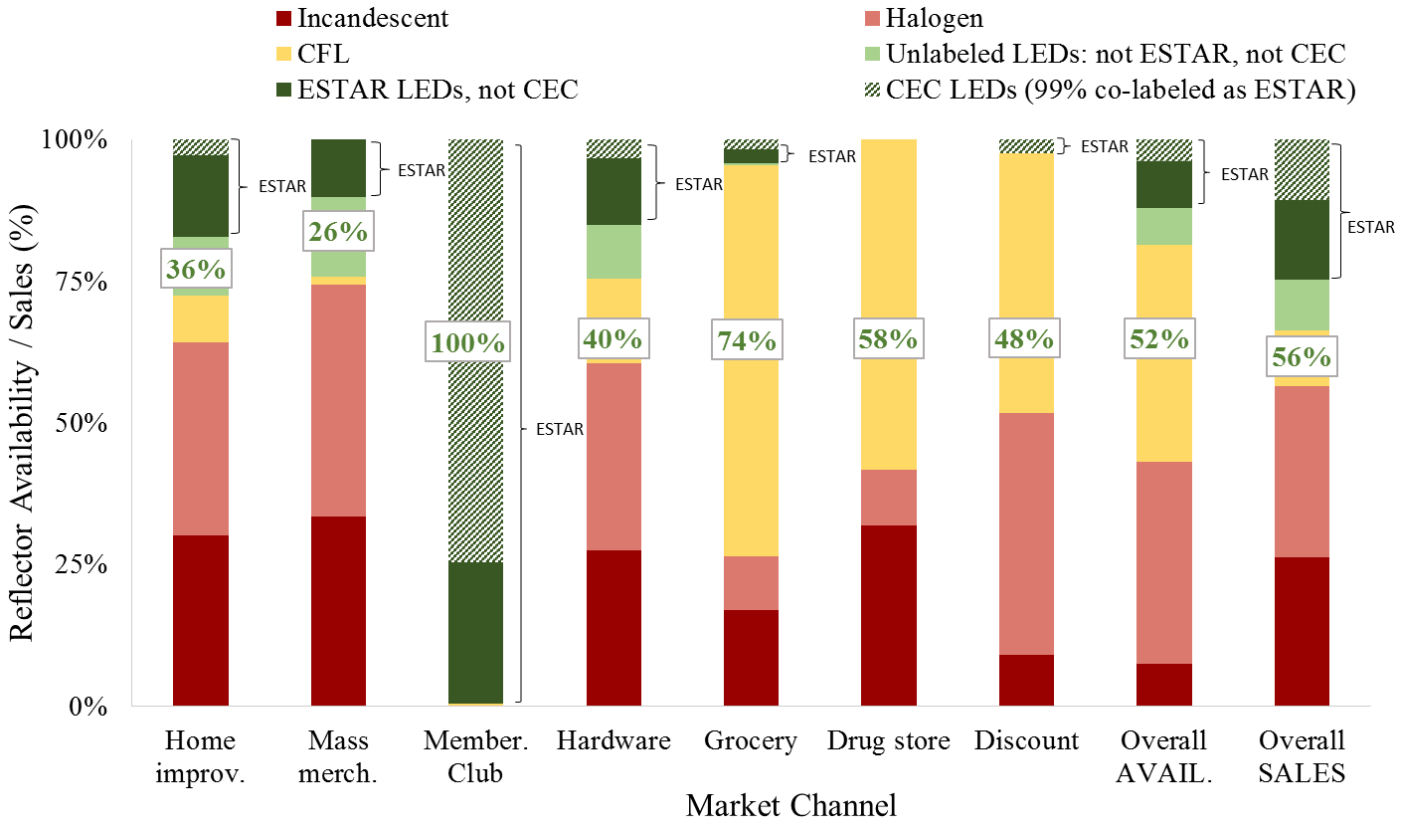


Similar to the A-lamp analysis, TRC aggregated results across all lumen bins for reflectors to show Overall Availability, and applied sales multipliers to estimate Overall Sales. Figure 8 shows results of the reflector availability by market channel, Overall Availability, and Overall Sales.

As shown in Figure 8:

- Overall Sales have a slightly higher fraction of high efficacy lamps (56%) compared with Overall Availability (52%). The more significant difference between sales and availability of reflectors is that LEDs comprise 34% of sales but only 22% of lamps available, while CFLs comprise 10% of sales but 46% of lamps available. This is because of the increased weighting of the home improvement and membership club channels (which have greater availability of LEDs), and decreased weighting of grocery, drug, and discount stores (which have greater availability of CFLs), by the sales multipliers.
- The majority of reflector LEDs sold are ENERGY STAR (25% of all reflectors). CEC-spec LEDs comprise 11% of all reflectors sold, and Unlabeled LEDs comprise 9%.
- The membership club stands out as an outlier, since 100% of reflector lamps available are LEDs, all are at least ENERGY STAR labeled, and the majority (74%) are both CEC-spec and ENERGY STAR labeled.

Figure 8. Reflector Availability by Market Channel, and Overall Sales



For details on the availability of CEC-spec and ENERGY STAR reflector LEDs by market channel by lumen bin, please see Table 4 in Appendix B.

4.4 Globe Lamp Results

Figure 9 presents availability of globe lamps by technology, and by LED label. In reviewing the results, note that:

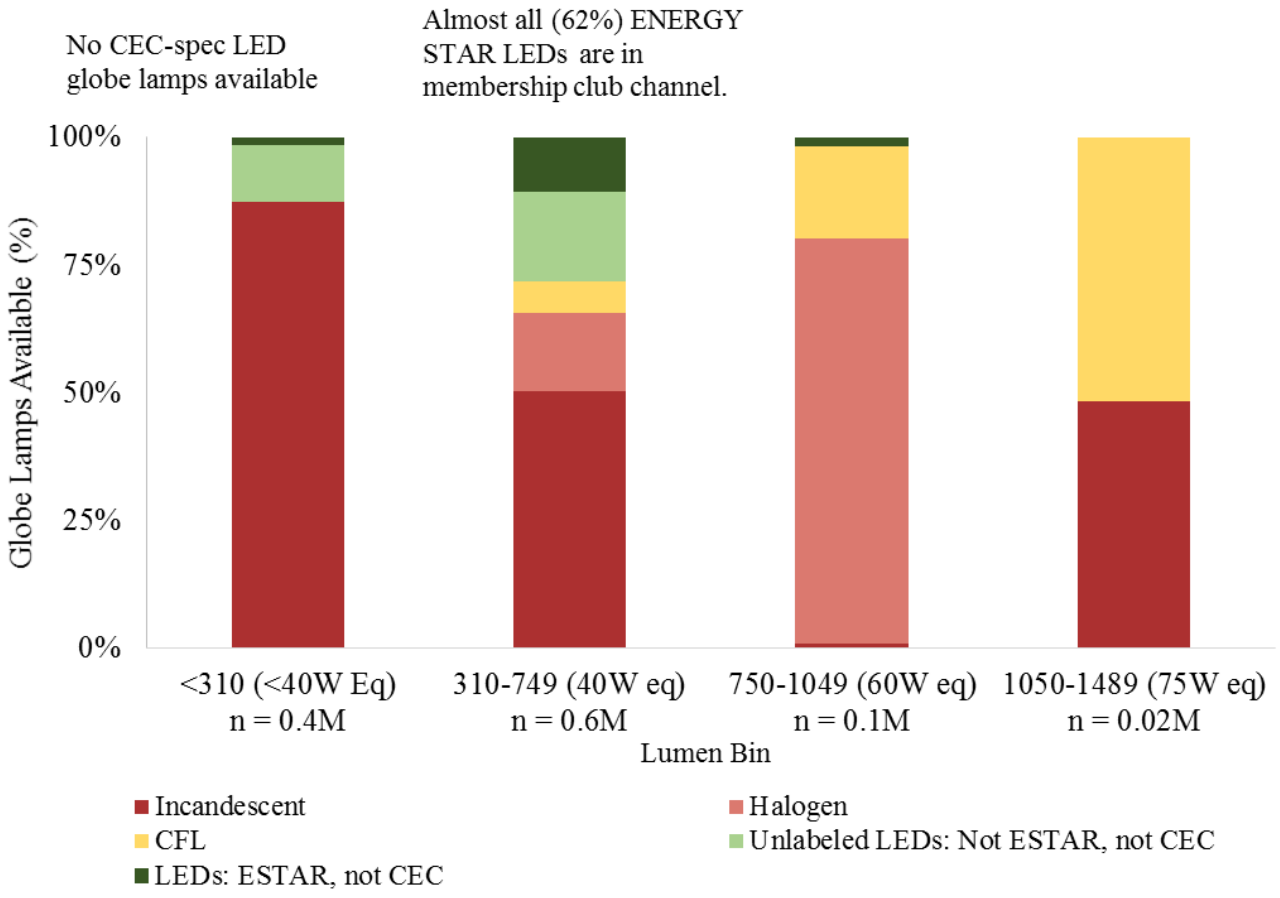
- 40W equivalent lamps comprised 55% of globes in the 2015/16 shelf survey, indicating that this is the most significant lamp class for globes;
- <40W equivalent lamps comprised 37% of globes, indicating this class is of secondary significance; and
- 60W and 75W equivalent lamps comprised 6% and 2% of globes respectively, indicating these are the least significant. There were almost no globe lamps > 100W equivalent, so this analysis excluded that lamp class.

The results indicate that:

- Most available globe lamps are low efficacy. For the two most significant class of globes (40W and <40W equivalent), the majority of lamps available are incandescent.
- LEDs are more prevalent than CFLs, and ENERGY STAR LEDs comprise a significant fraction of 40W equivalent lamps available (11%). However, the majority of ENERGY STAR LEDs (62%) are provided in the membership club channel. ENERGY STAR LEDs were generally unavailable in most channels. There were no CEC-spec globe LEDs in any channel.

The high availability of incandescent lamps in some lumen bins may be because some globe lamps are exempt from EISA. For example, lamps with a diameter greater than 5" are exempt, and some of the 75W equivalent globe lamps may meet this exemption.

Figure 9. Globe Lamp Availability by Technology and (for LEDs) by Label



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https://pda.energydataweb.com/api/downloads/1682/LTG4%20CA%20Res%20Ltg%20Mkt%20Status%20Report%20-%20Final.pdf

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6. APPENDIX A. LAMP SALES METHODOLOGY

6.1 Purpose of Multipliers

TRC developed the sales multipliers because the shelf surveys indicate lamp availability on retailers' shelves, not sales. Lamps may be sold in greater volume through some channels (e.g. big box retail) than through other channels (e.g. grocery stores) due to different lamp sell through rates[8]. TRC accounted for this discrepancy by developing the sales multipliers, which amplify the sales impact of the respective channel to more accurately reflect the channel sales volume.

The motivation for the multipliers is illustrated in Figure 10, which compares the percent of all lamps in the winter 2015/16 shelf survey by channel (weighted by DNV-GL to account for their sampling of store channels), with where consumers reported they recently purchased lamps in a phone survey (DNV-GL 2016).

Figure 10. Lamps by Channel in Winter 2015/16 Shelf Survey Compared with Consumer Purchasing Preferences

	Disc.	Drug	Grocery	Hard-ware	Home Impr.	Mass Merch.	Memb. Club	Total
Lamps in shelf survey	1,032,504	957,556	3,648,138	2,159,511	3,226,312	6,209,000	491,391	17,724,412
Lamps in shelf survey (%)	6%	5%	21%	12%	18%	35%	3%	100%
Lamps purchased in channel (%) based on consumer phone survey	2%	2%	2%	9%	57%	16%	12%	100%

Figure 10 shows that the influence of each market channel varies when comparing lamp availability in the shelf survey (second row) with where lamps are purchased according to the consumer phone survey (third row). For example, if we treated the shelf survey results as a proxy for sales, grocery stores are over-represented since 21% of the lamps available on the shelves are in this channel, but the consumer surveys indicate only 2% of lamps were purchased in this channel. Similarly, 35% of all lamps in the shelf survey were in the mass merchandise channel, but the consumer survey indicates that only 16% of purchases are in that channel. Conversely, the home improvement and membership club channels would be under-represented if we treated shelf survey data as sales, since these channels have lower availability in the shelf survey (18% and 3% for home improvement and membership club, respectively) compared with the consumer survey (57% and 12%).

It was beyond the scope of this research to investigate the source(s) of the discrepancy between the lamps observed in the shelf survey compared with consumer reported preferences. But possible reasons include:

- Product price may create an incentive to purchase these lamps in some channels (e.g., membership club) over others.
- The home improvement channel provides a very wide variety of lamp options, so this channel may offer a product solution to meet most consumers' needs. In contrast, some of the other channels are limited in the lamp variety on the shelf, so may not offer a viable replacement lamp under some circumstances.
- Home improvement and membership clubs both offer larger packs of multiple lamps, which encourage volume purchasing and reduces the need to purchase through other channels.

[8] The sell through rate refers to the amount of inventory a retailer receives from a manufacturer or supplier compared to the amount that is sold to the customer, over a given timeframe.

- Grocery stores have a high representation in the shelf survey because there are many grocery stores in the state. Consequently, there are many outlets to potentially purchase these lamps, even though they appear to represent a small portion of lamp purchases.

Regardless of the reason, because of the differences in lamp availability and consumer reported purchasing preferences, TRC developed the multipliers to adjust lamp availability data to better represent lamp sales.

6.2 Description of Calculations

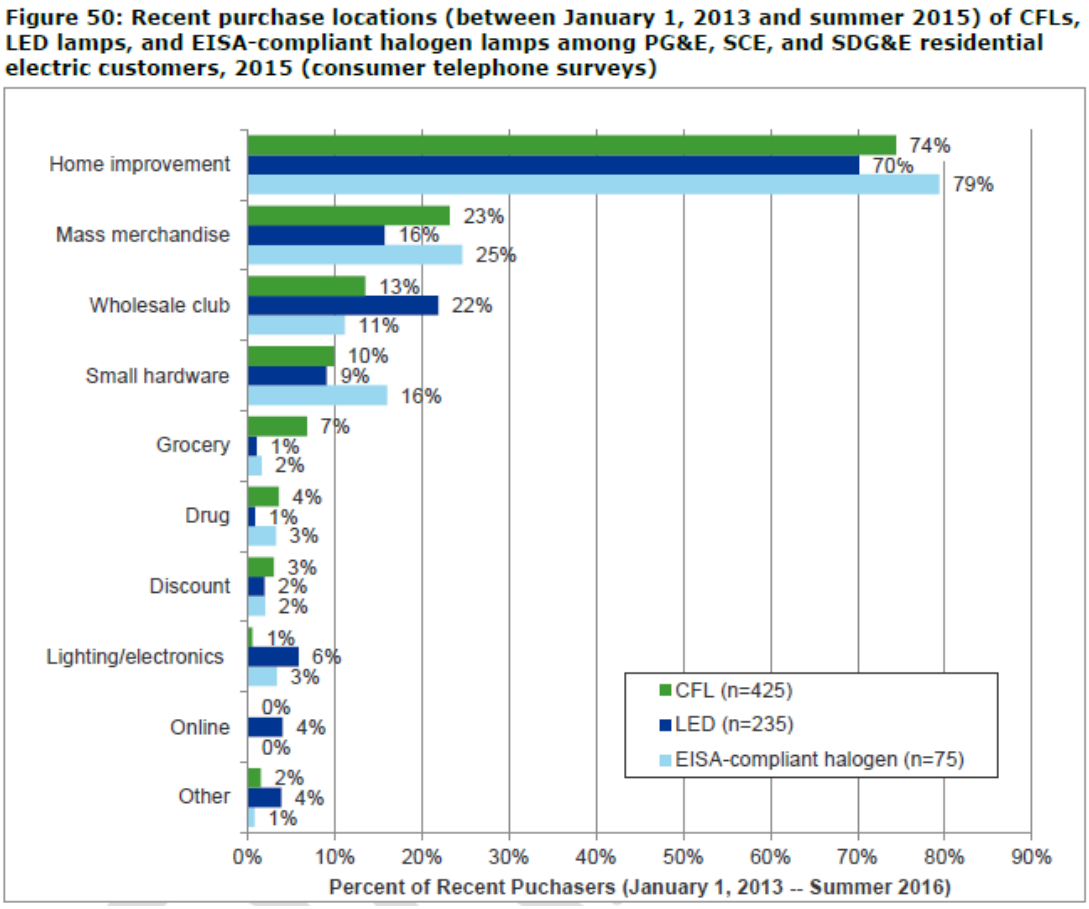
As an overview of our approach, TRC assumed that:

1. Consumers purchased lamps by channel according to the results of the DNV-GL consumer phone survey (DNV-GL 2016). DNV-GL conducted the survey in summer 2015, so DNV-GL defined "recent" as between January 2013 and summer 2015;
2. Within each channel, consumers purchased lamp technologies relative to lamp availability, as found in the shelf survey[9].

The consumer survey provides information on purchase locations, by asking consumers in which channels they recently purchased lamps. Multiple channel selections were permitted. Figure 11 provides the raw survey results. Respondents could provide multiple responses to the question.

[9] TRC developed sales multipliers specific to each shelf survey, because the calculation varies by the number of lamps in the shelf survey, and each shelf survey has a different number of total lamps.

Figure 11. Results of Consumer Survey on Channel Preference (DNV-GL 2016)



This data is recent and is also the most robust survey of consumer preference by channel in California. It provides information from consumers statewide in California, whereas other sources that TRC considered for estimating consumer purchasing preferences were limited to only one IOU territory and had much older information (e.g., collected in 2011).

To develop sales multipliers, TRC first made adjustments to the consumer phone survey (DNV-GL 2016) results to calculate a "Normalized Preference" for each channel, representing the percent of sales that occur in that channel, and that sum to 100% across all channels. TRC developed the Normalized Preferences percentages, as illustrated in Figure 12 and described here:

- The first set of rows in Figure 12 ("Consumer purchasing preference") show the unadjusted results from the survey. The distribution of values in the consumer survey total to greater than 100%, because respondents were permitted to select more than one channel. Additionally, the consumer surveys included an "Other" category that the shelf survey did not.
- TRC adjusted the consumer survey results by removing the "Other" category, to align the categories with the channels in the shelf survey. Next, TRC normalized results to sum to 100% for each lamp technology. The results of these two steps are shown in the second set of rows in Figure 12: "Removing Other and normalizing to 100%".
- TRC then calculated a weighted average across the four technologies (incandescent, halogen, CFL, and LED) to provide a single percentage for each channel. To weight each technology, TRC used sales

estimates from the LightTracker report[10] and assumed that consumers purchase incandescent lamps according to the channel preferences they identified for halogen lamps. Figure 12 shows the results in the row, "Normalized Preference", which represents the fraction of sales we estimate occurs in each channel.

Figure 12. Consumer Purchasing Preferences (DNV-GL 2016) and Subsequent Sales Multiplier

Description	Technology or Calculation	Disc.	Drug	Grocery	Hard-ware	Home Impr.	Mass Merch.	Memb. Club	Other	Total
Consumer purchasing preference (DNV-GL 2016)	Halogens	2%	3%	2%	16%	79%	25%	11%	4%	142%
	CFLs	3%	4%	7%	10%	74%	23%	13%	3%	137%
	LEDs	2%	1%	1%	9%	70%	16%	22%	14%	135%
Removing Other and normalizing to 100%	Halogens	1%	2%	1%	12%	57%	18%	8%		100%
	CFLs	2%	3%	5%	7%	55%	17%	10%		100%
	LEDs	2%	1%	1%	7%	58%	13%	18%		100%
Normalized Preference (%)	Based on weighted average across technologies	2%	2%	2%	9%	57%	16%	12%	---	100%

6.3 Results

6.3.1 Calculation and Results for Winter 2015/16 Sales Multipliers

TRC used the Normalized Preferences to adjust the shelf survey results for an estimate of lamp sales, as described here and illustrated in Figure 13.

- The first set of rows shows the Lamp Availability per Channel based on the winter 2015/16 shelf survey.
- The second set of rows shows the normalized consumer preference percentages, and the resulting channel sales multipliers. To calculate the multiplier for each channel, TRC divided the "Normalized Preference" (calculated in Figure 12) by the "Lamps in shelf survey". For example, for discount stores, the sales multiplier is 2% / 6% = 0.3.
- The third set of rows provides the estimated lamp sales per channel when applying the sales multipliers to the individual channels and lamp technologies. The final row shows the total sales estimate results per channel.

In Figure 13, TRC rounded the percentages to the nearest whole number and the multipliers to the nearest tenth, so as not to imply a higher level of precision than is appropriate. However, TRC used the full values when calculating the lamp sales numbers. TRC rounded all lamp numbers to the nearest whole number. Consequently, there are some discrepancies between the lamp sales numbers and what would be calculated using the rounded (interim) values in Figure 13.

[10] The LightTracker report is an estimate of lamp sales at the state (California) and U.S. level developed by Apex Analytics. To develop the LightTracker report, Apex Analytics uses actual point-of-sales (POS) data from some channels; for the remaining (non-POS) channels, Apex Analytics extrapolates purchases from a sample of consumers that scan their purchases. The LightTracker report provides sales estimates by technology, but not broken out by categories in the California shelf survey such as type (e.g., A-lamp), lumen bin (e.g., 60-W equivalent), or LED label (e.g., ENERGY STAR). Consequently, TRC developed its sales estimates methodology to estimate sales by category in the California shelf survey. Section 6.4 provides a comparison of LightTracker and TRC sales results.

For the multipliers, a value less than one reduces the influence of that channel on the total sales, and a value greater than one increases that channel's influence on sales. For example, for discount stores, the sales multiplier is 2% / 6% = 0.3, so the multiplier reduces this channel's impact on sales.

Figure 13. Calculation of Lamp Sales based on Channel Preference through TRC Sales Multiplier

	Disc.	Drug	Grocery	Hard-ware	Home Impr.	Mass Merch.	Memb. Club	Total	% of Total Lamps
Lamp Availability per Channel based on Winter 2015/16 Shelf Survey									
Incandescent	748,156	279,840	1,314,030	928,080	877,830	1,962,965	1,421	6,112,322	34%
Halogen	69,086	284,580	739,234	415,826	698,973	1,913,162	812	4,121,672	23%
CFL	203,733	353,813	1,324,736	479,642	502,643	1,410,011	141,264	4,415,843	25%
LED	11,530	39,323	270,138	335,964	1,146,865	922,862	347,894	3,074,576	17%
Total	**1,032,504**	**957,556**	**3,648,138**	**2,159,511**	**3,226,312**	**6,209,000**	**491,391**	**17,724,412**	**100%**
Lamps in shelf survey (%)	6%	5%	21%	12%	18%	35%	3%	100%	
Consumer Preference per Channel Information and Sales Multiplier									
Normalized Preference (%) of lamp purchases	2%	2%	2%	9%	57%	16%	12%	100%	
TRC Lamp Sales Multiplier: Normalized Preference / Lamps in shelf survey	0.3	0.4	0.1	0.8	3.1	0.5	4.2		
Estimated Lamp Sales per Channel based on Consumer Channel Preference									
Incandescent	217,592	98,686	133,220	706,828	2,748,631	911,535	6,033	4,822,525	27%
Halogen	20,093	100,358	74,946	316,694	2,188,600	888,407	3,446	3,592,543	20%
CFL	59,253	124,773	134,305	365,297	1,573,857	654,761	599,832	3,512,079	20%
LED	3,353	13,867	27,387	255,871	3,591,023	428,546	1,477,217	5,797,264	33%
Total	**300,291**	**337,685**	**369,858**	**1,644,689**	**10,102,111**	**2,883,249**	**2,086,527**	**17,724,412**	**100%**

The calculations maintain the total lamp sales observed in the shelf survey (17.7 million lamps), but shift purchases toward the more heavily favored channels, and away from the less favored channels. For example, the total sales in grocery stores dropped from 3.6 million lamps to 369,858 lamps. This is a considerable change, but it now reflects what appears to be a more reasonable sell through rate for products in this channel.

This calculation also changes the percentages of the lamp technologies that have been sold in the state, because there are different percentages of technologies available in each channel, including different ratios of high efficacy (CFL and LED) versus low efficacy (incandescent and halogen) lamps. Sales in channels with predominantly low efficacy lamps (e.g., grocery) decreased, and sales in channels with predominantly high efficacy lamps (e.g., membership club) increased. Consequently, TRC's adjustments result in an *increase* in sales of high efficacy lamps. Figure 13 shows that the distribution of LED lamps has approximately doubled from 17% (for availability) to 33% (for sales) through this calculation, and the other technologies have decreased to

compensate. Incandescent lamps had the largest reduction by percentage, from 34% (for availability) to 27% (for sales).

Another way to interpret TRC's results is as follows: The shelf survey estimated 17.7 million lamps on California retailer's shelves at the time of the shelf survey. TRC's estimates indicate that, in the time for 17.7 million lamps to be sold, some of the incandescent lamps observed in the shelf survey were not sold (since the multipliers reduced their sales); while the LEDs observed in the shelf survey were sold, and replaced on retailers' shelves with new LEDs which also sold (since the multipliers approximately doubled LEDs).

6.3.2 All Sales Multipliers

TRC calculated different sales multipliers for each shelf survey in Section 3, and when calculating sales multipliers for different lamp types (e.g., all lamps, A-lamps, and reflectors). This is because the total number of lamps varies by shelf survey, and by lamp type.

Figure 14 presents all sales multipliers used in this analysis. For all multipliers, TRC assumed the consumer purchasing preferences shown in the last row of Figure 12 based on the DNV-GL (2016) telephone survey.

The "Winter 2015/16: All lamps" results (bolded) are used most often in this analysis, since they are the most recent and the most comprehensive, and Section 6.3.1 describes how TRC calculated these values.

Figure 14. Sales Multipliers used in Analysis

Shelf Survey Data Analyzed		Disc.	Drug	Grocery	Hardware	Home Impr.	Mass Merch.	Memb. club
Spring 2009: All lamps	% of lamps in survey	3%	1%	1%	1%	53%	25%	16%
	Sales Multiplier	0.54	1.83	1.56	9.83	1.07	0.66	0.75
Fall 2011: All lamps	% of lamps in survey	5%	2%	3%	11%	41%	15%	22%
	Sales Multiplier	0.36	0.79	0.69	0.81	1.38	1.09	0.53
Summer 2012: All Lamps	% of lamps in survey	11%	6%	23%	14%	16%	26%	3%
	Sales Multiplier	0.15	0.34	0.09	0.65	3.49	0.63	3.51
Summer 2013: All Lamps	% of lamps in survey	9%	6%	28%	12%	14%	28%	2%
	Sales Multiplier	0.19	0.30	0.08	0.76	3.97	0.58	4.84
Winter 2014/15: All lamps	% of lamps in survey	10%	8%	19%	14%	17%	30%	3%
	Sales Multiplier	0.17	0.24	0.11	0.68	3.43	0.55	3.79
Winter 2015/16: All lamps	**% lamps in survey**	**6%**	**5%**	**21%**	**12%**	**18%**	**35%**	**3%**
	Sales Multiplier	**0.29**	**0.35**	**0.10**	**0.76**	**3.13**	**0.46**	**4.25**
Winter 2015/16: A-lamps	% of lamps in survey	6%	6%	23%	9%	17%	35%	3%
	Sales Multiplier	0.28	0.30	0.09	1.01	3.27	0.47	4.02
Winter 2015/16: Reflectors	% of lamps in survey	2%	2%	2%	9%	57%	16%	12%
	Sales Multiplier	0.63	0.62	0.09	0.49	2.29	0.67	3.08

The sales multipliers were fairly similar for all lamps among shelf surveys starting in Summer 2012. The multipliers were significantly different for the earlier shelf surveys (Spring 2009 and Fall 2011). This may be because these earlier surveys had an order of magnitude fewer lamps (< 1 million) compared with the surveys starting in Summer 2012 (>12 million), because lamp stocking practices have changed over time, or for other reasons.

For winter 2015/16, the multipliers were fairly similar for all lamps and A-lamps, but were significantly different for reflectors. This may be because of differences in stocking practices for reflectors, or for other reasons.

The results of the sales multiplier approach are likely less accurate for older shelf surveys and for reflectors, since the phone survey (conducted in 2015) asked about recent lamp purchases, and because it did not ask about purchases by lamp type. Consumers may have different purchasing preferences for reflectors than the more common A-lamps.

6.4 Methodology Check

LightTracker provides sales estimates based on Point-of-sales (POS) channels and Non-POS Channels. Appendix C provides the LightTracker methodology.

Figure 15 summarizes the inclusion of channels in the POS vs Non-POS data in LightTracker.

Figure 15. LightTracker Coverage by Channel

	Discount	Drug	Grocery	Hardware	Home Improve.	Mass Merch.	Membership club
Coverage in LightTracker POS data	Near full	full	full	none	none	full	partial
Assumption of Channel	POS	POS	POS	Non-POS	Non-POS	POS	Non-POS

As a methodology check, for our estimates of all lamp sales based on the winter 2015/16 shelf survey, TRC totaled our sales estimates in the POS channels (Discount, Drug, Grocery, and Mass Merchandise) and our sales estimates in the Non-POS channels (Hardware, Home Improvement, and Membership Club). TRC then compared our results for POS vs. Non-POS purchases with LightTracker results. As shown in Figure 16, the results were very similar, which indicates that the sales multiplier is a reasonable method to make adjustments to the shelf survey results.

Figure 16. TRC Estimate Compared to LightTracker by Channel Type

Sales Estimate Source	POS: % of total purchases	Non-POS: % of total purchases
LightTracker	24%	76%
TRC estimate	22%	78%

7. Appendix B. Availability of CEC-spec and ENERGY STAR LEDs by Market Channel

Table 3 presents availability of CEC-spec and ENERGY STAR A-lamp LEDs by market channel. The table represents all lamps labeled as meeting CEC-spec and/or ENERGY STAR; therefore, they are not mutually exclusive and lamps may be included in both categories.

- CEC-spec A-lamp LEDs were primarily found in the membership club channel, with some availability in hardware and grocery stores.
- ENERGY STAR LEDS were much more prevalent than CEC-spec LEDs. All channels (except drug store) carried at least some ENERGY STAR A-lamp LEDs, and they comprised at least 20% of lamps in the 60W equivalent class (the largest class for A-lamps) for the home improvement, hardware, grocery, and membership clubs channels.

Table 3. Availability of CEC-spec A-lamp LEDs vs. ENERGY STAR A-lamp LEDs by Market Channel

Lumen Range (Incandescent Equivalent)	Availability of **CEC spec A-lamp LEDs** by Market channel: CEC-spec LEDs / total lamps in class (%)						Availability of **ENERGY STAR A-lamp LEDs** by Market channel: ENERGY STAR LEDs / total lamps in class (%)					
	Mass Merch.	Home Impr.	Hardware	Drug	Grocery	Memb. Club	Mass Merch.	Home Impr.	Hardware	Drug	Grocery	Memb. Club
<310 (<40W Eq) n = 0.3M												
310-749 (40W eq) n = 1.0M		<1%				99%	2%	15%	4%	5%	2%	99%
750-1049 (60W eq) n = 3.2M		1%	12%		18%	35%	5%	21%	26%		21%	36%
1050-1489 (75W eq) n = 1.1M							6%	8%	2%		1%	
1490-2600 (100W eq) n = 1.0M							7%	4%	6%			10%

Blank cells indicate no availability (i.e., no CEC spec LEDs in the left half of the table, or no ENERGY STAR LEDs in the right half)

Table 4 shows availability of CEC-spec and ENERGY STAR reflector LEDs by market channel. Drug store channels are not shown, because there were no CEC-spec or ENERGY STAR reflector LEDs in those channels.

- Similar to A-lamps, CEC-spec reflector LEDs were primarily found in the membership club channel, with some availability in the secondary lamp class (60W equivalent) in the home improvement channel.
- ENERGY STAR LEDs were much more prevalent than CEC-spec LEDs. All channels (except drug store) carried at least some ENERGY STAR LEDs, and they comprised at least 10% of lamps in the 40W equivalent class (the largest class for reflectors) for all channels except discount.

Table 4. Availability of CEC-spec Reflector LEDs vs. ENERGY STAR Reflector LEDs by Market Channel

Lumen Range (Incandescent Equivalent)	Availability of **CEC spec Reflector LEDs** by Market channel: CEC-spec LEDs / total lamps in class (%)					Availability of **ENERGY STAR Reflector LEDs** by Market channel: ENERGY STAR LEDs / total lamps in class (%)					
	Mass Merch.	Home Impr.	Hardware	Grocery	Memb. Club	Mass Merch.	Home Impr.	Hardware	Grocery	Memb. Club	Discount
<310 (<40W eq) n = 0.2M						3%		9%			
310-749 (40W eq) n = 1.2M		1%	7%		63%	17%	17%	20%	10%	100%	
750-1049 (60W eq) n = 0.5M		19%	2%	5%	78%		40%	32%	7%	99%	8%
1050-1489 (75W eq) n = 10.5M					100%	7%	14%	8%		100%	
1490-2600 (100W eq) n = 0.1M											

Blank cells indicate no availability (i.e., no CEC spec LEDs in the left half of the table, or no ENERGY STAR LEDs in the right half).

8. APPENDIX C. LIGHTTRACKER METHODOLOGY

The following is a description of the LightTracker sales report methodology, provided by Apex Analytics.

To: TRC Energy Services

From: Scott Dimetrosky, Apex Analytics

Date: April 17, 2017

Re: LightTracker Sales Report Methodology

Data Sources

To develop the LightTracker sales report, Apex Analytics leveraged a variety of data sources for model development, but relied primarily on 2015 sales data prepared by the Consortium for Retail Energy Efficiency Data (CREED) LightTracker initiative.[1,2] These sales data were primarily generated from two sources: point-of-sale (POS) state sales data (representing one group of retail channels) and National Consumer Panel (NCP) state sales data (representing a different group of retail channels). These two sources collectively represent the majority of bulb sales across the United States.

The primary model input data sources are listed here:

- National bulb sales
  - POS data (grocery, drug, dollar, discount, mass merchandiser, and selected club stores)
  - Panel data (home improvement, hardware, online, and selected club stores)

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1 CREED serves as a consortium of program administrators, retailers, and manufacturers working together to collect the necessary data to better plan and evaluate energy efficiency programs. LightTracker is CREED's first initiative, focused on acquiring full-category lighting data—including incandescent, halogen, CFL, and LED bulb types—for all distribution channels in the entire United States. As a consortium, CREED speaks as one voice for program administrators nationwide as they request, collect, and report on the sales data needed by the energy efficiency community. There are more details available online: https://www.creedlighttracker.com. Note that 2015 data was the most recent year available at the time of this study.

2 The information contained herein is based in part on data reported by IRI through its Advantage service, interpreted solely by LightTracker. Any opinions expressed herein reflect the judgement of LightTracker, Inc. and are subject to change. IRI disclaims liability of any kind arising from the use of this information.

- U.S. Census Bureau import data (CFLs)
- ENERGY STAR® shipment data (imports and ENERGY STAR market share)
- North American Electrical Manufacturers Association shipment data

Lighting Sales

The LightTracker POS dataset includes lighting sales data for grocery, drug, dollar, club, and mass market distribution channels. These data represent actual sales that are scanned at the cash register for participating retailers.

The NCP represents a panel of approximately 100,000 residential households that are provided a handheld scanner for their home and instructed to scan every purchase they make that has a bar code. For California, the NCP included approximately 6,000 households in 2015. The use of a scanner avoids the potential recall bias that is prevalent in self-report methods that ask about lighting purchases. While these data included scans from both the channels in the POS data and the remaining channels, only scans from the remaining channels (home improvement, hardware, online, and selected club stores) are included so as to avoid double counting the POS sales.

Though the dataset Apex Analytics received included detailed records of lighting data purchases, the data required a considerable effort to ensure data integrity and the inclusion of all necessary bulb attributes. For example, not all records had some of the more critical variables populated, including bulb type, style, and wattage, and some clearly had erroneous values (e.g., 60-watt CFLs).

After a thorough review and quality control of the dataset, Apex Analytics reclassified, standardized, populated missing records, created additional variables, and performed general enhancements to the data. To populate missing records, validate existing records, and include additional bulb attributes, Apex Analytics created a proprietary Universal Product Code (UPC) database with approximately 20,000 bulbs from four sources:

- Manufacturer product databases provided to LightTracker
- Product catalogs downloaded from manufacturer websites
- Product offerings downloaded from retailer websites
- Automated lookups of online UPC databases, such as www.upcitemdb.com

LightTracker then merged the UPC bulb database with the POS/panel data, populating fields based on a hierarchy of data sources based on reliability, prioritized in the following order: manufacturer specifications, UPC lookups, and original IRI-based database values. Apex Analytics also conducted a large number of manual website lookups of individual bulbs to determine final assignments.

In addition, Apex Analytics investigated the bulb assignment and the quantity of bulbs per package by examining the average price per unit and identifying outliers. This process helped us identify misclassification of certain bulb types (e.g., bulbs that were flagged as low cost LEDs but were really LED nightlights, so needed to be classified as "other"), as well as bulb counts that sometimes represented box shipments (e.g., a box identified as having 36 bulbs was really six packages of six-pack CFLs).

The final model ended up representing 39 states, excluding some smaller states that lacked sufficient sample size from the panel data. The model provides sales estimates at the individual state level (for states represented), and aggregated across the U.S. Key aspects of the lighting dataset include:

- 2015 sales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for all retailer sectors combined, and broken out by POS and non-POS channels
- Data reporting by state and bulb type
- Inclusion of all bulb styles and controls