The First Generation of Thin is No Longer In – Knowing your T8s

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ABSTRACT

Linear fluorescent lamps are recognized as T12 (fat tubes), T8 (thin tubes), and T5 (skinny tubes) lamps. Thin tubes, however, are not all created equal. Thin tubes encompass five generations of technology with advancement in efficiency, color rendering, lumens, and expected life evolving in a technology commonly referred to as a T8. Recent implementation of the Energy Policy Act (EPAct) of 2005 bans the manufacturing or importation of most T12 and First Generation T8 lamps.

The impact of phasing out the First Generation of T8 lamps has received little attention. While collecting information on the share of T12 lighting simply requires a count of T12 lamps, developing an understanding of the stock of First Generation T8 lamps that will be upgraded in the future will require the development of new methods and databases. Collecting information on the share of thin tubes representing First Generation T8s will necessitate the collection of make and model numbers and the development of databases describing the efficiency by make and model number.

This paper describes a process for collecting linear lamp make and model numbers and how these data were used to describe the efficiency distribution of T8 lamps in California businesses in 2012. The paper describes the different generations of T8 lighting, the standardization of T8 make and model numbers collected from California businesses, and how the standardized make and model numbers were used to disaggregate T8 lamps into four efficiency characterizations. The paper concludes with a description of the existing stock and recent purchases (2009-2012) of linear technologies by California businesses.

Introduction

Linear fluorescent lamps have been one of the primary sources of lighting for the non-residential sector since their introduction in the 1930s. Until the late 1980s the vast majority of linear fluorescent systems included T12 lamps with magnetic ballasts. Technology improvements led to the introduction of electronic ballasts and more efficient T8 and T5 lamps. Non-residential energy efficiency programs have targeted the replacement of T12 lamps with T8 lamps, helping to speed the replacement of inefficient T12 lamps with higher efficiency T8 lamps.

In August 2005, Congress passed the Energy Policy Act (EPAct) effectively banning the manufacturing or importation of the majority of 4 foot T12 lamps as of July 14, 2012.[1] Less well known however, is that EPAct also banned the manufacturing or importation of the first generation of T8 fluorescent lamps or 700 Series T8 lamps. Updates to the implementation of EPAct delayed the application of the 700 Series T8 ban to July 14, 2014.

The implementation of EPAct effectively changed the potential linear fluorescent lamps eligible for rebate within non-residential energy efficiency programs, while also requiring consumers, program implementers, and evaluators to better understand the types of linear lighting options available. Liner

1 A small number of specialty T12 lamps remain eligible for production. These lamps have very high lumens or high Color Rendering Index (CRI) exemptions.

fluorescent energy efficiency programs could no longer describe programs as being designed to replace T12 lamps with T8 lamps. It is became necessary to clearly define the type of T8 lamps forming the baseline of programs and those T8 lamps eligible for rebate.

Linear Fluorescent Lamps

The linear fluorescent terminology T12, T8, and T5 describes the type and diameter of fluorescent lamps. The T indicates that the lamp is a tube, while the number describes the diameter of the lamp. T12 lamps have a diameter of 12/8ths or 1.5 inches and have been commonly described as "fat tubes". T8 lamps have a diameter of 8/8ths or 1 inch and are described as "thin tubes" while T5 lamps have a diameter of 5/8 inch and may be characterized by customers as "skinny tubes". The characterization of T8 lamps as a single group of "thin tubes", however glosses over the many distinct types or generations of T8 lamps available in the market place.

T8 lamps or "thin tubes" have evolved through several generations of technology. Not all thin tubes are equally efficient. Descriptions of the different types of T8 lamps going from least to most efficient are provided below:

- **First Generation T8 Lamps**: These lamps are alternatively designated as 700 Series T8 lamps. These lamps usually provide initial lumen levels of up to 2,800, use 32 watts, have a Color Rendering Index (CRI) of 75-78,[2] and typically have a 15,000-20,000 hour life rating. The California Commercial Market Share Tracking Study (CMST)[3] found that First Generation T8 purchased during 2009-2013 had a median mean lumens of 2,520.[4] First generation T8 lamps have the lowest lumens and shortest life of any T8 lamp.
- **Second Generation T8 Lamps:** This technology is also described as 800 Series T8 lamps. These lamps are 32 watt lamps with initial lumen levels in the 2,800-3,000 range, 82-86 CRI, and 20,000-24,000 hour rated life. The California CMST found the median mean lumens observed for Second Generation T8 lamps was 2,800.
- **High Performance T8 Lamps:** These lamps are also designated as Third Generation T8 lamps. The Consortium for Energy Efficiency (CEE) classifies these lamps. High performance T8 lamps are 32 watt lamps with minimum initial lumen levels of 3,100, CRI in the range of 82 to 86, and a life rating of at least 24,000 hours. The California CMST found the median mean lumens observed for recently purchased High Performance T8 lamps was 2,935.
- **Reduced Wattage T8 Lamps:** Also designated as Fourth and Fifth Generation T8 lamps as classified by CEE. These lamps typically use 25-28 watts, have a CRI rating from 82 to 86, and life ratings up to 30,000 hours with lumens from 2,285 to 2,650. The California CMST found that recently purchased Reduce Wattage T8 lamps had a median of 28 watts and their median mean lumen levels were 2,560.

2 CRI is a measure of a lamps ability to render colors the same as sunlight. A CRI of 100 is equivalent to sunlight's rendering. An incandescent bulb typically has a CRI of 95. Higher CRI values are typically associated with better lighting characteristics.

[3] *California Commercial Market Share Tracking Study*, Itron, Inc. produced for the California Public Utilities Commission, November 2014. The report and data tables are available here: http://capabilities.itron.com/wo024/ .

[4] The lumens produced by linear lamps can be described by their initial and/or mean values. The initial value reflects the lumens produced when the lamp is new (the first 100 hours of use) while the mean lumens represent the lumens typically produced by the lamp as it reaches 40% of its rated life.

One of the key challenges for evaluators in the field is distinguishing different generations of T8 lamps since despite their improving hours of use, higher lumen ratings, and lower watts, all T8s are physically represented by 1 inch diameter thin tubes. The one-inch diameter "thin tube" distinguishes T8 lamps from T12 and T5 lamps but it does not help to identify the lamps' generation or relative efficiency within T8 lamps. This makes it difficult to classify these lamps without evaluators having to collect detailed information on their make and model numbers. Understanding the distribution of efficiency for T8 lamps, however, is necessary to better understand the remaining non-residential linear lighting savings potential and where this potential exists.

California Commercial Saturation and Market Sales Trend Data

The California Commercial Saturation (CSS)[5] and CMST Surveys collected on-site information from approximately 1,500 businesses in California from 2012-2013. The CSS collected detailed linear lighting information, including make and model numbers, to describe the distribution and efficiency of the existing stock of linear lighting in California. The jointly implemented CMST collected make and model numbers for recently purchased (2009-2013) linear fluorescents to describe the size of the market for non-residential linear fluorescents within the three electric IOUs in California and to analyze the efficiency distribution of these purchases.

Make and model lookups develop the crucial secondary information needed to classify the efficiency level of linear fluorescent measures.[6] The on-site forms for the CSS and CMST allowed for the collection of make, model, size specifications, and wattage information from the bulbs and ballasts. Additional information needed for a thorough description of the efficiency of the linear technologies includes lumens, rated life, and light color. These additional details, however, cannot be collected directly from looking at the bulbs while on-site but must be obtained through a look up of the make and model numbers that were collected while on-site.

Make and Model Lookup Tables

To determine the efficiency level of T8 lamps observed during data collection, lookup tables were developed using the make and model numbers collected on-site. The on-site make and model numbers were entered into a workbook along with on-site information concerning the lamp length, diameter, watts, and the total quantity of lamps of this type observed on-site. The make and model number lookup workbook included a macro designed to limit the number of entries for a specific on-site make and model number to a single entry. This process ensures that once a given make and model number is analyzed, information is entered into the workbook to ensure that it is not analyzed again.

The on-site make and model numbers were compared with information collected from reference sources largely collected from internet searches. Using the internet made it possible to collect data from many sources. The following general types of sources were instrumental to the success of the T8 lamp make and model look ups:

[5] *California Commercial Saturation Survey*, Itron, Inc. produced for the California Public Utilities Commission, August 2014. The report and data tables are available here: http://capabilities.itron.com/wo024/ .

6 This common term efficiency is used to represent what lighting designers would term efficacy. These two terms are very similar for lighting applications, with efficiency used by the wider community and efficacy used by lighting designers and other professionals.

- Lighting catalogs were collected from many manufacturers' web sites. These catalogs contained the information needed to convert the make and model number from the T8 lamps into efficiency information.
- Lighting Technology sheets were also collected from various web sites to help characterize T8 lamps.
- The CEE Workbook of High Performance T8 Qualifying Products lists the manufacturer, product name, and model number along with the required information to characterize the lamps.
- Internet searches of T8 make and model numbers were used when other sources were not available to characterize the T8 lamps.

The first step of the comparison of the make and models collected on-site to the reference material is to standardize the model number information collected on-site. The standardization eliminates inconsistencies in text such as upper cases and eliminates special characters. The standardization process also checks for data errors potentially made when the surveyors write down the model number on-site or when data entry technicians enter the model number into the database. Common issues caught here include instances where a "0" is entered as an o or a "1" as an l or vice versa.

The manufacturer name also needs to go through a round of quality control to ensure it is consistent with the data in the reference sources. For example, if the manufacturer name is recorded as GE it will need to be updated to General Electric. When undertaking the make and model lookups it is necessary to also have a list of manufacturers and brands that may lead to confusion or an inability to identify the lamp. For example, an on-site surveyor may identify the lamp's manufacturer as Ecolux when Ecolux represents a brand of the manufacturer General Electric. Some manufacturers have merged over time and the merged company may maintain both brands out of potential company loyalty but it may only be possible to find a lighting catalog or technology sheet from one company. For Example, Radiant and Westinghouse have merged, making the available information on these products more difficult to identify.

The standardization process is a very manual process that includes looking up the make and model number on the internet or in lighting technology workbooks and catalogs to ensure that the information collected on-site is consistent with the naming conventions used by manufacturers. During this process, available information is collected on CRI, initial and mean lumens, and wattages.

A Sas program was developed to compare the standardized on-site make and model number with information from the CEE workbooks to classify T8 lamps as High Performance or Reduced Wattage. For lamps not classified as High Performance or Reduce Wattage the lighting information was reviewed to ensure the remaining lamps were 700 or 800 Series T8 lamps. Lamps categorized as 700 or 800 Series T8s can be identified by their CRI; 700 lamps have a CRI less than 80 and 800 Series have CRIs that are 80 and higher.

The quality control process included a review of the recorded watts and lumens to ensure that the lamps are correctly identified. Lamps that are found to be outside their identified efficiency level are manually reviewed to ensure that the information is correct and/or the efficiency identification is correct. Adjustments are made where necessary.

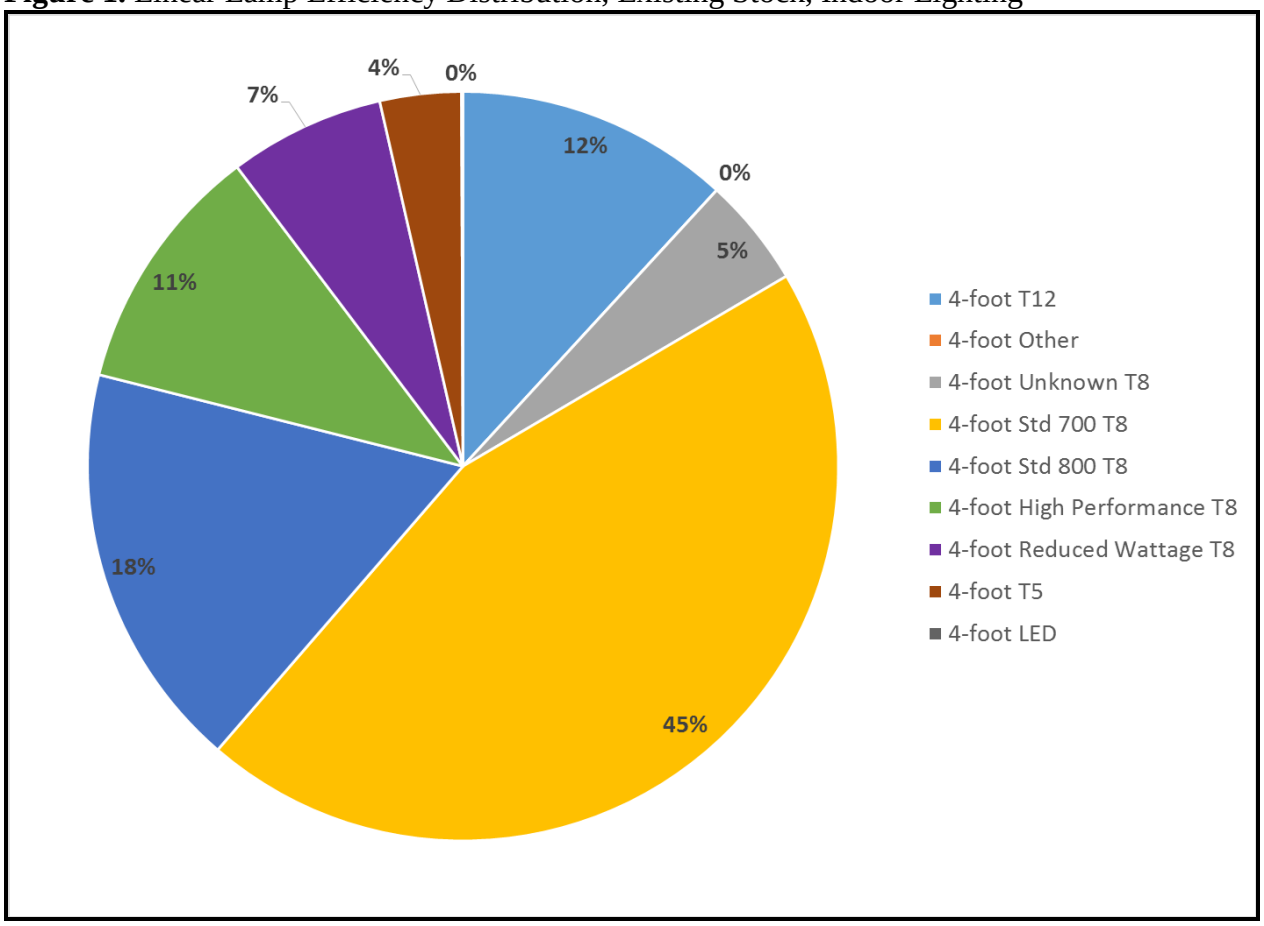
CSS Linear Lighting

The California CSS on-site survey collected on-site information from 1,439 customers. The study found indoor linear technologies present at 1,436 of the surveyed facilities. The study found that over 90% of the linear lamps in California businesses were four foot linears, leading the CSS to focus the efficiency analysis on four foot linear technologies.

Figure 1 illustrates the CSS linear lamp efficiency distribution for four foot indoor lamps. These data indicate that 85% of linear lamp technologies are T8 lamps. All T8 lamps, however, are not created equally. EPAct bans the production of 700 Series or First Generation T8 lamps as of July 14, 2014. Within the CSS analysis, over half of the existing stock of T8 lamps were found to be first generation or 700 Series T8 lamps. Forty five percent of all four foot linear lamps or 53% of T8 lamps were 700 Series T8 lamps. Going forward, as these technologies burn out or are replaced prior to burn out, businesses will be required to replace these technologies with more efficient linear technologies. Combining the T12 and 700 Series T8 lamps, more than 50% (45 + 12 = 57%) of the existing stock of indoor 4 ft linear lamps were found to represent technologies banned from production following the full implementation of EPAct.

Classifying the existing stock of T8 lamps as a single group of desirable "thin tubes" obfuscates the true efficiency distribution of these lamps. Analysis of make and model numbers clarifies that approximately 50% of thin tubes are no longer produced given the full implementation of EPAct.

Figure 1. Linear Lamp Efficiency Distribution, Existing Stock, Indoor Lighting



* **The results presented above have been weighted by site weight.** The results represents linear lamps found during 1,352 non-residential on-sites. Unknown T8s represent the share of T8s whose efficiency was not found during the make and model lookups. Other linear lamps represent tube diameters other than T12, T8, or T5. On-site data was collected from 2011 to 2013.

Once indoor T8 efficiency distributions are disaggregated by their distinct efficiency level, it is possible for programs to target those segments where inefficient thin tubes dominate the distribution. Table 1 present the share of linear lamps by performance group and business type. Relative to other commercial business types in California, Offices have the greatest share of liner lighting whose production or

importation is banned following the implementation of EPAct (see Table 1). Within Offices, 9% of linear lighting lamps were T12 lamps and 66% were 700 Series T8 lamps as of 2012. Offices had the largest share of 700 Series or First Generation T8 lamps of any segment analyzed in the CSS on-site data collection. The high share of 700 Series T8 lamps in 2012 may indicate that Offices were early converters to T8 technologies and that they have been slow to upgrade existing First Generation T8s to more efficient alternatives. Conversely, the Retail and Warehouse segments had a relatively low share of less efficient T8 lamps and a larger share of high efficient T8 technologies.

Table 1. Linear Lamp Efficiency Distribution by Business Type – Indoor Lighting

Performance Group	Food Liquor	Health Medical - Clinic	Miscel-laneous	Office	Restau-rant	Retail	School	Ware-house
Base Efficiency	78%	84%	79%	89%	85%	65%	82%	58%
High Efficiency	22%	16%	21%	11%	15%	35%	18%	42%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Base Efficiency Tiers Distribution								
4-foot T12	4.5%	27%	14%	9%	30%	8%	8%	17%
4-foot Other	0%	0%	<0.1%	<0.1%	0%	0%	0%	0%
4-foot Unknown T8	4.1%	1.5%	5%	4.2%	3.3%	10%	2.6%	4.0%
4-foot Std 700 T8	50%	40%	36%	66%	40%	21%	47%	26%
4-foot Std 800 T8	20%	16%	25%	10%	12%	26%	23%	10%
High Efficiency Tiers Distribution								
4-foot High Performance T8	8%	12%	9%	6%	11%	19%	8%	23%
4-foot Reduced Wattage T8	12%	3.8%	9%	3.8%	3.9%	9%	9%	7%
4-foot T5	0.5%	0.3%	2.8%	1.4%	0.5%	8%	1.1%	13%
4-foot LED	0.4%	<0.1%	0.1%	<0.1%	0%	0.1%	<0.1%	<0.1%
n	**120**	**124**	**228**	**237**	**163**	**219**	**160**	**121**

*** The results presented above have been weighted by site weight.** *n*'s represent the number of surveyed sites included in the analysis. Unknown T8s represent the share of T8s whose efficiency was not found during the make and model lookups. On-site data was collected in 2011-2013.

Table 2 present the efficiency distribution of linear lamps by business size, based on kWh consumption. Standard 700-series T8s represent the bulk of indoor four foot T8 lamps for large, medium, and small businesses. Very small businesses have a relatively high share of T12 lamps but they also have a relatively small share of 700-series T8 lamps. Going forward, very small sized businesses in California represent a business segment where the replacement of T12 lamps will be undertaken with EPAct compliant high efficiency T8 lamps.

Table 2. Linear Lamp Efficiency Distribution by Business Size – Indoor Lighting

Performance Group	Large	Medium	Small	Very Small
Base Efficiency	73%	82%	79%	76%
High Efficiency	27%	18%	21%	24%
Total	**100%**	**100%**	**100%**	**100%**
Base Efficiency Tiers Distribution				
4-foot T12	4.0%	5%	12%	29%
4-foot Other	0%	0%	0%	<0.1%
4-foot Unknown T8	2.8%	2.9%	9%	3.0%
4-foot Std 700 T8	49%	54%	44%	26%
4-foot Std 800 T8	17%	20%	15%	19%
High Efficiency Tiers Distribution				
4-foot High Performance T8	7%	7%	13%	15%
4-foot Reduced Wattage T8	13%	7%	4.7%	6%
4-foot T5	7%	4.0%	2.6%	2.1%
4-foot LED	0.2%	0.1%	<0.1%	<0.1%
n	**96**	**458**	**468**	**350**

*** The results presented above have been weighted by site weight.** *n*'s represent the number of surveyed sites included in the analysis. Large sites have annual usage over 1,750,000 kWh, Medium have greater than 300,000 kWh and less than or equal to 1,750,000, Small have max annual usage greater than 40,000 kWh and less than or equal to 300,000, and Very Small have annual usage less than or equal to 40,000 kWh. The on-site data was collected from 2011 to 2013.

CMST Linear Lighting

Information on recent purchases (2009-2012) of linear technologies was analyzed within the California Commercial Market Share Tracking Study.[7] On-site data on recently purchased linear technologies were collected from 568 businesses. These data indicated that 90% of recently purchased linear lamps were T8s. Make and model numbers from recently purchased linear technologies were analyzed to describe their efficiency distribution.

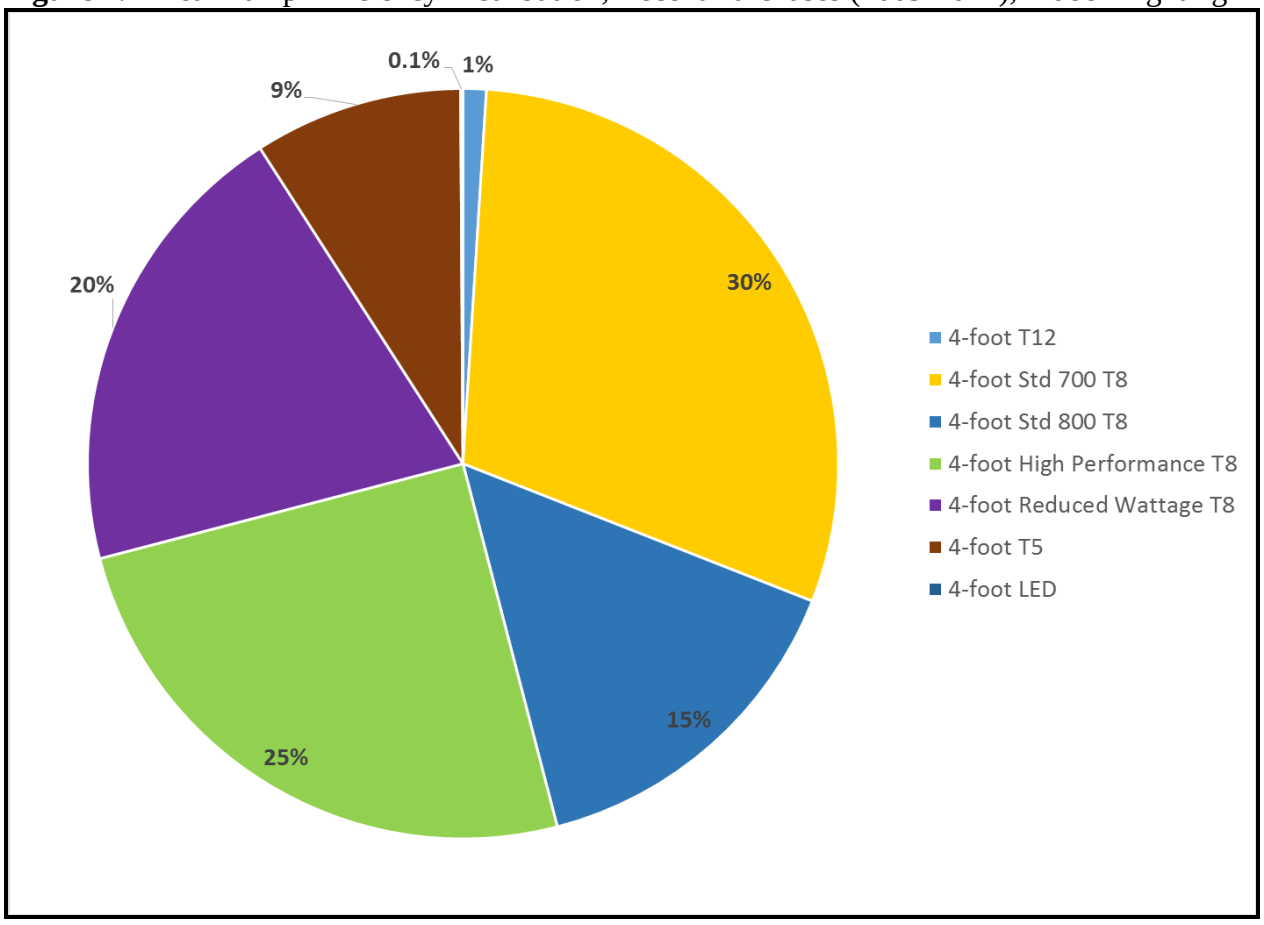
While 90% of recently purchased linear technologies were T8 lamps, only a third of these technologies (30%) were 700 Series or First Generation T8 lamps (see Figure 2). Given the purchase date of these technologies, the production and importation of 700 Series T8s were not yet banned by the implementation of EPAct (the analyzed lamps were purchased prior to July 14, 2014). Comparing the share of 700 Series T8 lamps in the existing stock of linear technologies (45%) with their share within recently purchased linear technologies (30%), it appears that customers were making substantial purchases of higher efficiency T8 technologies prior to the July 14, 2014 implementation of the ban on 700 Series T8 production and importation.

The characterization of recent T8 purchases clearly indicates that the majority of recently purchased (2009-2012) linear technologies are EPAct qualified even though the T8 EPAct restrictions did not go into

7 Given the timing of the on-site data collection, a limited number of purchases were observed in 2013. The 2013 purchases are reported with the 2012 purchases for data presented by year.

effect until after the on-site surveys were completed. The largest share of T8 or "thin tube" technologies purchased from 2009 to 2012 by California businesses complied with EPAct rules implemented in 2014.

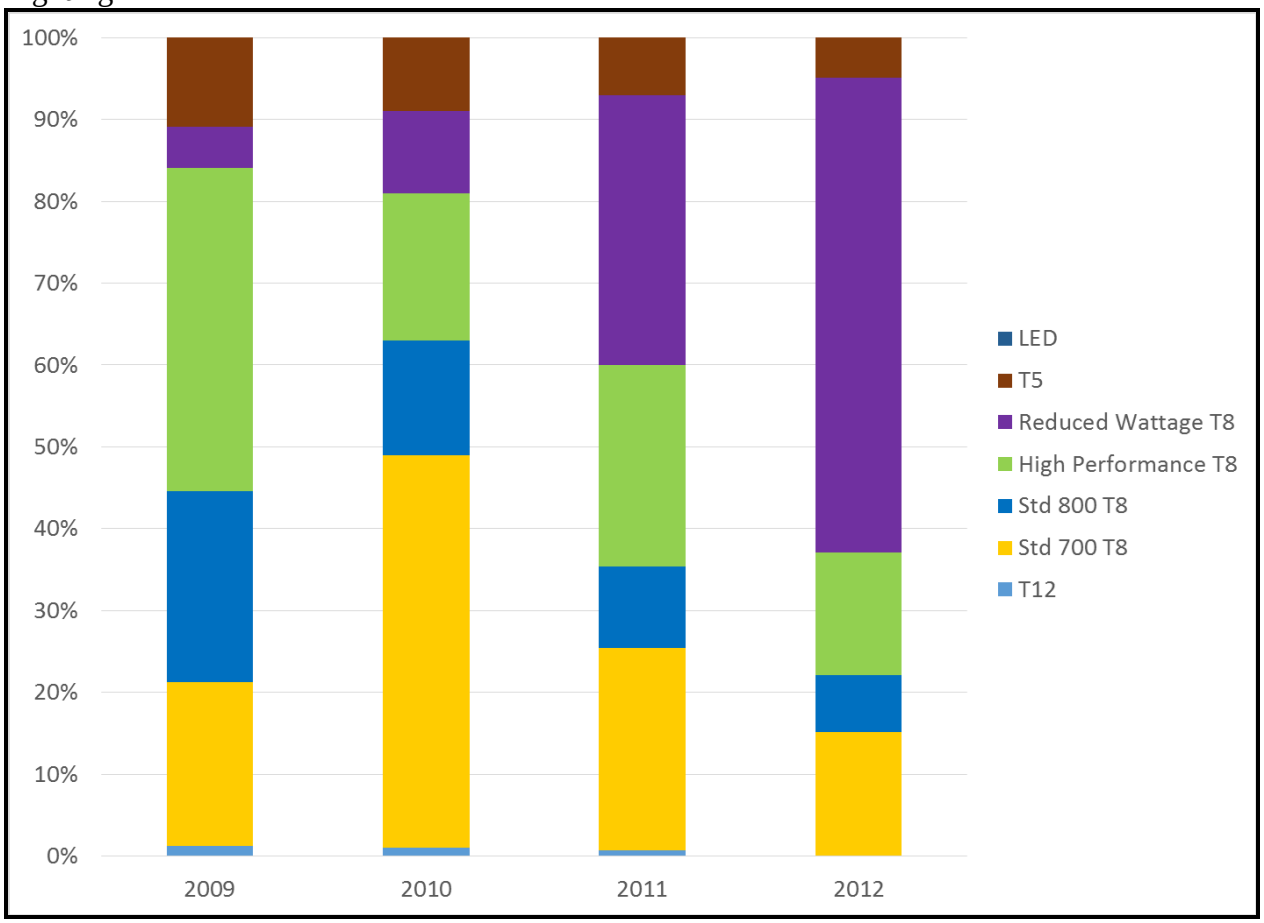
Figure 2. Linear Lamp Efficiency Distribution, Recent Purchases (2009-2012), Indoor Lighting



The CMST on-site data collection effort gathered on-site information on the year of lamp installation. Using these data it is possible to characterize the yearly efficiency distribution of linear lamps purchased from 2009 to 2012 (see Figure 3). Prior to disaggregating T8 lamps into their efficiency groupings, the share of linear lamps represented by T8 technologies grew from 88% in 2009 to 90% in 2010, 92% in 2011, and 95% in 2012. Looking at the share of purchases represented by T12, T5, and LED lamps, it appears that there was a slight decline in the share of T12 lamps from 1.2% in 2009 to 0.1% in 2012 and a larger decline in the share of T5 lamps from 11% in 2009 to 5% in 2012.

The most significant change in the distribution of recently purchased lamps, however, was within the T8 classification. There was a large increase in the share of 700 Series or First Generation lamps from 2009 to 2010 (from 20% to 48% of linear lamp purchases). This may reflect, at least in part, a decline in the energy efficiency program influence during 2010 as 2010 represents the first year in the energy efficiency program cycle. The first year of energy efficiency program cycles is often associated with a lag in the start-up of programs and a decline in the shares of high efficiency products. Following 2010, however, there was a substantial decline in the share of 700 Series T8s and an equally impressive increase in the share of Reduced Wattage T8 lamps. The dramatic increase in the share of high efficiency Reduced Wattage T8 lamps over this time period would be unobservable without the make and model analysis and the disaggregation of T8 lamps into efficiency designations.

Figure 3. Linear Lamp Efficiency Distribution, Recent Purchases (2009-2012), By Year of Purchase, Indoor Lighting



The disaggregation of the T8 recent purchase information into efficiency tiers also enables a description of the efficiency of recent purchases by business segments and business size. The disaggregation of these data into important domains of interest enables program planners to focus their programs on businesses where additional efforts may be needed to encourage customers to purchase high efficiency linears. Table 3 illustrates the efficiency distribution of recently purchased linear lamps by business size. These data clearly indicate that larger customers installed a larger share of high efficiency linear lamps than smaller customers. For Large customers, 26% of their linear lamps installed from 2009 to 2012 were First or Second generation and 63% were Third or Fourth generation. Medium customers installed 38% First and Second generation and 47% Third or Fourth while Small customer installed 49% First and Second and 44% Third or Fourth generation. Very Small customer had the largest share of First and Second generation lamps installed from 2009 to 2012 at 59% of their linear installations. Without the make and model analysis of T8 lamps, it would not be possible to determine that the "thin tubes" installed in the facilities of smaller customers were less efficient than those installed in the facilities of Medium and Large sized customers.

Table 3: Linear Lamp Efficiency Distribution, Recent Purchases (2009-2012) by Business Size - Indoor Lighting*

Efficiency Level	Large		Medium		Small		Very Small	
	Percent	**Relative Precision**	**Percent**	**Relative Precision**	**Percent**	**Relative Precision**	**Percent**	**Relative Precision**
Base Efficiency	26%	29%	38%	12%	49%	27%	61%	11%
High Efficiency	74%	10%	62%	7%	51%	26%	39%	18%
Base Efficiency Tiers Distribution								
T12	1%		<1%		<1%		2%	
Std 700 T8	23%		20%		36%		38%	
Std 800 T8	3%		18%		13%		21%	
High Efficiency Tiers Distribution								
High Performance T8	15%		18%		36%		25%	
Reduced Wattage T8	48%		29%		8%		12%	
T5	11%		15%		7%		2%	
LED	0%		<1%		<1%		0%	
n	**43,468**		**90,005**		**18,728**		**4,476**	

*** The results presented above have been weighted by site weight.** The fixture counts represent two light equivalent fixtures. Large sites have annual usage over 1,750,000 kWh, Medium have greater than 300,000 kWh and less than or equal to 1,750,000, Small have max annual usage greater than 40,000 kWh and less than or equal to 300,000, and Very Small have annual usage less than or equal to 40,000 kWh.

Recent purchases of T8 lamps were also analyzed by recent participation in a utility energy efficiency rebate program. Participant sites for this analysis are customers that received a rebate for linear lamps between 2009 and 2012 while non-participant sites are customer that did not receive a rebate for linear lamps during this time period.[8] Table 4 presents the disaggregation of recent purchases of linear lamps by energy efficiency program participation. These data indicate that program participation purchased higher efficiency lamps than non-participants. For participants, 66% of their linear lamps purchases between 2009 and 2012 were Third and Fourth generation T8s while 36% of linear lamp purchases during this time period by non-participant customers were Third and Fourth generation. The relatively large share of Third and Fourth generation lamp purchases by non-participants clearly indicate that the linear lamp market was transitioning to higher efficiency lamps while the 38% share of First generation T8 lamps also indicates that a substantial share of the market was choosing the least efficient T8 lamp.

[8] Non-participant sites may have receive rebates for other technologies.

Table 4. Linear Lamp Efficiency Distribution, Recent Purchases (2009-2012), by Participation in a Linear Technology Energy Efficiency Program – Indoor Lighting

Performance Group	Linear Technology EE Program Participant	Linear Technology EE Non-Participant
Base Efficiency	23%	56%
High Efficiency	77%	44%
Total	**100%**	**100%**
4-foot T12	<1%	1%
4-foot Std 700 T8	11%	38%
4-foot Std 800 T8	12%	16%
4-foot High Performance T8	29%	23%
4-foot Reduced Wattage T8	37%	13%
4-foot T5	11%	8%
4-foot LED	<1%	<1%

* **The results presented above have been weighted by site weight.** Large sites have annual usage over 1,750,000 kWh, Medium have greater than 300,000 kWh and less than or equal to 1,750,000, Small have max annual usage greater than 40,000 kWh and less than or equal to 300,000, and Very Small have annual usage less than or equal to 40,000 kWh.

Conclusions

The Energy Policy Act banned the production or importation of 700 Series T8s after July 14, 2014. This Act effectively eliminates the ability of customers, implementers, and program planners to classify linear technologies by their common size groupings T12, T8, and T5. It is necessary to disaggregate T8 lamps into their efficiency categories of First Generation 700 Series T8, Second Generation 800 Series T8, Third Generation High Performance T8, and Forth and Fifth Generation Reduced Wattage T8 lamps. Creating the disaggregation of T8 lamps into their appropriate generation requires the collection of information on the make and model numbers of the lamps. The analysis of make and model numbers is a very labor-intensive manual process, but the outcome of the process is highly informative for future program planning. Developing make and model lookup databases allows for the development of a detailed understanding of the distribution of T8 lamps within your customer segments.

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