



# The Rise of TLEDs: What Have we learned?

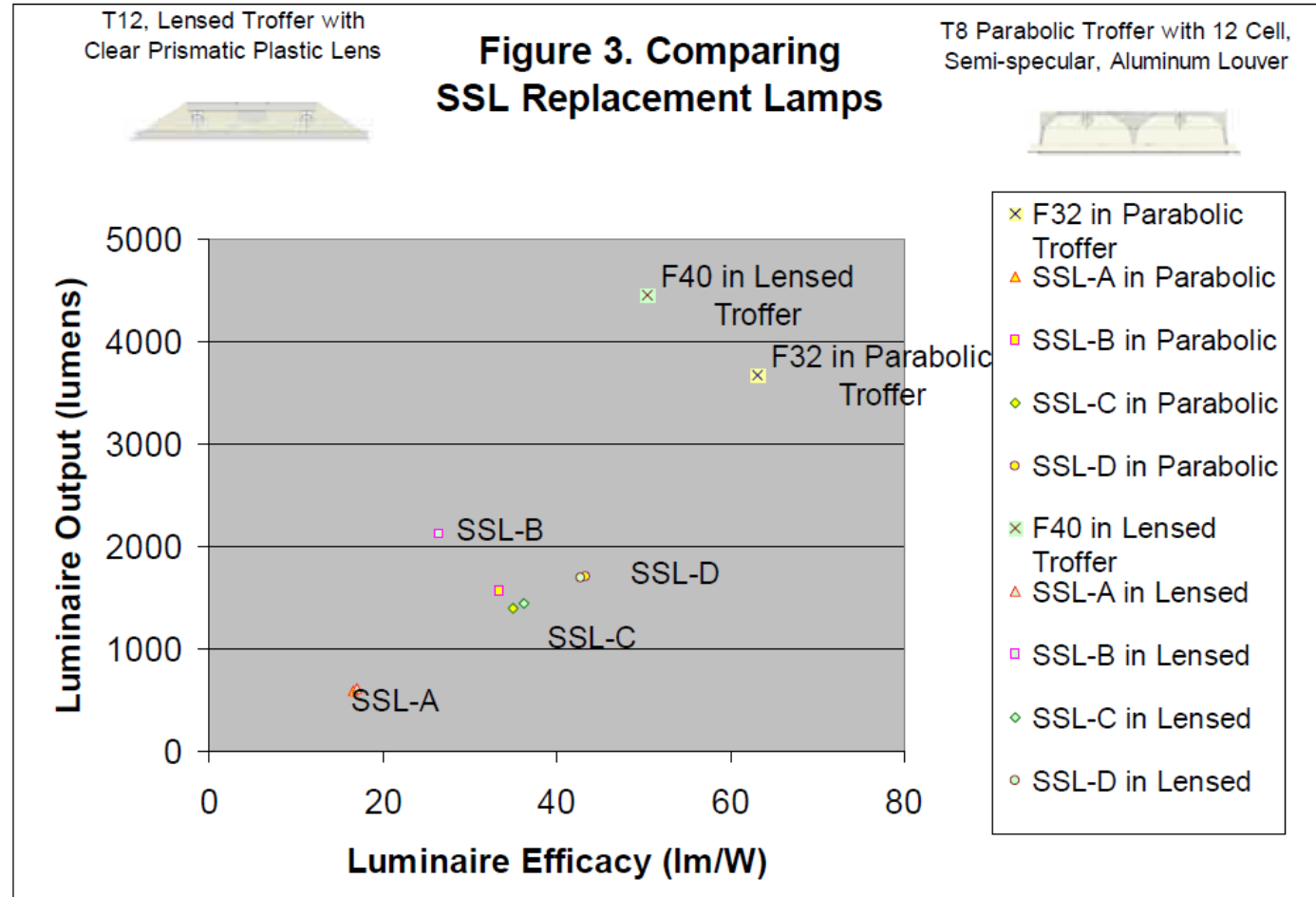
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## Utility Perspective

Teren Abear, PE  
Emerging Products  
Southern California Edison

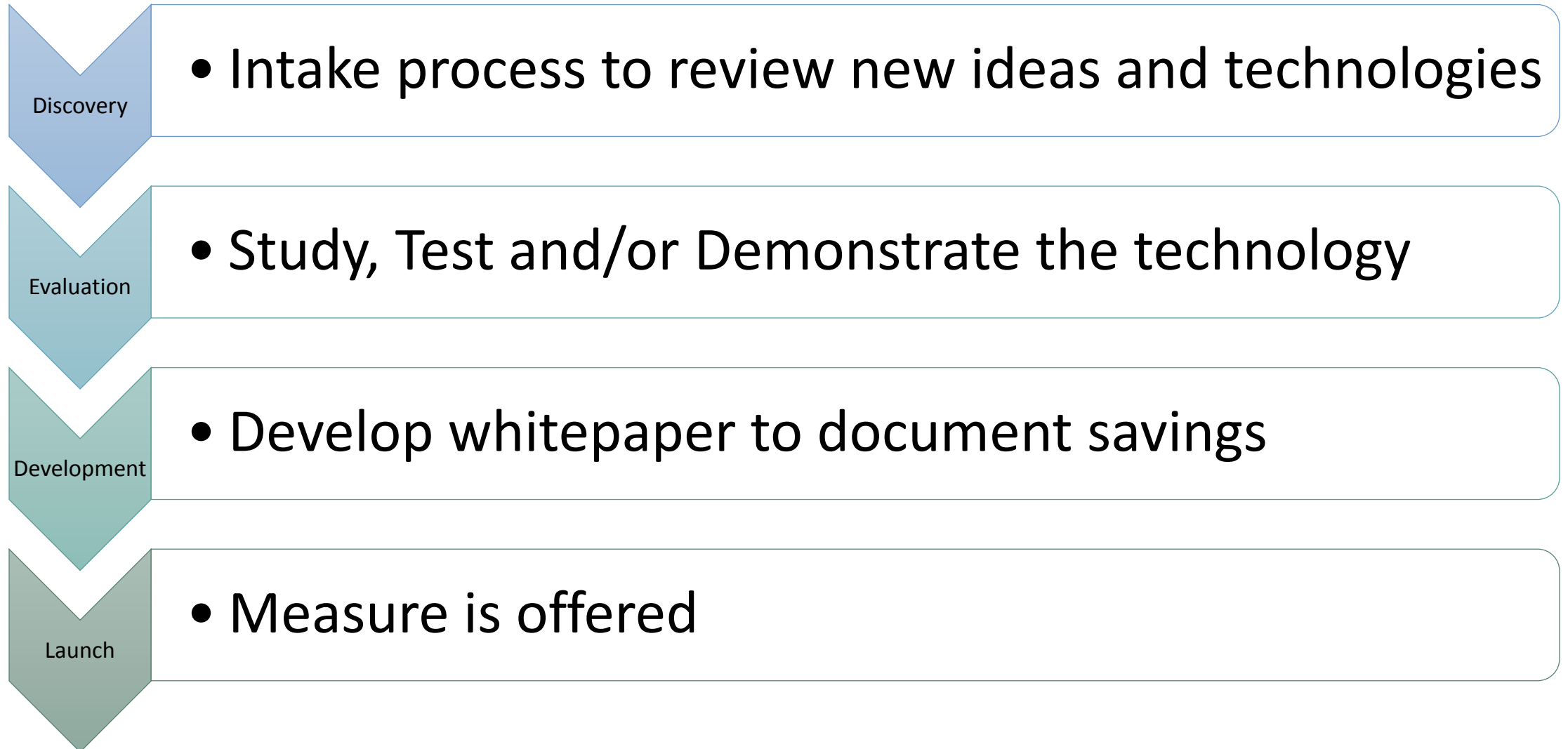
# Remember When...

From the May 2008 CALiPER Summary Report

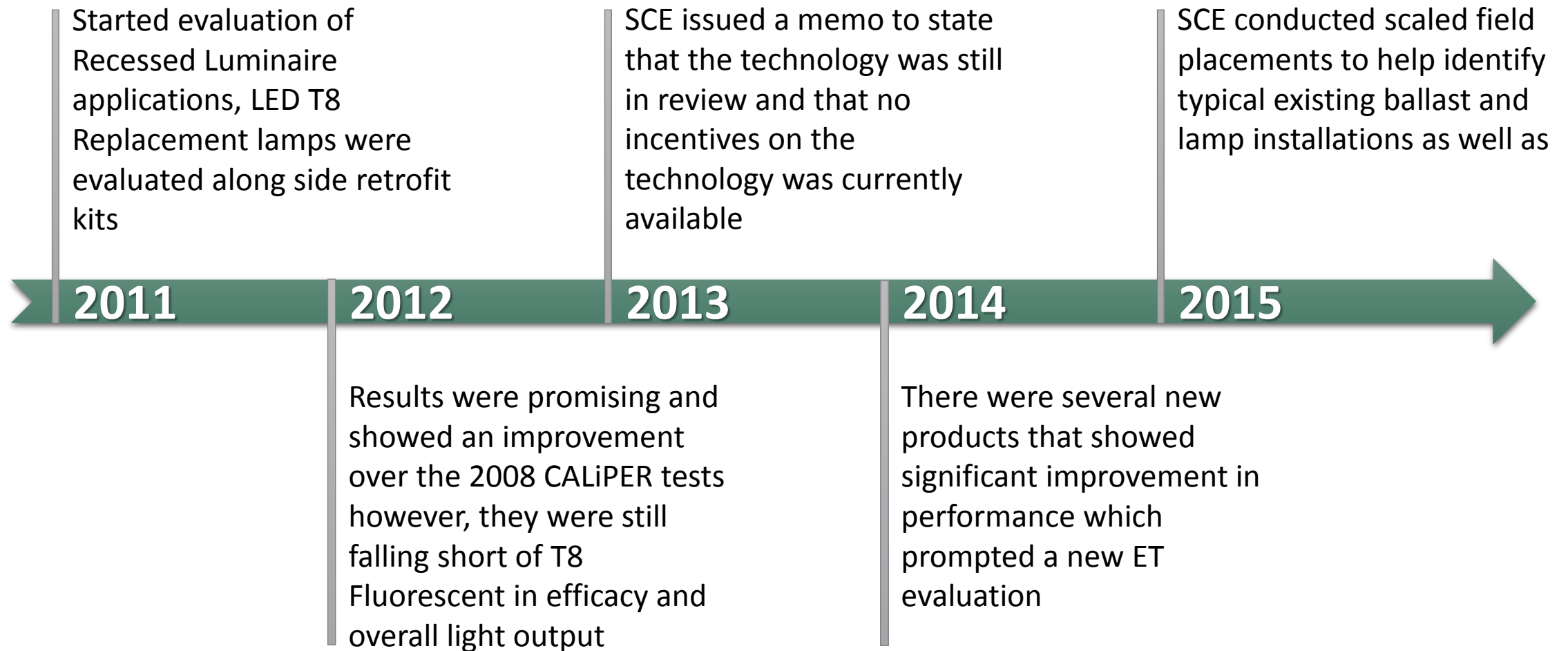


- 4 different SSL replacement tube products were used (2 samples each)
- SSL-B uses troffer ballast. SSL-A, C, & D bypass troffer ballast

# Utility Processes



# Technology Evaluation Timeline

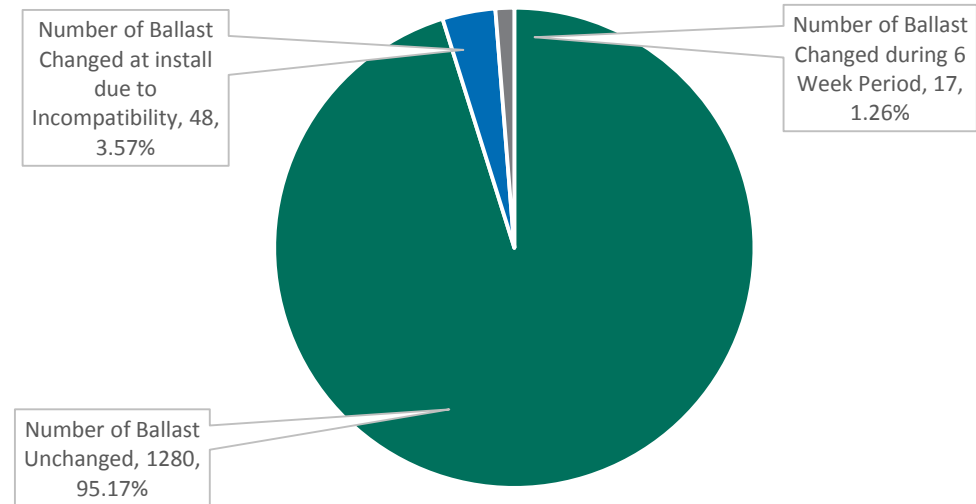


# Field Trials

- **Scaled Field Placement – Customized (Completing)**

- Sampled over two dozen installations of TLEDs through the Custom Program
- Documented existing equipment
  - Luminaire Type, Number of Lamps, Ballast and Lamp Make and Models
  - Tracked installed TLEDs and existing Ballasts
  - Checked at 6 Weeks and at 1 year/4,380 hours Post-Install
- Over 75,000 Lamps installed
  - 1,539 Ballasts Inspected
  - 1.26% of the ballasts replaced within the 6-Week Period

Sampled Ballasts Distribution



- **Midstream Offering (In Progress)**

- Gathering additional ballast and lamp data from the Midstream Offerings

# Long Term Testing

- Phase II Lab Testing

- 1 Year of data collection
- 4 different LED Lamps
  - 3 TLEDs in 2-Lamp Configuration
  - 1 TLEDs in a 1-Lamp Configuration
  - Fluorescent in 2-Lamp Configuration
- Lamps cycled at the following rates:
  - 9 hrs Off
  - 7 hrs On
  - (1.5 hrs On -> .5 hrs Off) x 4
- Lamps were measured in the integrating sphere Bi-Weekly for the first several months, then monthly there after
- Approx. 4,700 hours of On- time



TABLE 12. PHASE II - EVALUATION SCHEMES AND MEASUREMENTS

MEASUREMENT TYPE	EVALUATION SCHEME		
	POWER CYCLING	DARK ROOM	LM-79
Electrical	Ballast input	Ballast input and lamp input	Ballast input
Thermal	Ballast and lamp surfaces	Ballast and lamp surfaces	Inside and outside sphere ambient
Photometric	None	Illuminance at 10 different points along lamps	Total lumen output, CRI and CCT

# Drivers

- Being Green



- Energy Efficiency



- Having more Green



- There are many drivers that are pushing TLEDs, but it ultimately comes down to the cost. The cost to purchase, the cost to install, the cost to operate.
- There are dedicated LED retrofit kits and luminaires however it depends on how you view your cost...
  - Upfront Cost, Maintenance Cost, Life Cycle Cost, Simple Payback, ROI, etc.

# The Options

- TLED

- (UL Type A) Replacement lamp using existing fluorescent ballast
- (UL Type B) Replacement lamp that bypasses the ballast and operates on line voltage

- Retrofit Kit

- Lamp with Remote Driver (UL Type C)
- Replacement Lamp (UL Type A) with Remote Driver
- LED Strips or Arrays or Tubes with Dedicated Driver (May include reflectors and/or lenses)

- New Luminaire

- Dedicated luminaire designed from the ground up around LED technology
  - Optimized Optics, Electronics and Housing
- May have integrated controls capabilities

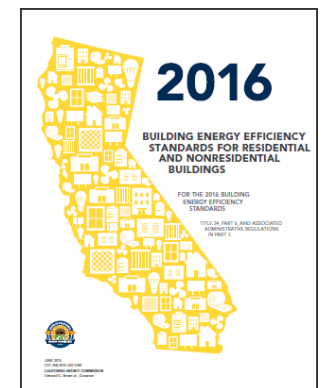
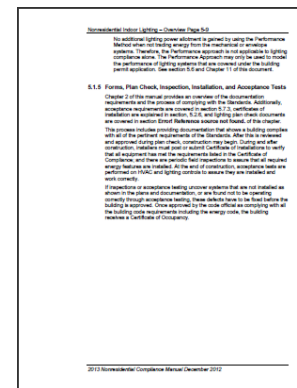
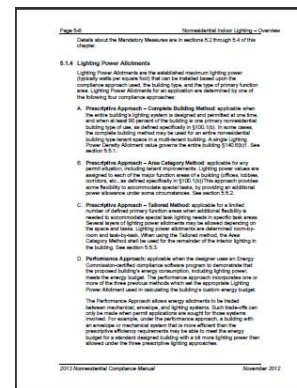
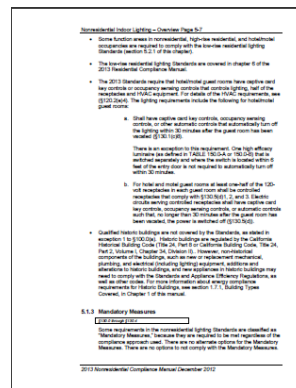
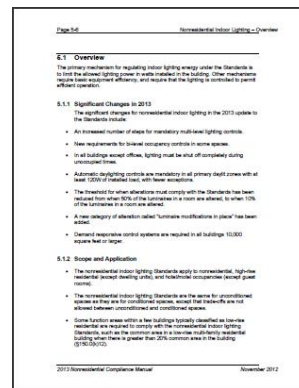
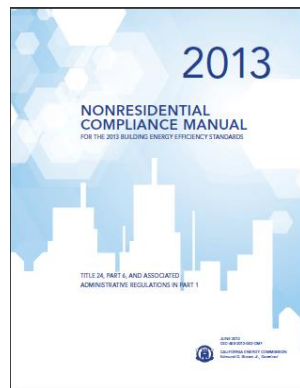


# Pros and Cons

	Pros	Cons
<b>Ballast Compatible LED Replacement Lamp</b>	<ul style="list-style-type: none"> <li>• Low Cost per Lamp &amp; Installation</li> <li>• Quickest Installation</li> <li>• Does Not Trigger Code</li> </ul>	<ul style="list-style-type: none"> <li>• Not compatible with all ballasts</li> <li>• Ballast may be at or past End of Life</li> <li>• Potential for retrograde</li> </ul>
<b>Line Voltage LED Replacement Lamp</b>	<ul style="list-style-type: none"> <li>• Does not need a ballast</li> <li>• Will require rewiring</li> <li>• Does not allow for easy retrograde</li> </ul>	<ul style="list-style-type: none"> <li>• Additional cost to rewire</li> <li>• Uses Line Voltage</li> <li>• Can Trigger Code</li> </ul>
<b>Retrofit Kit</b>	<ul style="list-style-type: none"> <li>• Utilizes existing luminaire housing</li> <li>• Can include new optics</li> <li>• System with dedicated LED driver</li> <li>• More options for Controls</li> </ul>	<ul style="list-style-type: none"> <li>• Additional Installation Costs</li> <li>• Costs more than just a lamp replacement</li> <li>• Can Trigger Code</li> </ul>
<b>New Luminaire</b>	<ul style="list-style-type: none"> <li>• Optimizes overall lighting design</li> <li>• Longest Effective Useful Life</li> <li>• Option for integrated controls</li> <li>• Eliminates potential for retrograde</li> </ul>	<ul style="list-style-type: none"> <li>• Most costly per luminaire</li> <li>• Higher installation costs</li> <li>• Can Trigger Code</li> </ul>

# The Code

- Energy Codes vary among each State
- In California there are two codes that can impact TLEDs
  - Title 20
    - Appliance Codes which set minimum specifications for the actual products
  - Title 24
    - Building Energy Codes which set minimum efficiency for the lighting within a space
    - Currently changing out a Fluorescent T8 Lamp with an LED T8 Replacement lamp does not Trigger Code



# Incentives

- **Calculated vs Prescriptive**

- Calculated

- Rebate amounts are calculated by multiplying the savings of the measure from the baseline technology and a set monetary rate
    - May require Pre and Post inspections to document savings amounts

- Prescriptive (AKA Deemed)

- Rebates are fixed amounts per widget
    - Simpler and quicker to administer, but requires upfront documentation of energy savings prior to offering the measure

- **What are Utilities doing?**

- The California IOU's are working towards developing State-Wide incentive offerings for TLEDs

- Currently undergoing data gathering to support savings documentation for prescriptive measure

- There are several Municipal Utilities in California with rebates available for TLEDs

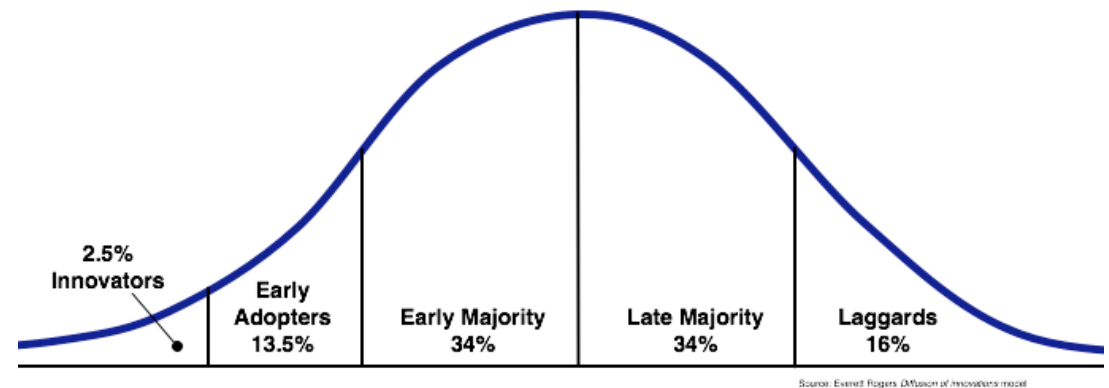
- Many other Utilities across the country have incentives

# Where the Market is Currently

## A Sample of Product Listings

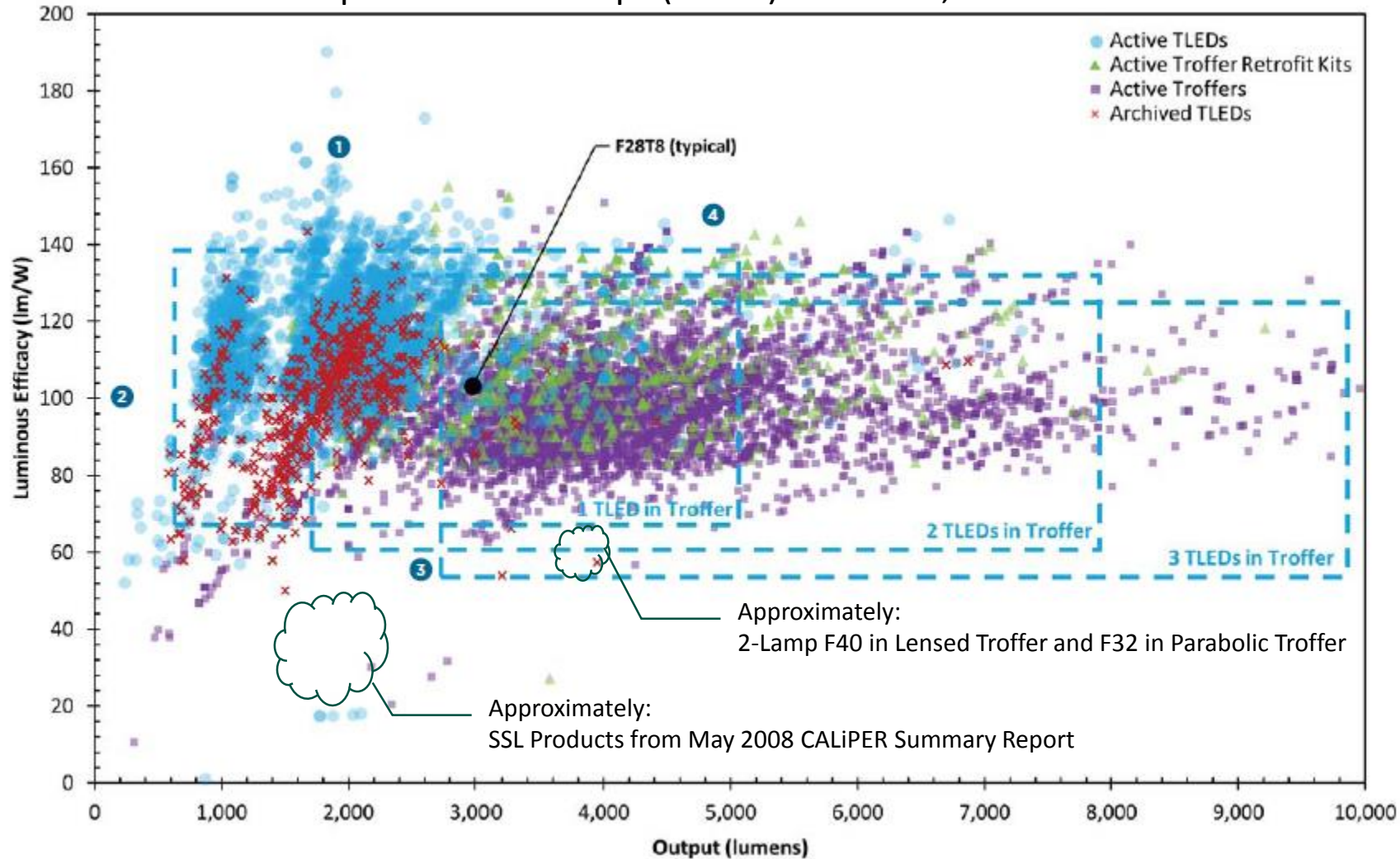
- 44,091 Total Active Products on Lighting Facts
  - June 17, 2016 CALiPER Snapshot Linear Lamps (TLEDs)
- 16,684 Total Currently Listed Products on the DLC Qualified Products List
  - November 4, 2016 – Search of DLC QPL

There are many options for lamps with various performance and compatibilities and each application or installation may require different specifications.



# We Remember When...

## CALiPER Snapshot Linear Lamps (TLEDs) – June 17, 2016



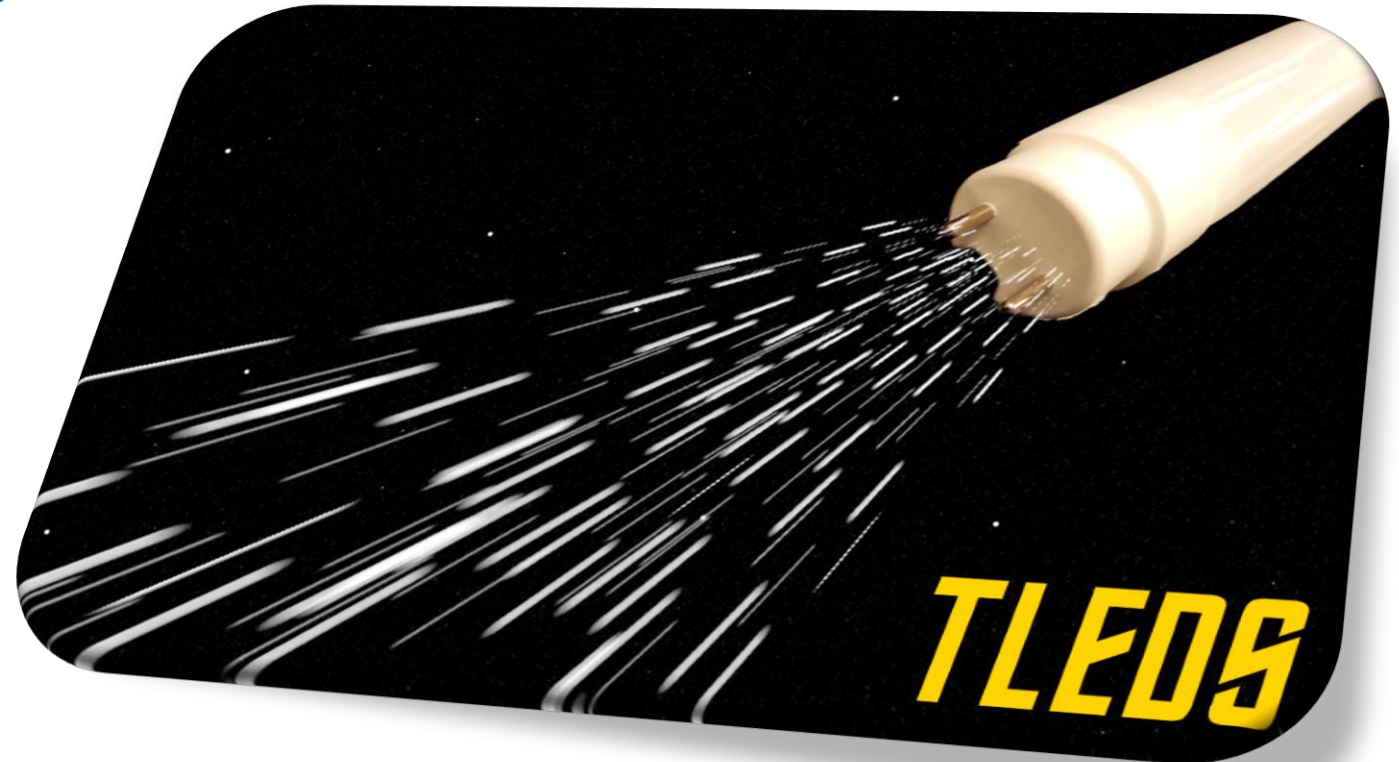
# The Trek Beyond

TLEDs are continuing to evolve adding more capabilities and applications

- Efficiency is still increasing
- Costs are reducing
- Enhanced controls and compatibilities
- Color Tunability

## New Applications

- T5 Compatible TLEDs
- T12 Compatible TLEDs



Thank you!



## **Teren Abear, PE**

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