

# Performance Insights on Solid State Lighting

ACEEE Market Transformation Conference  
Joey Barr- PG&E  
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- Market Transformation vs. Resource Acquisition
- SSL Challenges
- PG&E's Work to Address SSL Challenges





# Market Transformation vs. Resource Acquisition

## Tradeoffs within efficiency programs

- Need cost effective energy savings
  - One metric is Total Resource Cost (TRC)

$$\text{TRC (Ratio)} = \frac{\text{Gross Energy Savings (e.g. kWh*)} \times \text{Avoided Costs (e.g. \$/kWh*)} \times \text{NTG} \times \text{ISR} \times \text{GRR}}{\text{Administrator Costs (\$)} + \text{Net Participant Costs (\$)} + \text{Free Rider Incentive Costs (\$)}}$$

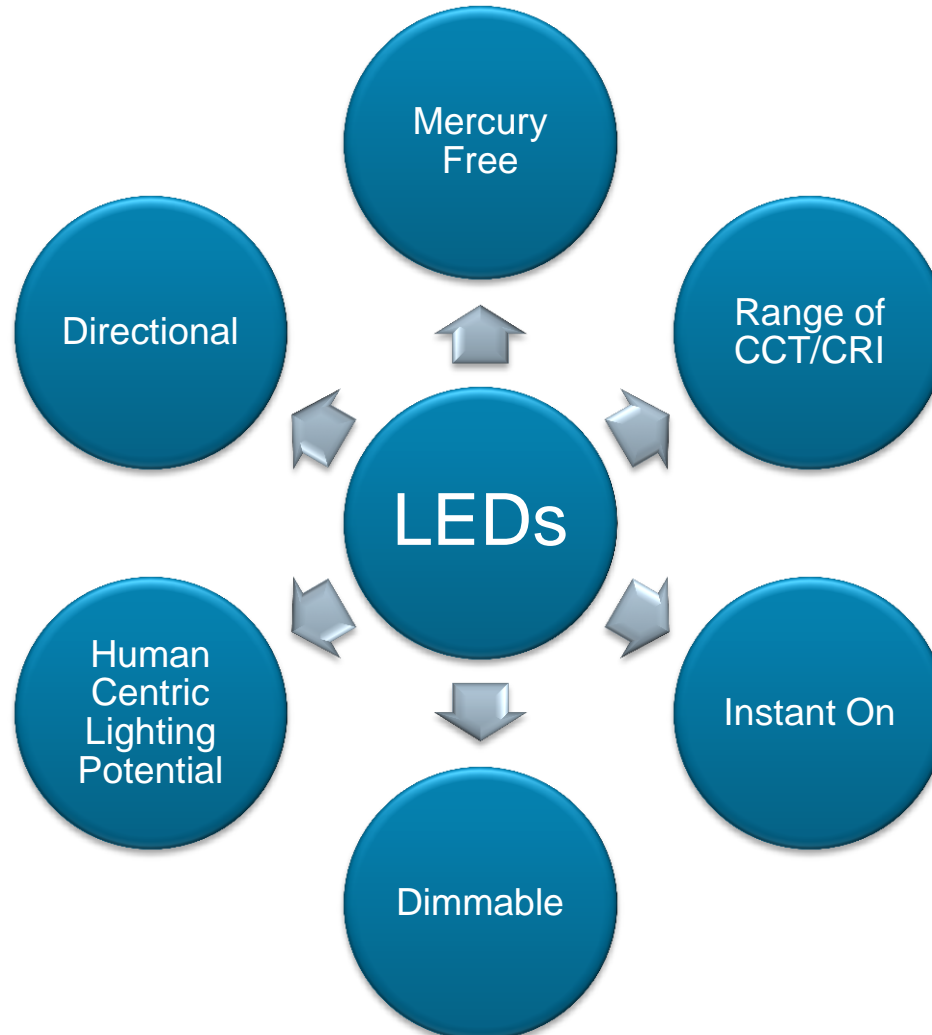
- Balance with support for newer, more expensive technologies
  - Examples:
    - Linear fluorescent vs. LED fixtures
    - CFLs vs. LED replacement lamps





# Why LEDs?

In addition to substantial energy savings, LEDs have other benefits over existing technologies



# SSL Challenges



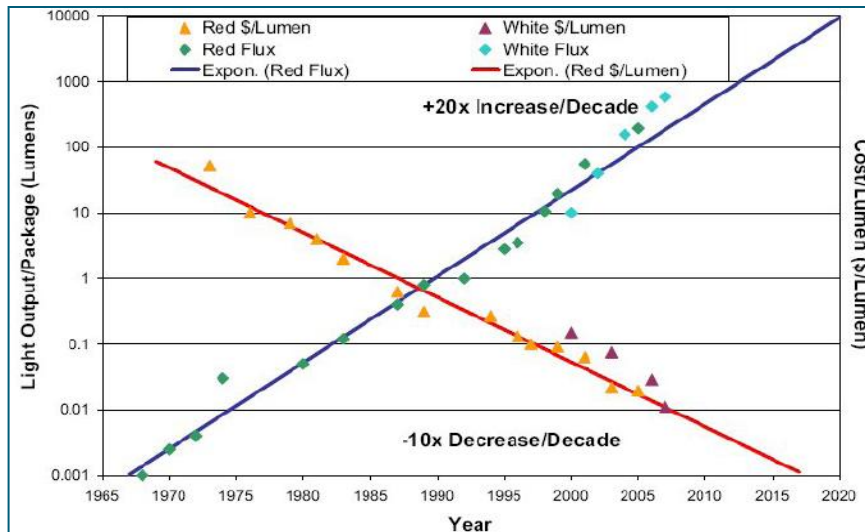


# High Cost Per Lumen

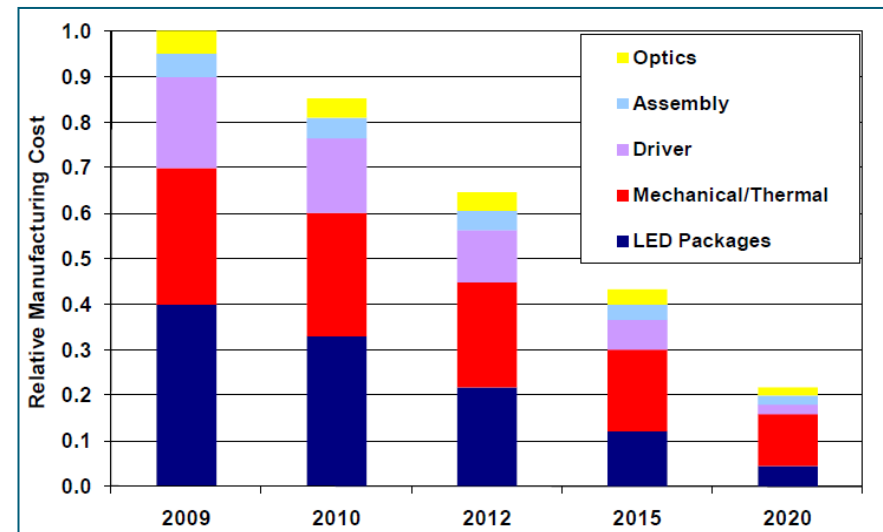
## LEDs Are Expensive, But Costs Are Decreasing

- Rapidly coming down the cost curve
  - Prices have dropped 10x/decade
  - Efficiency has improved 20x/decade

### Haitz's Law: LED Light Output Increasing/ Cost Decreasing



Source: DOE 2008 Multiyear Program Plan, referencing Roland Haitz and Lumileds



Source: Solid-State Lighting Research and Development: Manufacturing Roadmap, July 2010, DOE Manufacturing Workshop consensus



# Potential Quality Issues

## General Issues

- Dimmability
- Lifetime
- Color Quality
- Driver Lifetime/Reliability

## Specific Products

- MR16s
- T8 Replacement Lamps

## Channel Issues

- Residential
- Commercial

# What Needs to Happen? How Are We Addressing These Issues?







# Emerging Technology Projects/Assessments

**PG&E has a number of projects focused on quality issues**

- LED High Bay Fixtures/Retrofit Kits
- T8 LED Replacement Lamps
- Advanced Lighting Controls- Interior
- Adaptive Exterior Lighting Controls
- LED Replacement Lamps

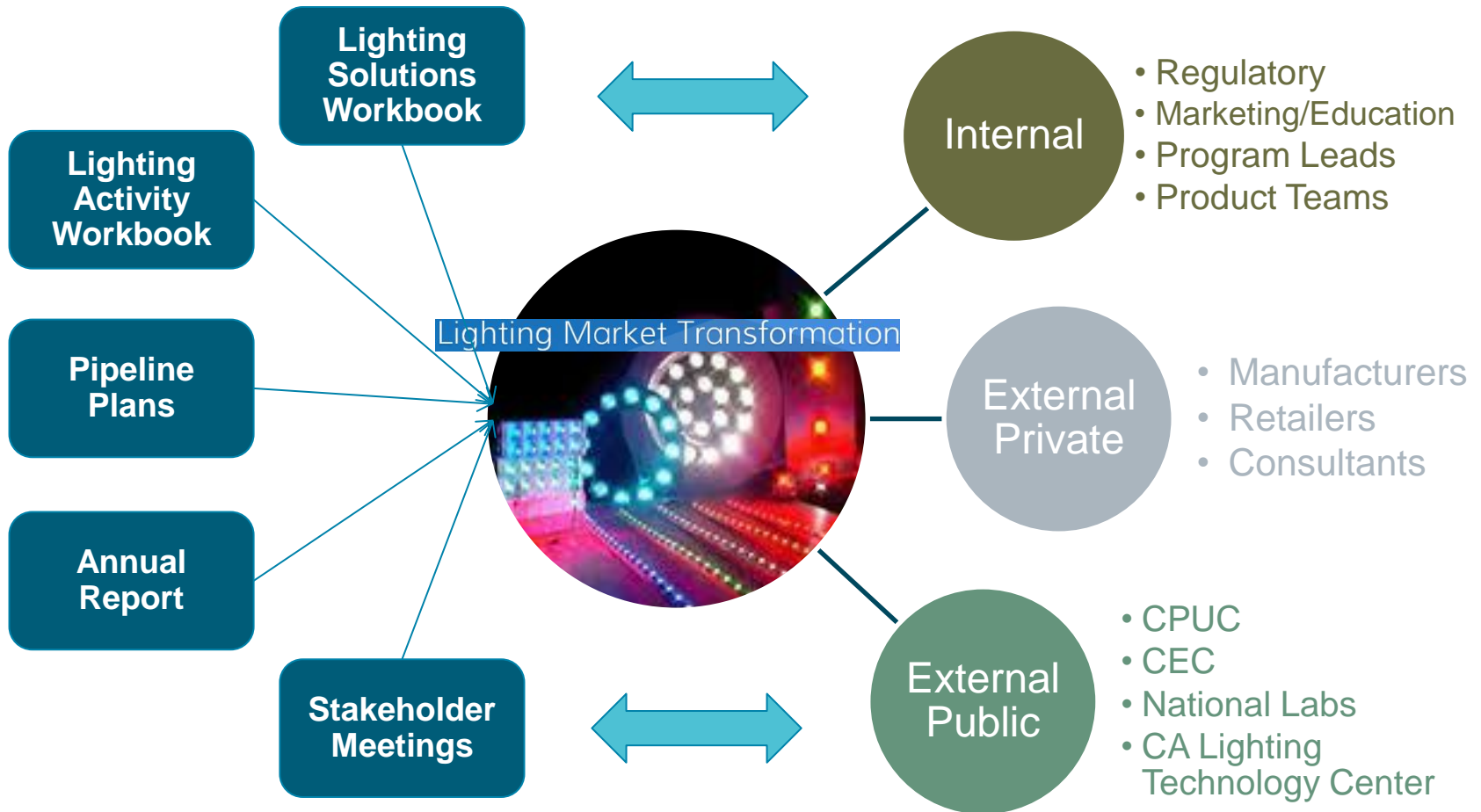


<http://www.etcc-ca.com/>



# Lighting Market Transformation (LMT) Program

Lighting Market Transformation (LMT) Program is a joint initiative with California Investor Owned Utilities (IOUs)



<http://www.lightingmarkettransformation.com/>



# Collaboration with External Stakeholders

PG&E collaborates and provides input to many different external organizations.



CALIFORNIA ENERGY COMMISSION



DESIGNLIGHTS CONSORTIUM

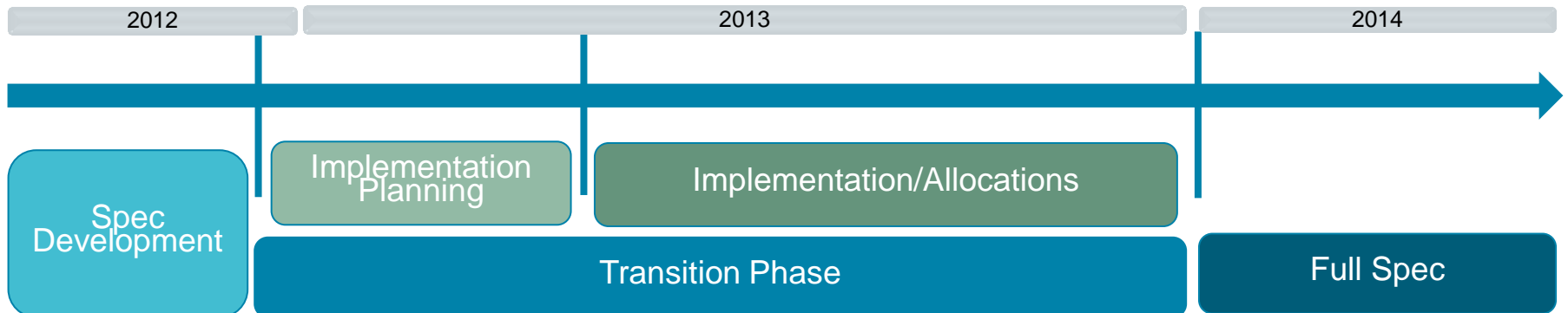




# California LED Quality Specification

The California IOUs collaborated on the creation of a Specification focused on higher quality LEDs

- Equivalent to ENERGY STAR Plus
- Focus on quality parameters
  - Color
  - Dimmability
  - Lifetime
- Timeline





# TopTen Collaboration

## Assessed key parameters of LED replacement lamps- quality can mean many different things

- Highlight high quality, efficient products that consumers will enjoy using
- Reduce the occurrence of a negative first-time experience with LED lamps

SCORING CATEGORIES	WEIGHTING (POINTS)
<b>Energy</b>	<b>24</b>
Efficiency exceeds ENERGY STAR requirements (15% or better)	11
Beam efficiency	10
Power factor	3
<b>Economics</b>	<b>20</b>
Simple payback	10
Cost of light	10
<b>Laboratory measured performance</b>	<b>31</b>
Lumen output (measured vs. rated)	10
CRI variance (color rendering index)	9
DUV (delta UV)	4
Dimming behavior (on incandescent dimmer)	10
<b>Human factors</b>	<b>22</b>
Paired comparison evaluation	22
<b>Physical</b>	<b>3</b>
Weight	3
<b>Highest Possible Score</b>	<b>100</b>





# Lighting For Tomorrow

## Competition to support development/market introduction of high quality, energy efficient residential lighting

- 2013 SSL Competition: Launched in January
  - LED fixtures, retrofit kits, replacement lamps (focus on senior lighting)
  - OLEDs
- Opportunity to review newest residential lighting products in an independent setting (rather than trade show)
- Mechanism to provide feedback to manufacturers on product improvements
- Winning products signal important quality parameters to the industry



## We have a lot of work to do

- More collaboration/communication between stakeholders
- More resources are needed for market transformation
  - Products
  - Processes/Innovative Models
- Realize that there is a win-win-win solution

