

# LED TRACK I: LUMINAIRE INTEGRATION, DRIVERS, AND CONTROLS

...opportunities and challenges for developing luminaires that demonstrate value beyond traditional lighting expectations

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# The Changing Landscape of Design and Applications

“Old” Fluorescent  
Multifunction Luminaire



Energy Efficient  
Good color rendition  
Limited control



Remodeled  
“Better” Fluorescent  
Multifunction Luminaire



Energy Efficient  
Good color rendition  
“Improved” control



PNNL Patient Room Survey, 2015



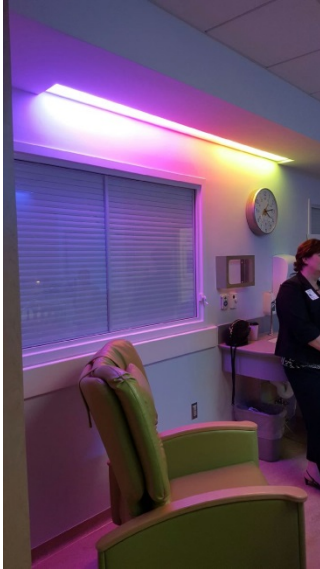
PNNL Patient Room Survey, 2015



# The Changing Landscape of Design and Applications

Today

Tunable White + Color Accent



**Patient & Family-centric for comfort**  
**Circadian support**  
**Automated & Integrated control**  
**Energy Efficient**



Tomorrow

Tunable Hue



**Patient & Staff-centric**  
**Circadian support and Wellness**  
**Connection with sky**  
**Automated & Integrated control**  
**Energy Efficient**

# Market Drivers and Influencers

## Research Community

Sleep  
Circadian regulation  
Health & Well-being  
Productivity



## Design Community



IALD



The Center for Health Design



AIA

## Standardization Community



**International WELL Building Institute**

**Mission:** To bring human health to the forefront of building practices

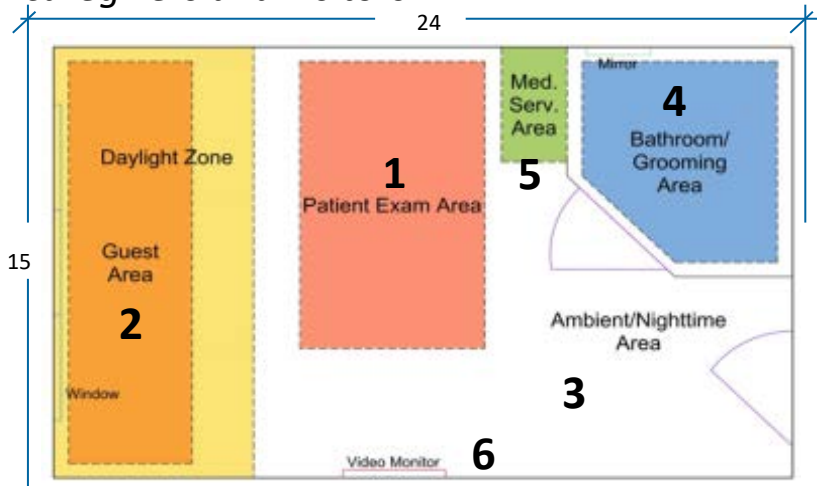
## WELL Buildings Quick Facts

- Globally
  - 333 registered projects
  - 14 certified
  - Total 71 million square feet
- USA
  - 152 of the registered projects
  - 10 certified projects

# DOE Project Overview

## Goal

*Develop an innovative LED patient suite (patient room and bathroom) lighting system solution that is energy-efficient and will meet the visual and non-visual needs of patients, caregivers and visitors.*

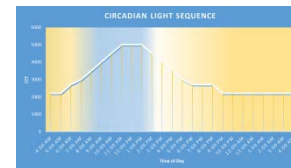


## DOE Application Area Criteria for Visual Performance

Illuminance	Horizontal/Vertical
Uniformity	3:1 Typical
Spectrum – Night lighting	>600 nm
Color	80 Min/ 85 Min for Exam
CCTs	2700K, 5000K + 2
Luminaire Efficacy	120 LPW
Controllability	100% to 1%
Energy Efficiency	40% below incumbent

## Philips Goals – Nonvisual

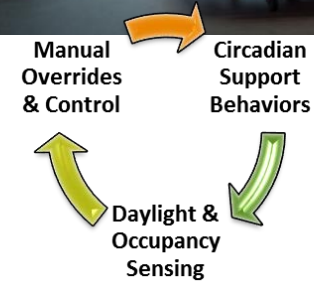
- Circadian support for patients, staff and family
- Light levels and spectrum adaptability to coordinate with 24hr day tempo
- Connection to nature to support well-being



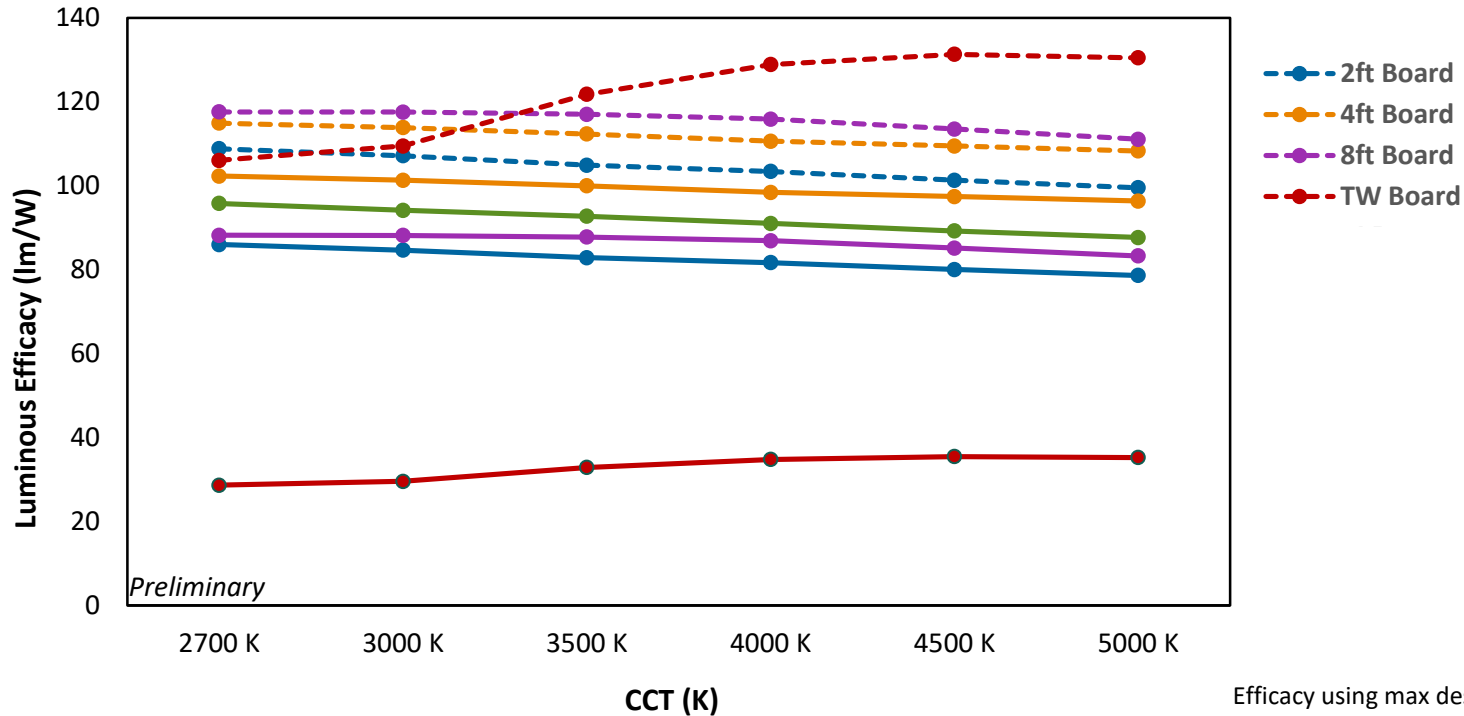
**PHILIPS**

# System Solution Overview

- Tunable platform enables spectral tuning for circadian support
- Skylight luminaire makes connection to the outdoors
- Low-glare luminaires
- Peripheral “light envelope”
- Multichannel platforms
- Daylighting control
- Vacancy sensing
- Manual overrides
- Integrated auto/ manual control



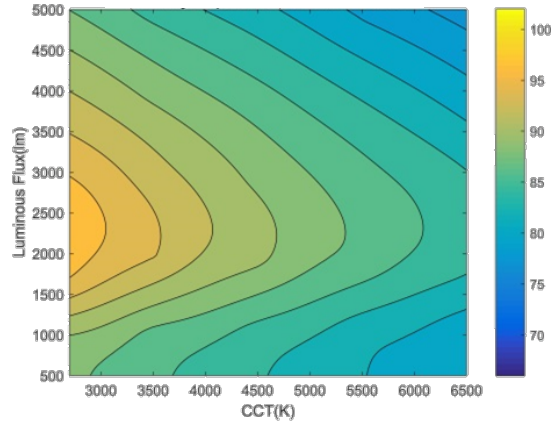
# Board & Luminaire Efficacy by Platform Across CCTs



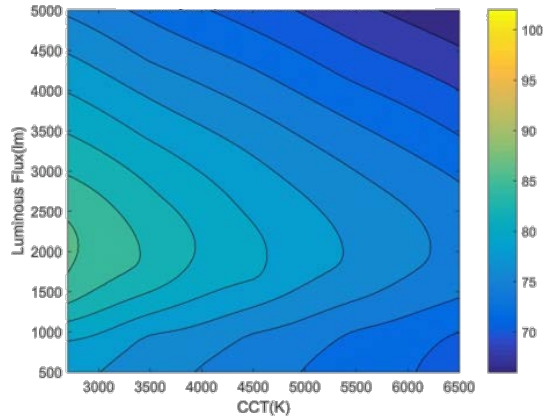
Efficacy using max design lumens

# Efficacy Maps – Board Length & Luminaire Type

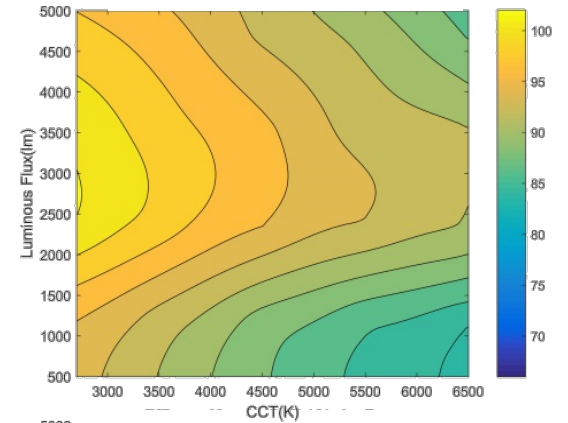
2' Board  
Surf. Mounted  
2' Linear



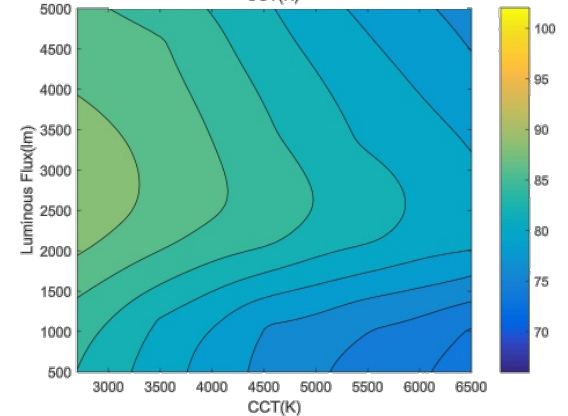
2' Board  
Recessed 2' Lin.



4' Board  
Surf. Mounted  
4' Linear

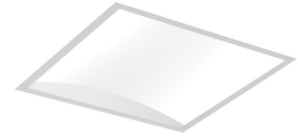


8' Board  
Recessed 2X2

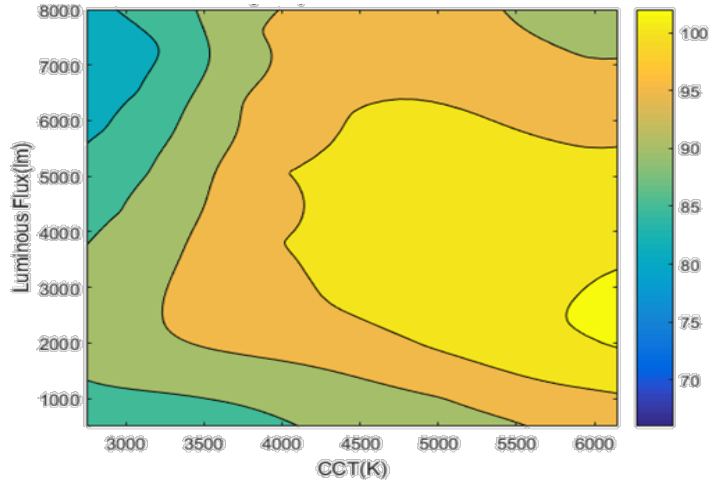




# Efficacy Maps – Platform Difference

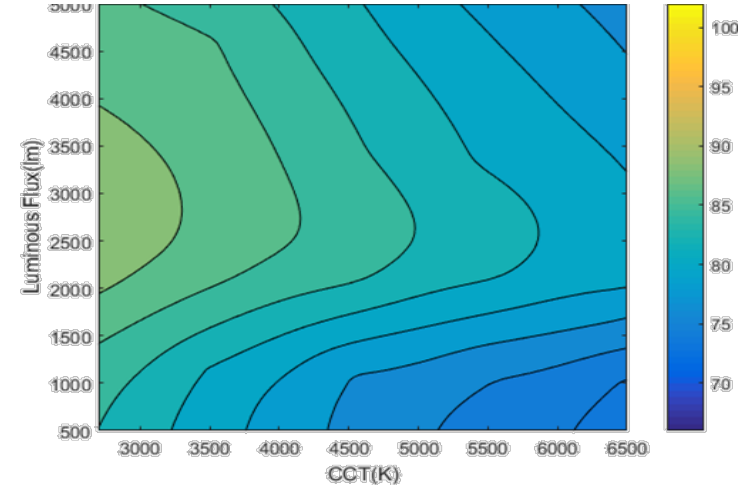


2-Channel platform



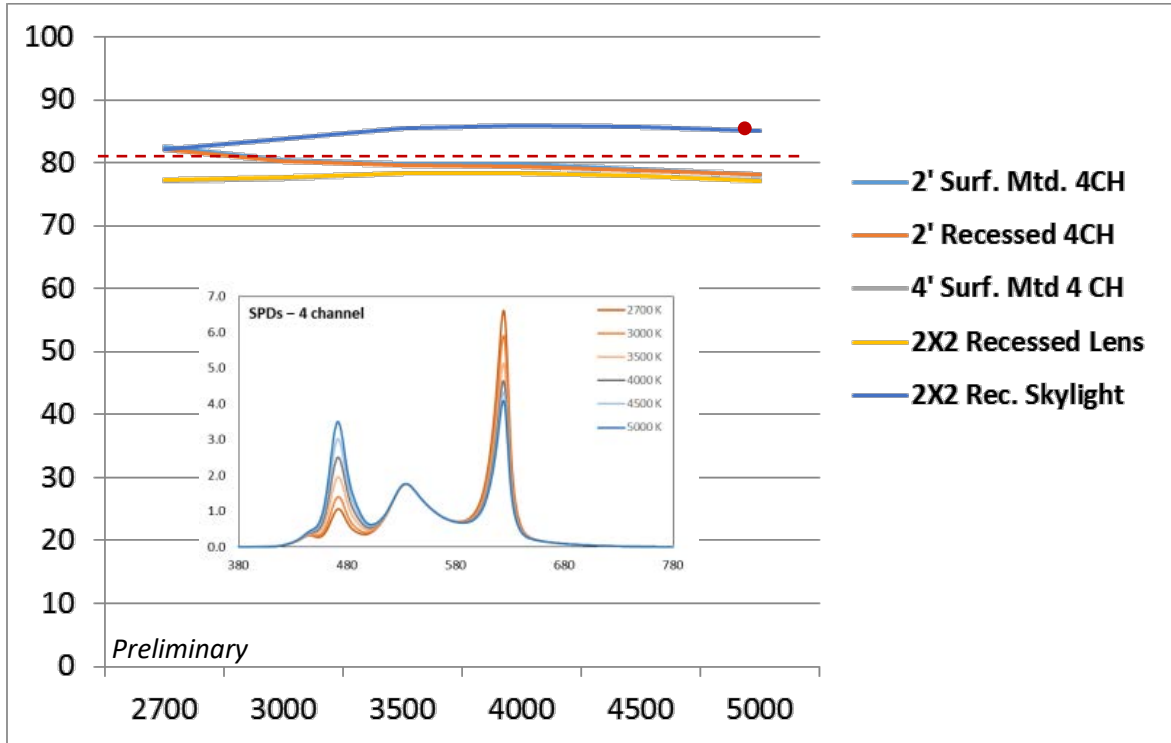
Tunable White  
2700K – 6500K

4-Channel platform

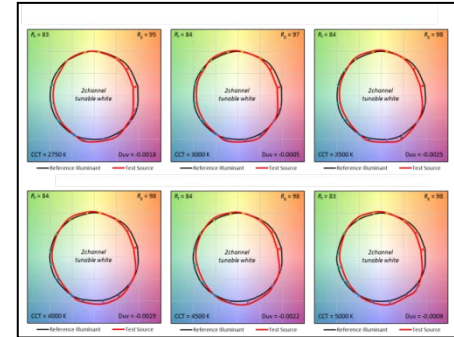


Tunable White +  
Tunable Hue

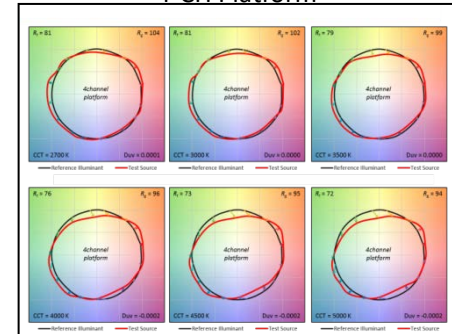
# CRI Across CCTs for Each Luminaire



2-CH Platform



4-CH Platform



# Energy Performance Comparison

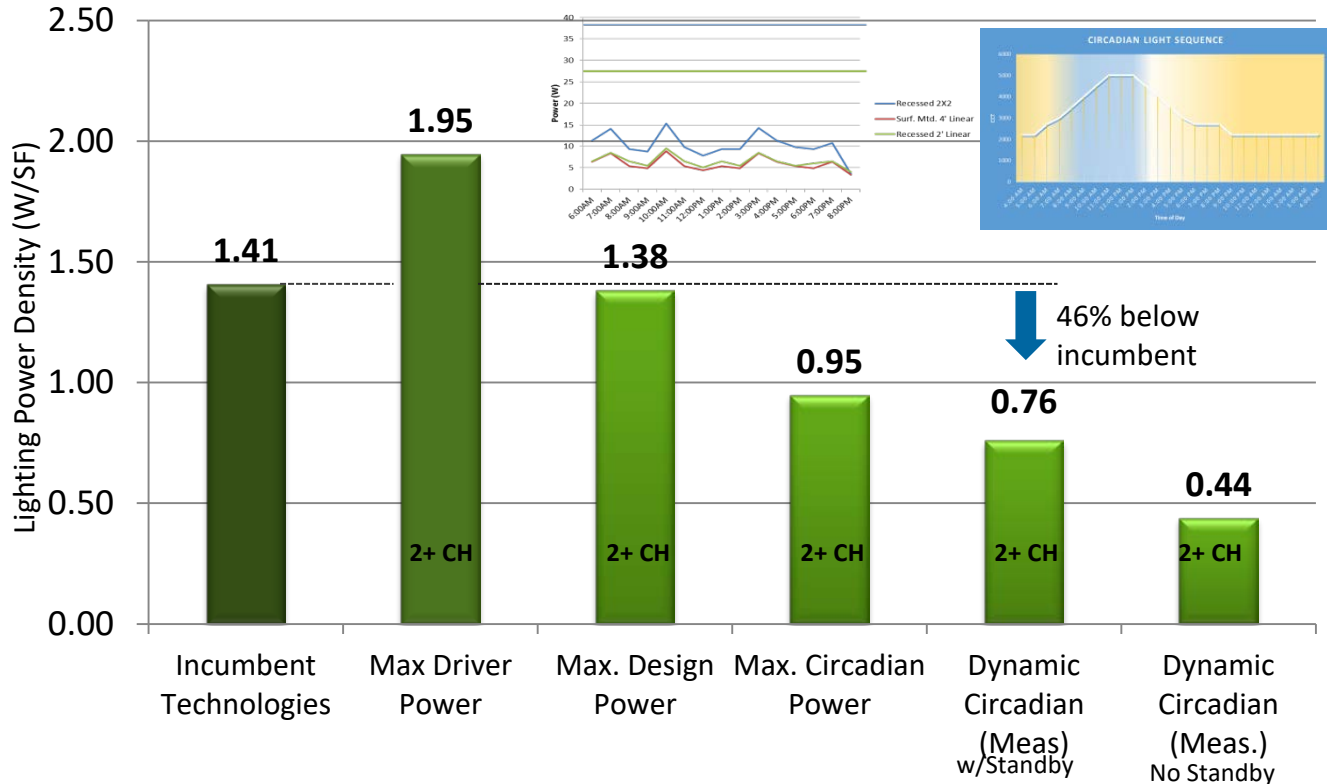
## Incumbent

- Linear Fluorescent
- CFLs

Compared to:

## Design Solution

- 2+ CH Tunable Color



# Summary

- Multichannel lighting systems provide opportunities for
  - Well and Healthy environments for people
  - Energy efficiency
- Challenges
  - Designing for positive health and well-being outcomes (metrics)
  - Traditional ‘energy first’ thinking
  - Quantifying the performance of multichannel systems
- HOW do we move forward?
  - Systems-centric and performance-based systems thinking
  - Rethink Luminaire Efficacy
  - More Application guidance
  - Metrics, metrics, metrics

# Acknowledgements

## **PLRNA Team:**

Patricia Rizzo

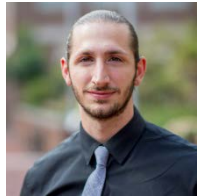
James Kim

Tony Esposito

Ron Li

Dan Zambienki

Jia Hu



A photograph of three business professionals in a bright, modern office setting. A man in a suit is on the left, looking towards a woman in a white dress who is holding a tablet. Another woman is on the right, looking towards the woman with the tablet. The scene is brightly lit, suggesting natural light from large windows.

**Humans need light –**

**Questions???**

