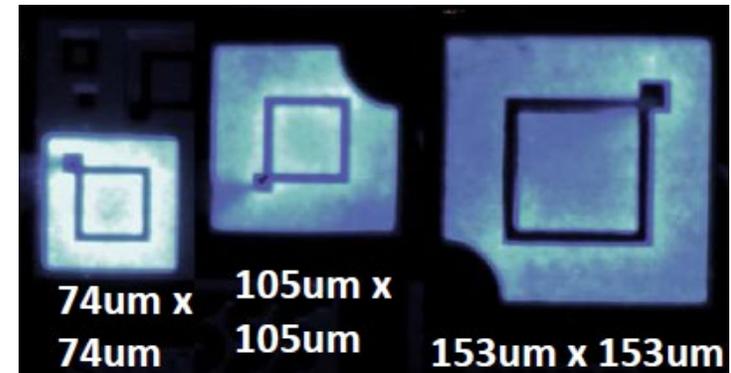
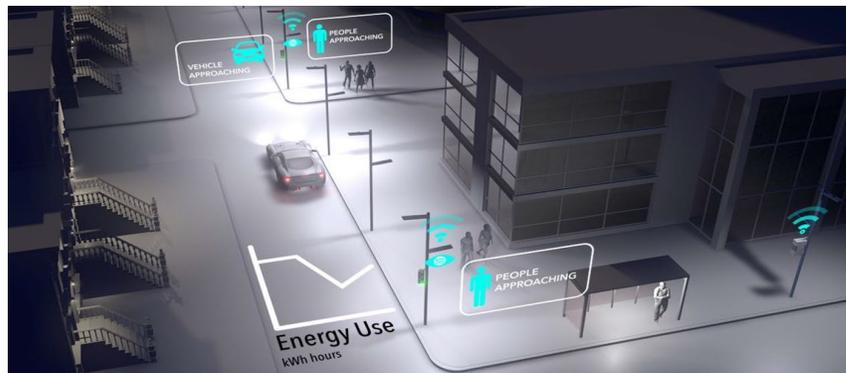
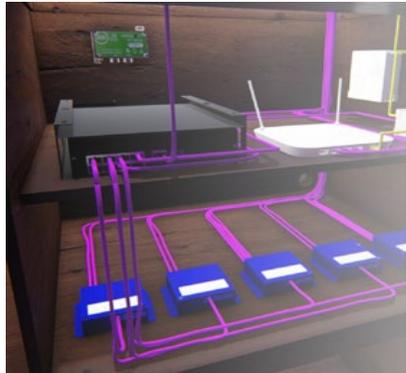
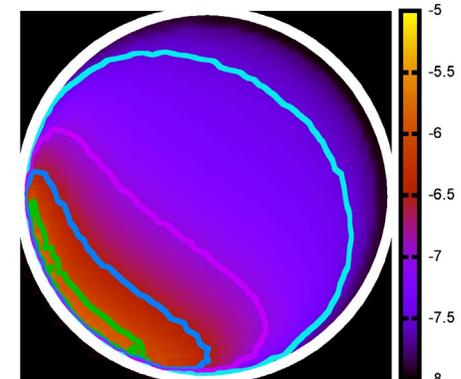
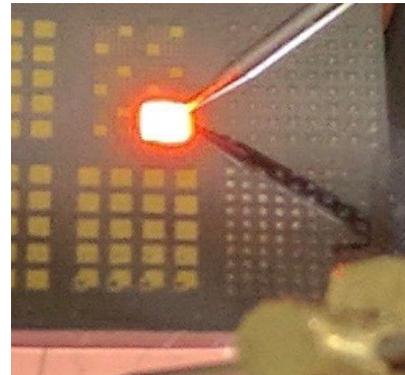
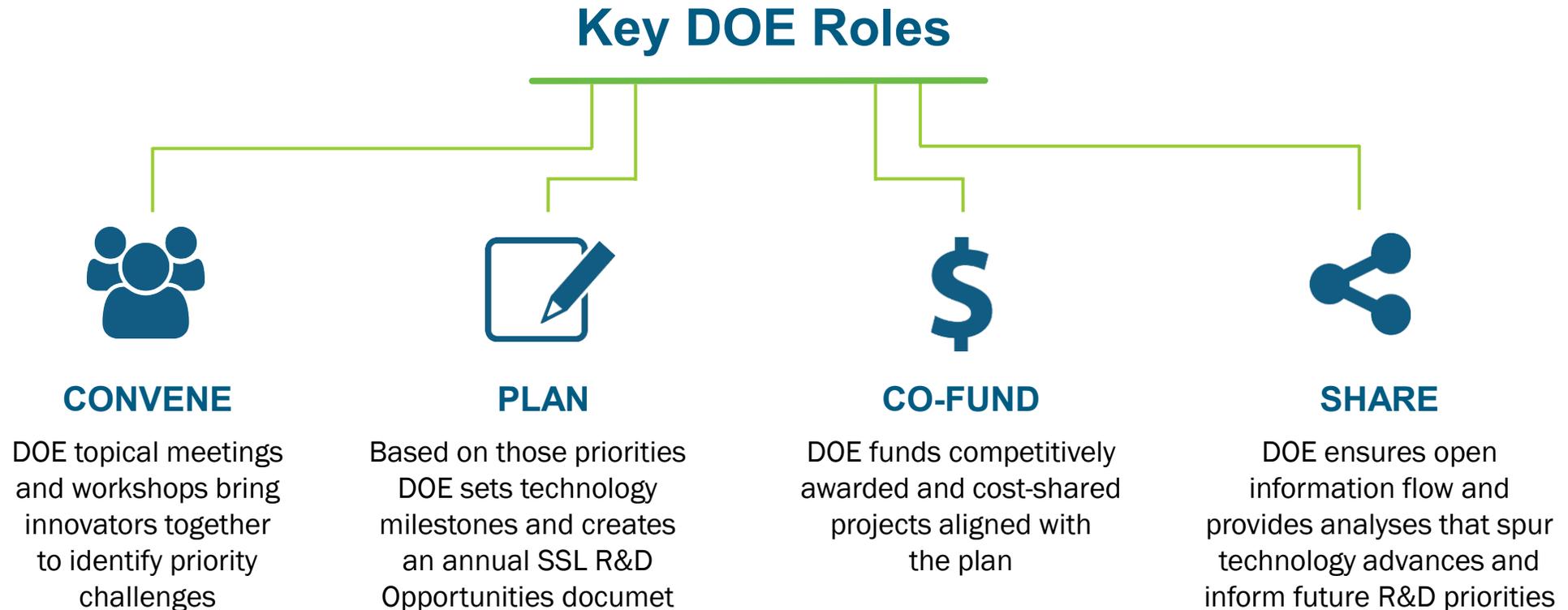


# Lighting R&D: What's next?



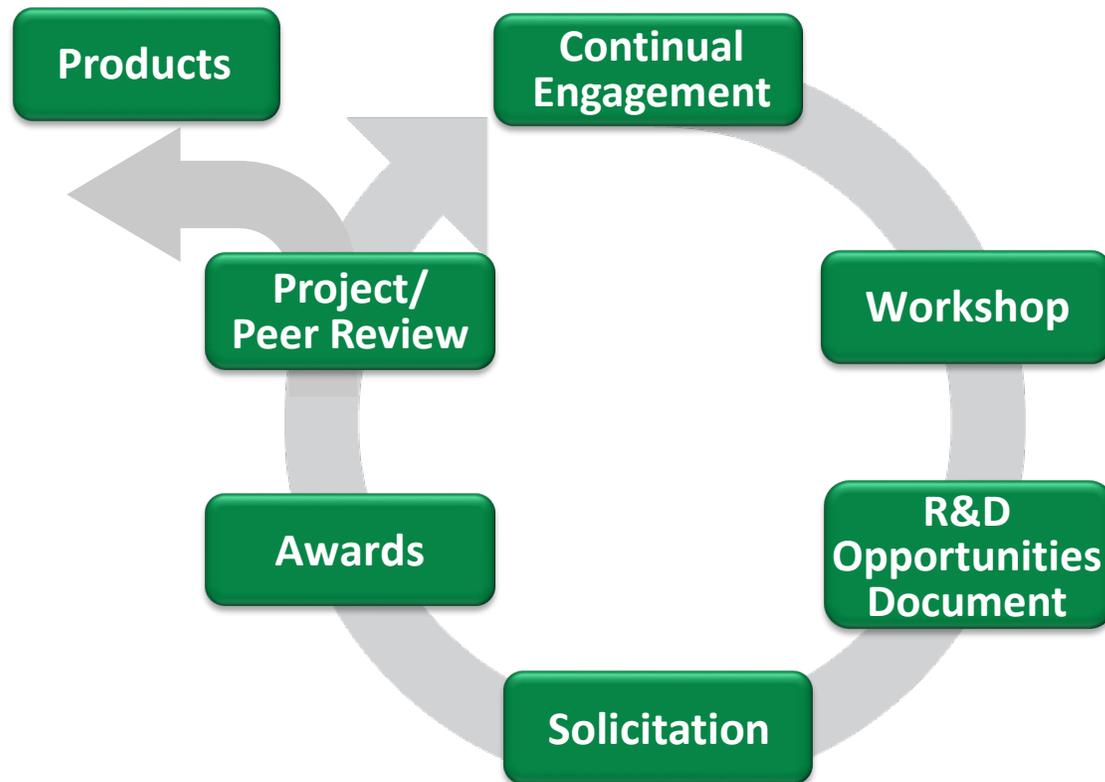
Brian Walker, Ph.D.  
Manager, DOE Lighting R&D  
February 4, 2021

# Lighting R&D uses a tested approach



# Planning: multiple opportunities for engagement

SSL community input from workshops and small topical meetings shape R&D priorities and DOE solicitations

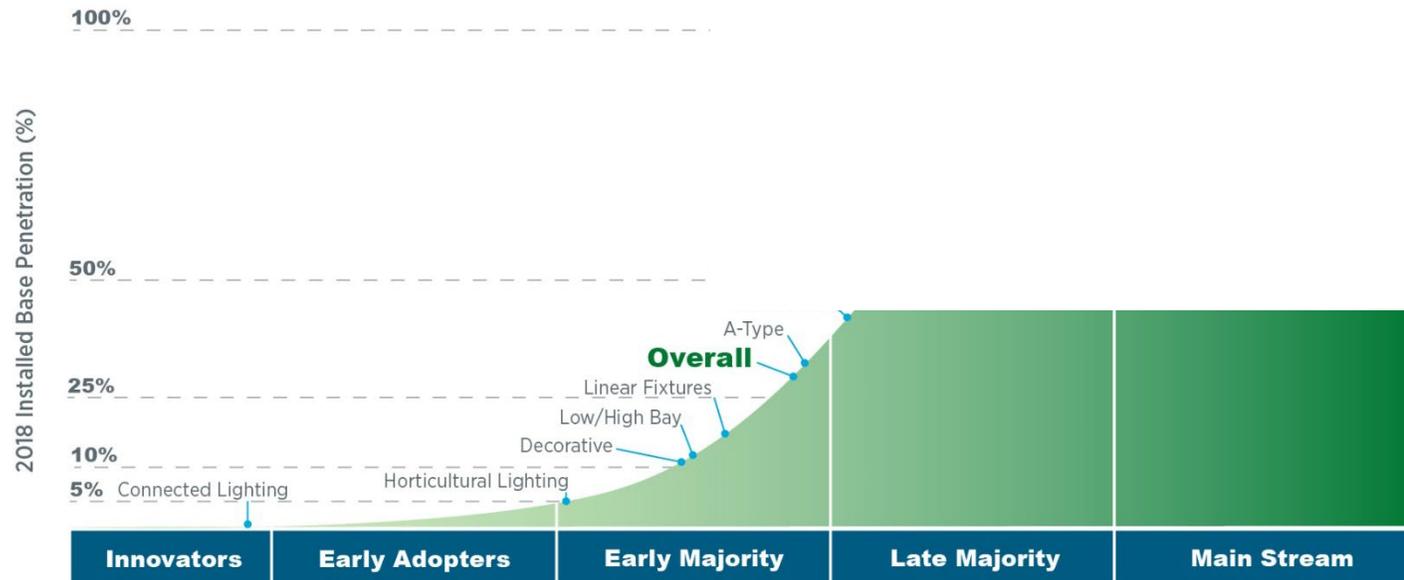


*DOE targets push industry to levels of efficacy and performance that might not otherwise be achieved.*

*Analysis of emerging products prompts improvements, informs R&D priorities.*

# Technology pipeline shows progress and potential

The adoption of LED lighting is progressing, but there is still significant head room in many segments.



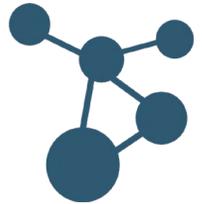
## New Directions in Light

- First focus: saving energy via more efficient **light sources for general illumination.**
- Now (LAE): saving energy via **more efficient sources and control of generation/delivery.**
- Potentially: saving energy **beyond general illumination where there are opportunities for impact.**

Evaluate technology problems/solutions based on energy savings, productivity benefits, and occupant comfort.

- Current total energy consumptions in the application;
- Projected future energy consumption;
- Prospects for technology enabled efficiency improvements;
- Impacts of DOE Lighting R&D support;
- Productivity, comfort, and other non-energy benefits associated with application; and
- Technology leverage with general illumination technologies

# Lighting R&D results to date



**335**  
Projects



**352**  
Patents



**346**  
Products



**1,328**  
tBTU



**14.7**  
Billion

# What's in Brian's crystal ball?

**Overall: Progress toward energy-efficient lighting that supports health, productivity, and well-being**

- **Select interests:**
  - Application efficiency: source, delivery, spectrum, intensity
  - Integration: technology, program
  - Quality: optimized spectrum, reduced glare/flicker, etc.
  - Resources to support a diverse, robust industry and workforce
- **Commercial segment: address concerns, increase competitiveness of LED, feedback with manufacturing**
- **“What’s the frontier?”**

# Innovations that save energy when using light

## Lighting R&D Goals

Energy-Efficient Lighting That Supports Health, Productivity, and Well-Being

### Platform Technology

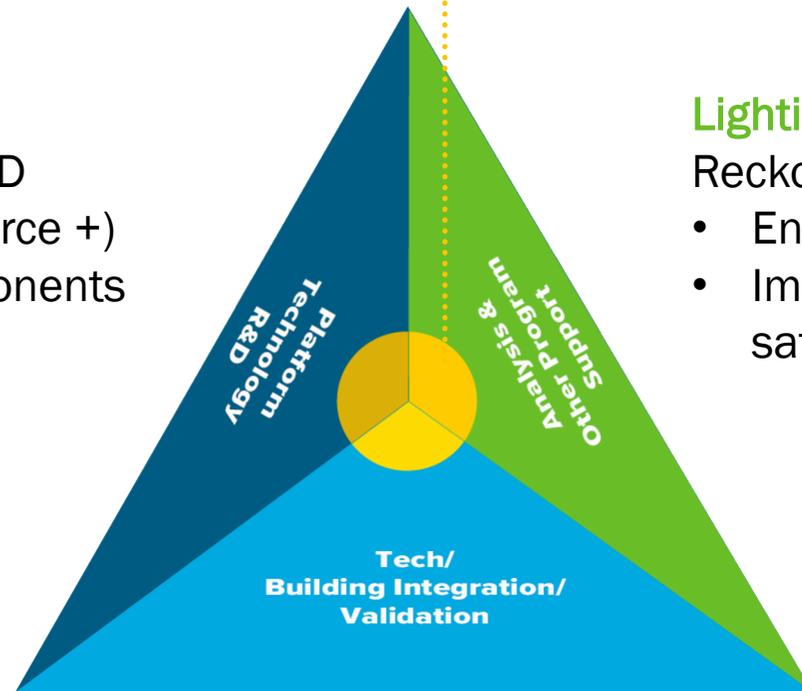
Application-focused R&D

- Efficiency gains (source +)
- Materials and components

### Lighting Science & Analysis

Reckoning SSL value/potential

- Energy efficiency
- Impacts: visual & non-visual physiology, safety, learning, animal welfare...



### Integration/Validation

- SSL + other technologies, real settings
- Failure modes
- Design, including new form factors

**Backup slides:  
What did we do about this in 2020?**

# Accomplishments: FY19–20

## Pacific Northwest National Laboratory Advanced Lighting studies:

- Tunable Lighting: Nurses' Satisfaction with Patient Room Lighting Conditions
- Connected Lighting: Modeling Lighting Contributions for Grid Services
- Peer-reviewed papers in progress



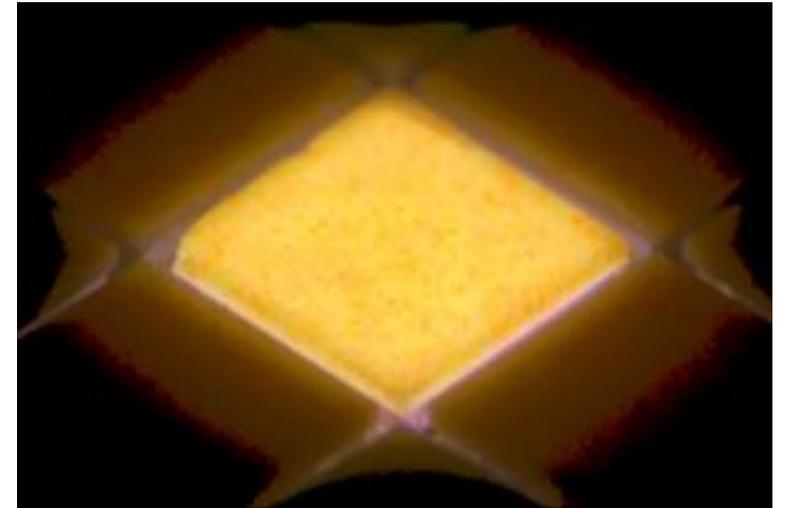
## RTI International studies:

- Lumen and Chromaticity Maintenance Behavior of LED Packages
- Stress Testing Results for OLED Panels and Luminaires

# Accomplishments: FY20

## Lumileds: high luminance, high-efficacy LED platform for directional lighting

- Today, efficiency in multi-emitter modules drops off as brightness increases from droop and getting light out
- Higher brightness to improve optical control and energy savings from more light on target
- Using novel manufacturing growth process to more closely pack emitters, Lumileds demonstrated luminous emittance of  $80 \text{ lm/mm}^2$  and efficacy of  $113 \text{ lm/W}$



*Lumileds' prototype high-luminance LEDs in dense array, with center LED lit up.*



## Sustainable Manufacturing of Luminaires Challenge Winner: Bamboo Pendant

- Design incorporates bio-derived and biodegradable, low-toxicity, sustainable materials
- Highlighted in trade publications (LEDs Magazine, LD+A)

# Near-term pipeline (PNNL)

## IES Sky Glow Technical Memorandum (TM)

- Concerns expressed over detriment of light at night, including increased brightness of the night sky, has increased with adoption
- Recommendations on reducing human contributions to light in the night sky
- Methods to estimate effectiveness of options



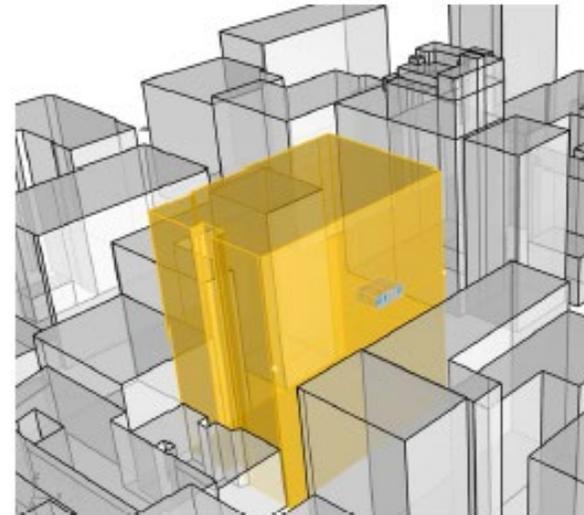
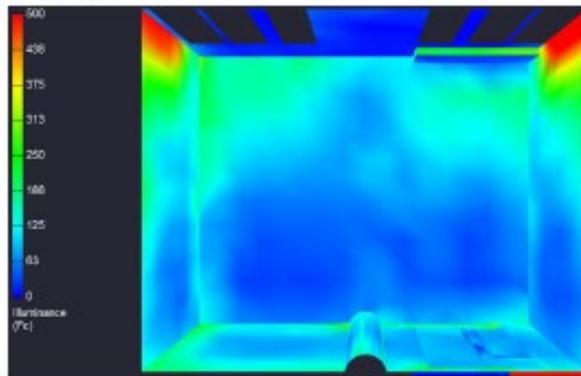
## Cook County, IL (Pilot): Circadian Lighting Design/Evaluation

- Investigate effectiveness of a lighting system and design
- Develop and demonstrate sustainable, evidence-based lighting design for the selected spaces, and experiments to measure and evaluate impact

# Near-term pipeline (PNNL)

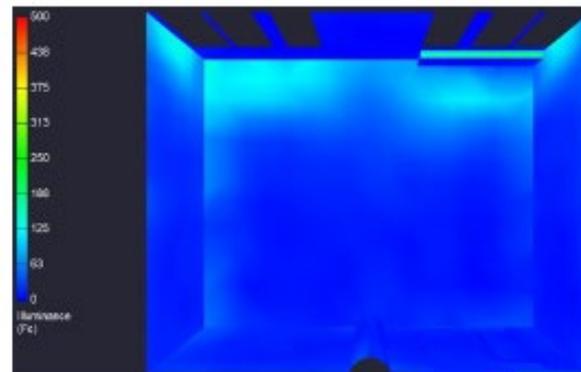


## Daylighting Potential in the NGLS Living Lab

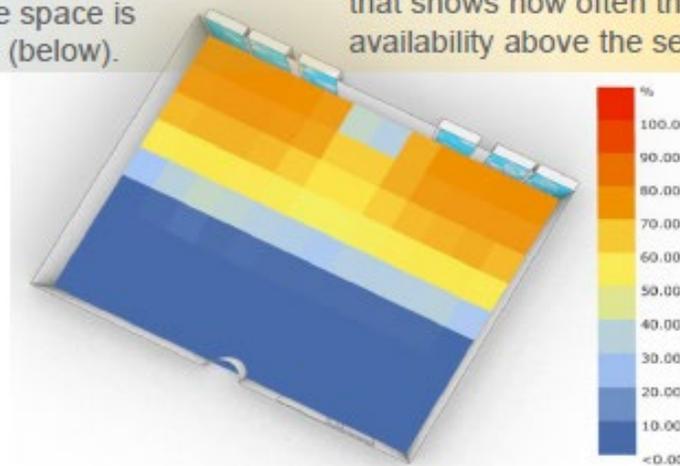


Cree installation space on the 11<sup>th</sup> floor of the 6 E 16<sup>th</sup> building at Parson's was modeled to better understand daylight availability and annual accessibility.

AGI32 simulations allow visualization of the daylight contribution at any given point in time. The available daylight for the same space is shown on the summer solstice (above) and winter solstice (below).



Daylighting Autonomy (below) is an annual metric that shows how often the space has daylighting availability above the setpoint (300 lux).



Modeled performance and calculated metrics (using RADIANCE and Daysim) can be visualized with Grasshopper.