Lighting Application Efficiency

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Morgan Pattison, Ph.D., LC

SSLS, Inc.

Consulting Senior Technical Advisor

DOE SSL R&D Program

Fine Print

Disclosure

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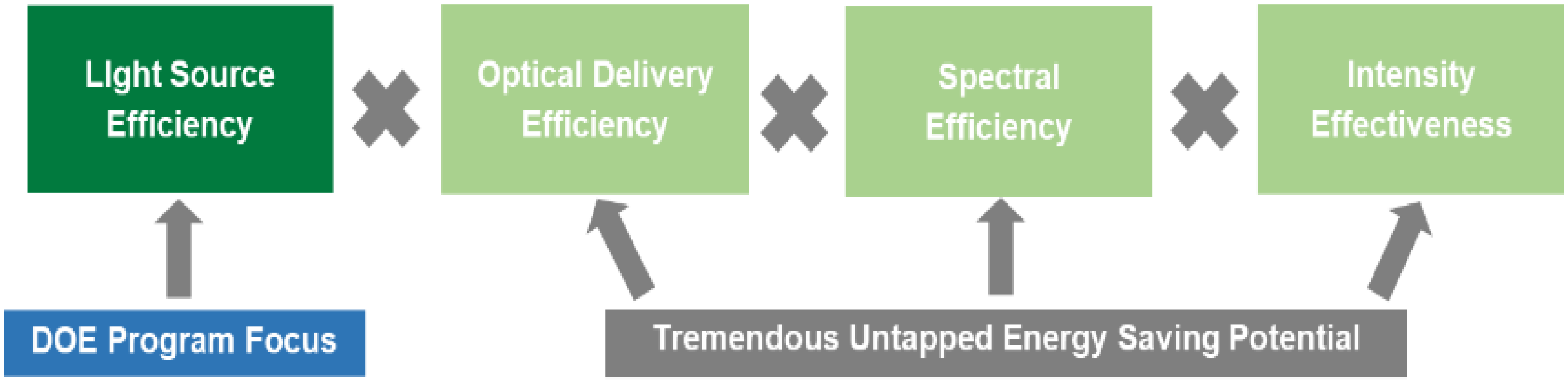
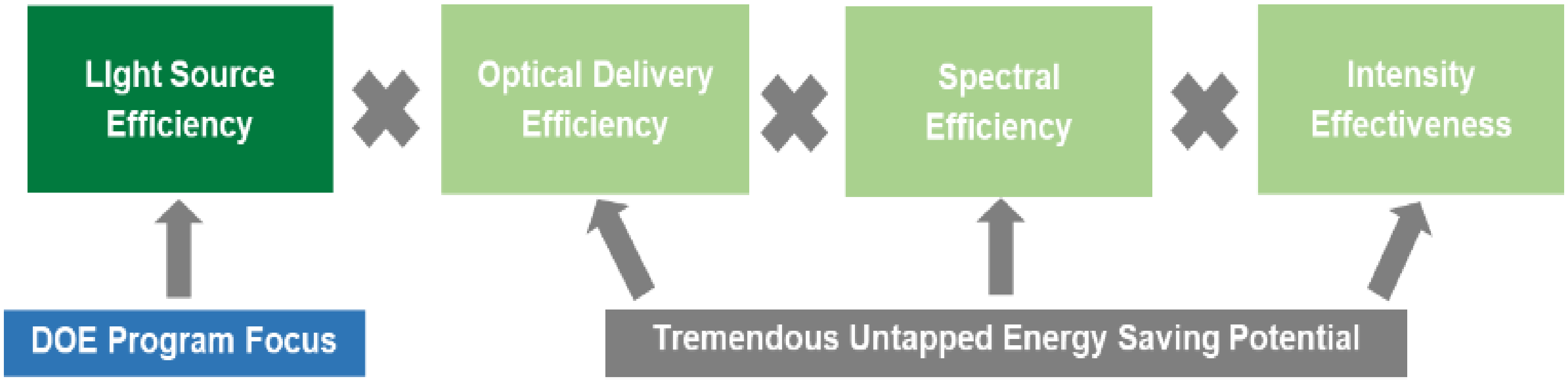
LAE Suggested Framework



2018 RDO. Figure 4-2

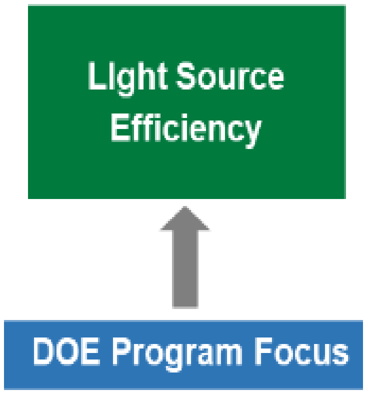
LAE Suggested Framework

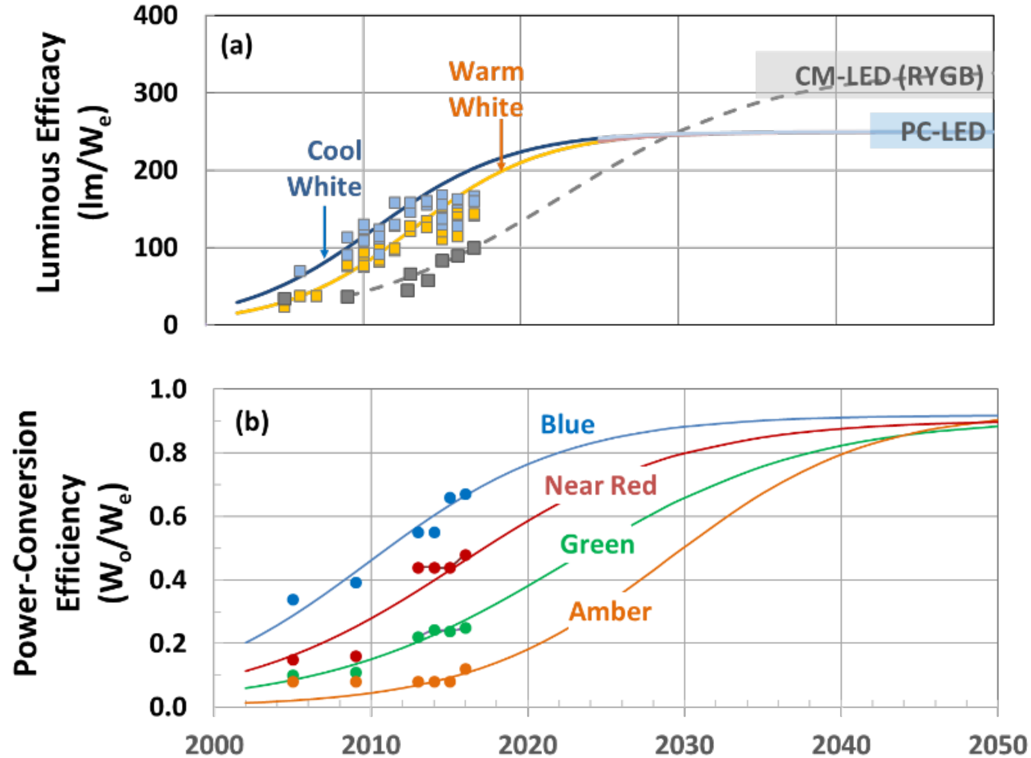


2018 RDO. Figure 4-2

~51% of potential ~40% of potential? ~82% of potential? ~50% of potential?

LED Source Efficiency





2018 RDO. Figure 3-1

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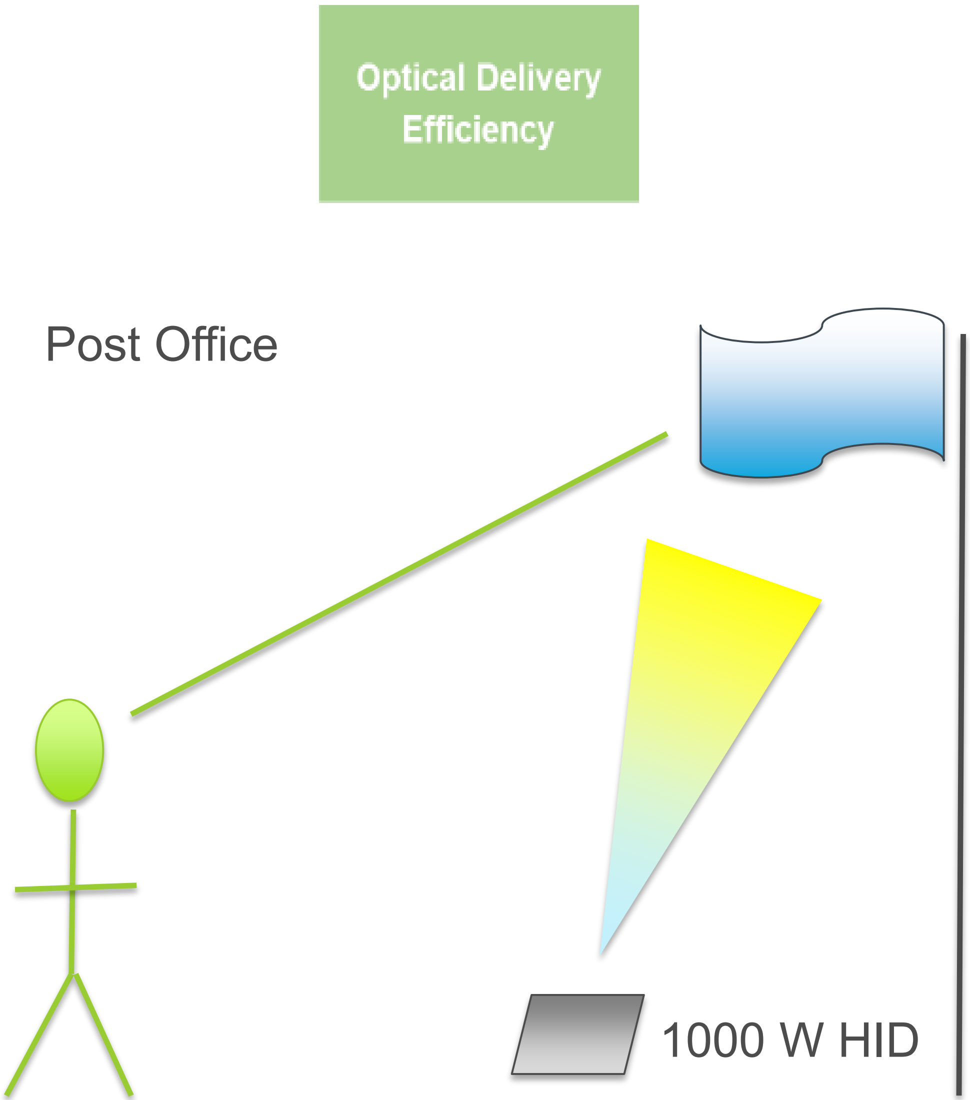
Optical Delivery Efficiency



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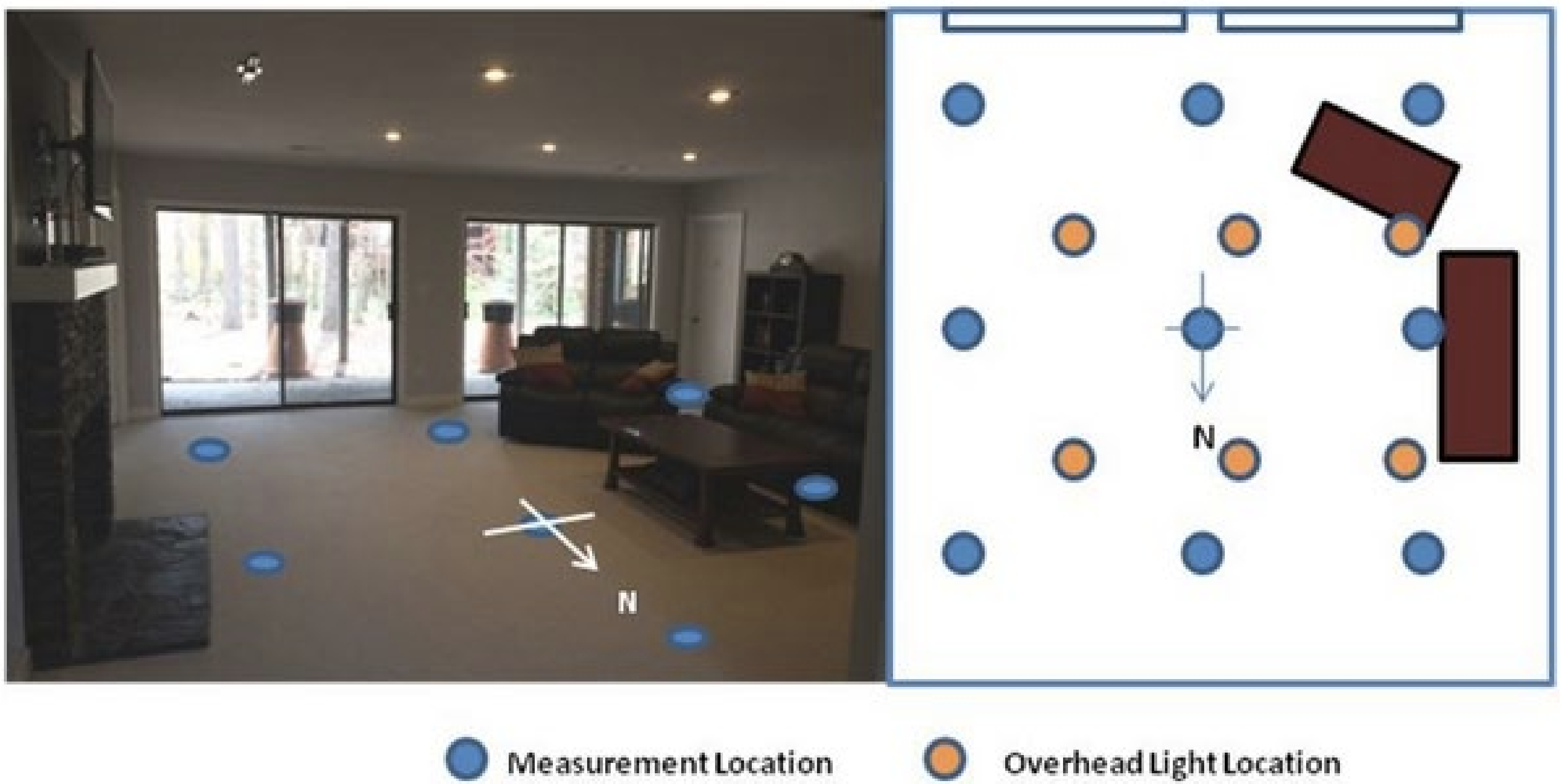
Optical Delivery Efficiency

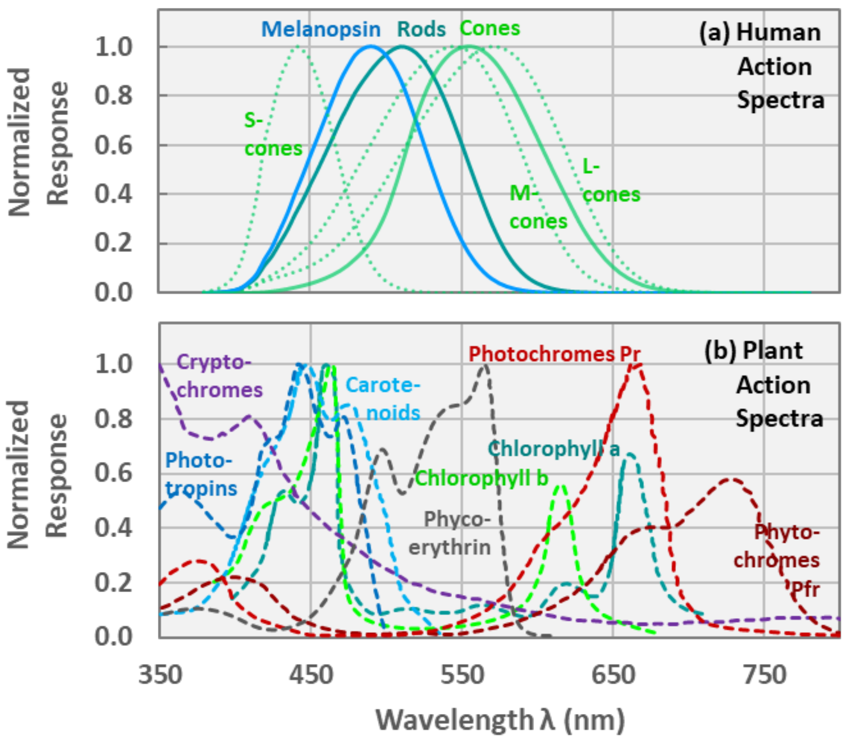
Optical Delivery Efficiency



Spectral Efficiency

Spectral Efficiency

Overlap of light SPD (at eye/detector) with optimum SPD



Optimizing for –

- Visibility
- Color rendering/highlighting
- Ambiance
- Human physiological Response
- Roadway safety
- Wildlife response
- Skyglow impact
- Plant growth properties

2019 DOE SSL RDO Figure 4-3

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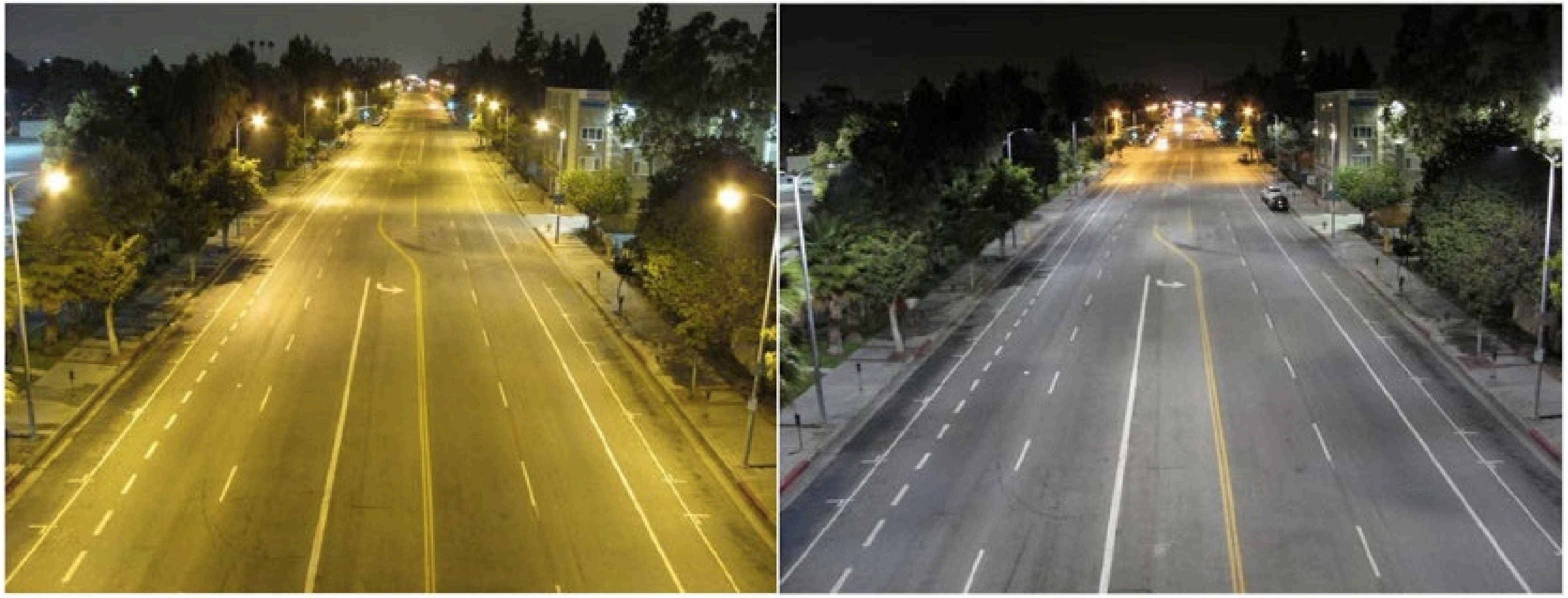
Intensity Effectiveness

Intensity
Effectiveness

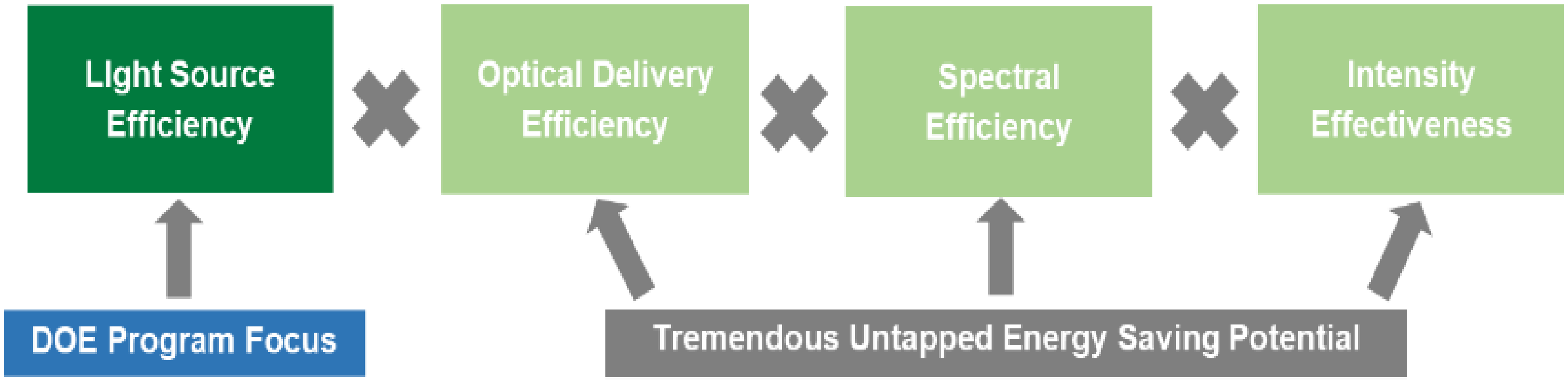


An Investigation of LED Street Lighting's Impact on Sky Glow, DOE SSL Program 2017

LAE Timing considerations

- LAE factors change over time
- Controls and 'smart lighting' necessary to adjust light for changing situations
- Intensity control – dimming, on/off
- Active spectral control may be helpful
- Active beam control may be helpful

LAE Framework



2018 RDO. Figure 4-2

- Can help make informed trade-offs for any lighting application
- Current status, practically achievable levels only known for light source efficiency
- Optimum optical distribution, spectral efficiency, intensity levels not known for most light applications
- Will require computational resources/methodology
- Can be used to optimize building designs and lighting layouts – unconstrained by limitations of previous technologies

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LAE R&D

Table 3-15. Understanding Lighting Application Efficiency

Understanding Lighting Application Efficiency			
Description: Develop a general framework, mathematical model, and computer simulation approach to characterize lighting application efficiency for any lighting application in terms of the four primary aspects of lighting application efficiency: light source efficiency, optical delivery efficiency, spectral efficiency, and intensity efficacy. Light source efficiency describes the efficiency of the lighting product in generating light from input electrical watts. Optical delivery efficiency describes how efficiently light is delivered for all of the various 'jobs' of the lighting. Spectral efficiency defines the overlap of the ultimate spectrum that reaches the task or eye with an optimum spectrum for the activity or intent of the lighting, e.g. visual acuity, color rendition, engagement of physiological responses, etc. Intensity efficacy describes the difference between the intensity of the provided light and the optimum intensity for the specific intent of the light. Optical delivery, spectral efficiency, and intensity efficacy may have temporal dependency as occupant positioning and activities in a space change over time. The proposed R&D and resulting models should be validated with lighting mock-ups with optimized light placements and optical distributions and then measured. Project status and metrics for progress for this R&D task should be supplied by researchers in this topic. The near term objective for this R&D task is to develop a working framework and vocabulary to characterize *Lighting Application Efficiency* in any lighting application. The framework should allow accurate computer modeling of *Lighting Application Efficiency* and this should be validated in the research against real lighting situations. In addition, the research should provide initial characterization of *Light Source Efficiency (this should be readily available), Efficiency of lighting delivery to receptor (typically the eye), Spectral efficiency, and Intensity effectiveness.*			
Metrics	**2017 Status**	**Interim 2025 Targets**	**2035 Targets**
Lighting Application Efficiency framework and model	No comprehensive framework or model	Application agnostic model that can be used to optimize total *Lighting Application Efficiency*	Ubiquitous use of *Lighting Application Efficiency* modeling for building, room, lighting layout, and product design

- Defining efficiency terms
- Quantifying full model
- Developing computational approaches
- Validating model and computation
- Understanding optimum beam direction, intensity, and spectrum
- Use of LAE framework to validate benefits of intensity controls, spectral tunability, active beam control

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Thank You!

Morgan Pattison
morgan@sslsinc.com
1-805-217-3878

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