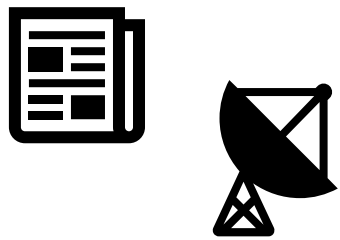


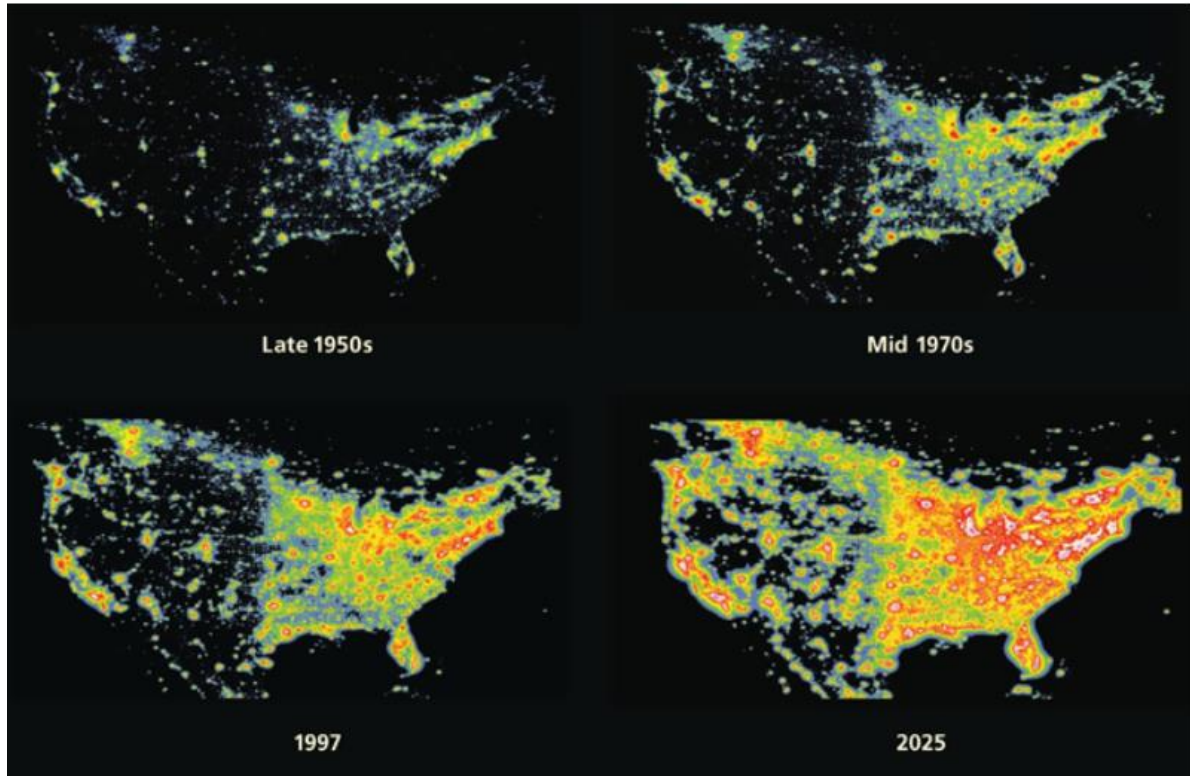
Outdoor Lighting – Emphasis on Data

Project Team: Bruce Kinzey and Naomi Miller, Pacific Northwest National Laboratory

Concerns Common in Public Media



- ➡ **Harvard Health Letter**
“Blue Light has a dark side”
- ➡ **CNN Health**
“LED lights damage eyes and disturb sleep, European health authority warns”
- ➡ **LEDs Magazine**
“Dark-Sky says boo to blue light”
- ➡ **Universe Today**
“LEDS: Light Pollution Solution or Night Sky Nemesis?”



Popularly cited impacts often rely on assumptions inconsistent with field experience...

Maps created by P. Cinzano, F. Falchi, and C.D. Elvidge.

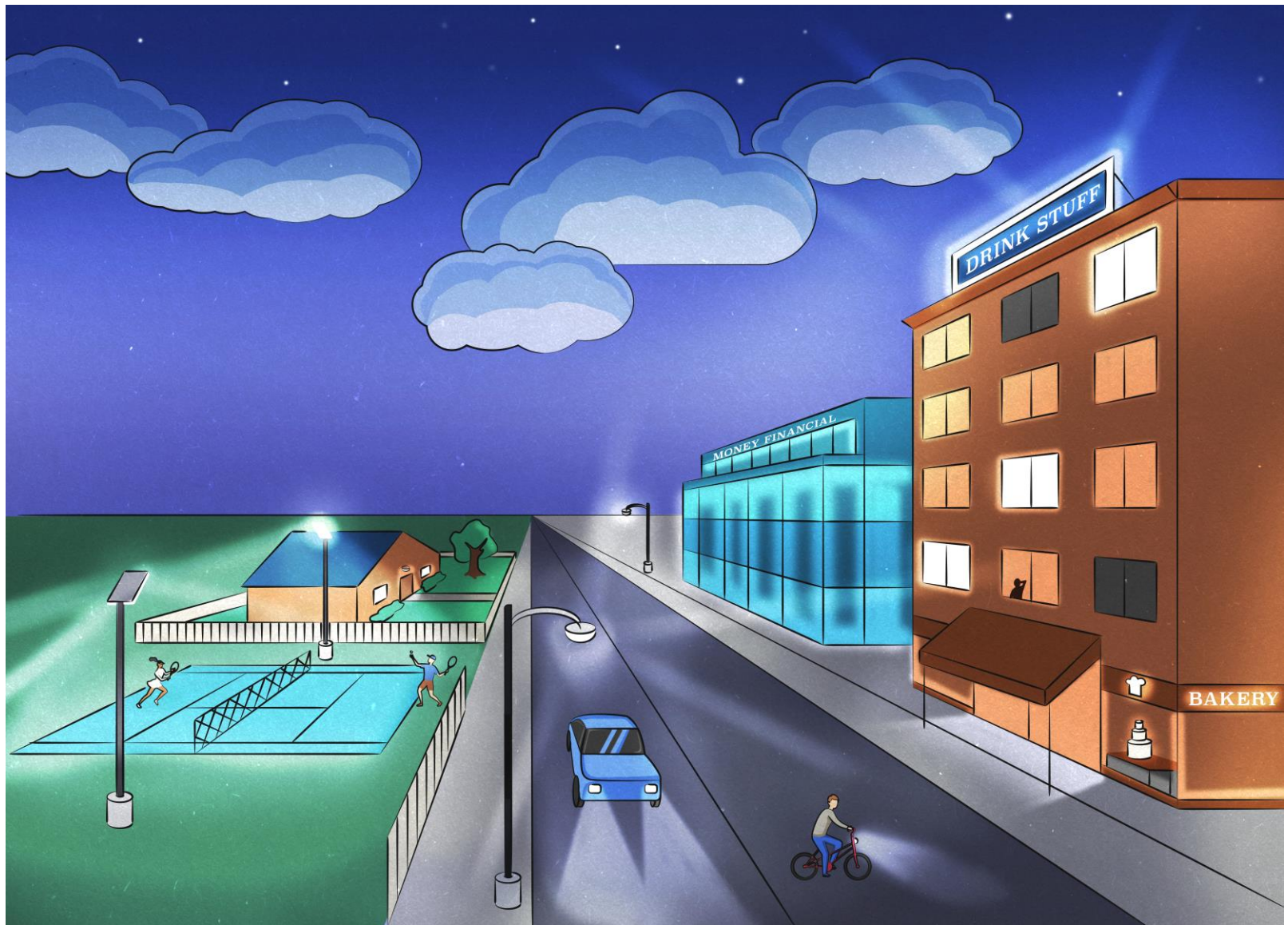
E.g., these projections assumed fixed light output and distribution

Product *	Output and Lumens per Watt at Respective CCT											
	2700K		3000K		4000K		5000K		Amber		%Δ LPW to Amber	
	Lumens	LPW	Lumens	LPW	Lumens	LPW	Lumens	LPW	Lumens	LPW	3000K	4000K
A			1680	76	2059	93.5	2024	95	382	46	-39%	-51%
B			3700	100	3750	101	3800	103	2000	61	-39%	-40%
C	395	60			445	65			295	49	NA	-25%
D	525	75	525	75	525	75	525	75	340	48.5	-35%	-35%
E									800	67		
F									960	32		
G									500	33		

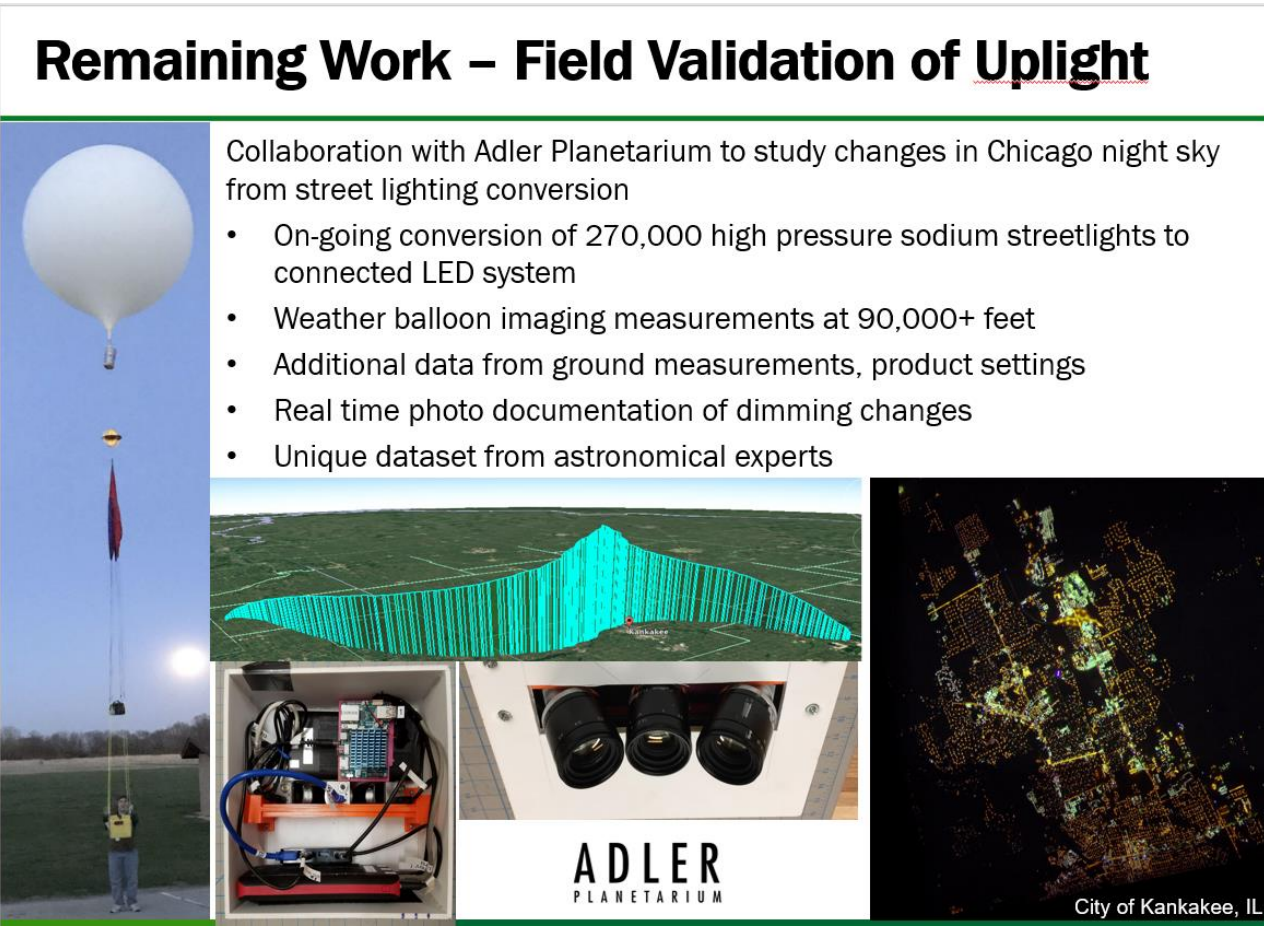
* Each row represents a single commercial product and its reported characteristics at different CCTs.

...whereas popularly cited remedies can have real energy impacts!

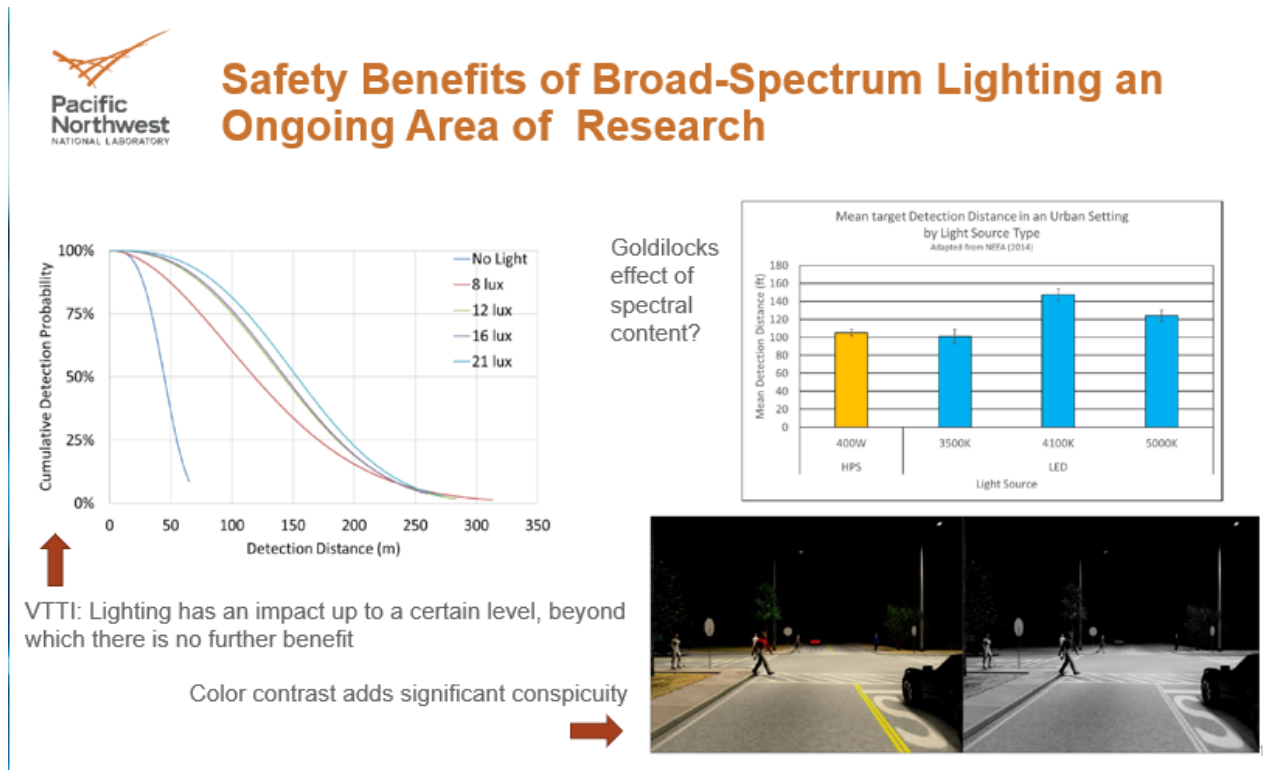
Proper Design and Implementation: A Better Way!



Objective data will end theoretical speculation (we hope)



Light in Chicago night sky expected to decrease as a result of LED street light conversion



Collaboration among Astronomical, Modeling, Environmental and Lighting Communities Needed for Consensus

Best Practices and Tools for Evaluating Sky Glow

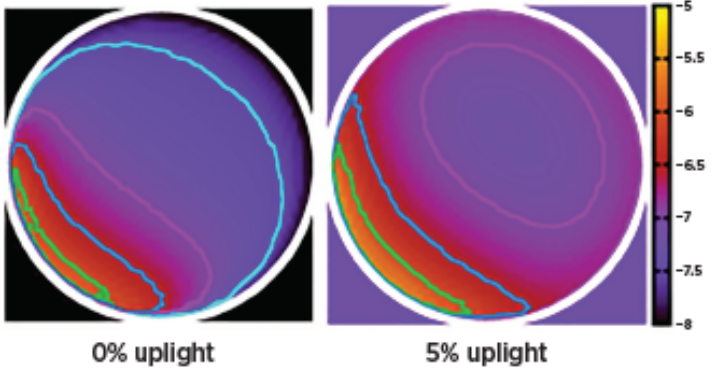


Research objective
The Illuminating Engineering Society (IES) has formed a Sky Glow Calculations Committee to develop impartial recommendations and tools for estimating contributions to sky glow across a suite of lighting applications
Global Interest In minimizing sky glow without hindering the benefits of light at night
Much potential for improvement, through careful design and implementation of appropriate luminaires

At present, no formal IES guidance exists for city planners, lighting designers, and others

Best practices and tools are needed

- Recommended best practices for minimizing contributions to sky glow
- Equations/methodologies for estimating contributions to sky glow
- Tools for conducting assessments of sky glow



Modeled sky results for street lighting
Modeled results show significant impact of uplight at observer location 40 km from the source



Diverse committee represents a collaboration among astronomers, modelers, lighting manufacturers, and other researchers
The committee welcomes input on corresponding efforts in light pollution theory, modeling, and measurement
Ian Ashdown, SunTracker Technologies Ltd.
Robert Clear, Lighting Research Consultant
Dan Durtsoe, Night Sky Metrics
Fabio Falchi, Istituto di Scienza e Tecnologia dell'Inquinamento Luminoso
Mike Grather, LightLab Allenstown
Li-Wai Hung, National Park Service
Bruce Kinzey, Pacific Northwest National Laboratory
Miroslav Kocifaj, ICA, Slovak Academy of Sciences
Lindsay Malbon, Vancouver Island University
Brad Schlesselman, Musco Lighting
Patrick Trepkowski, Speciales
Richard Wainscoat, University of Hawaii, Institute for Astronomy
Connie Walker, National Optical Astronomy Observatory

For more information, contact Committee Chair Bruce Kinzey (Bruce.Kinzey@pnnl.gov) or Miroslav Kocifaj (Miroslav.Kocifaj@savba.sk)

