DESIGNLIGHTS CONSORTIUM

2016

STAKEHOLDER MEETING

Future of Lighting

The Future of Lighting

Photo: Oddballs.co.uk

The Future of Lighting

Eric Bretschneider
CTO at EB Designs & Technology
Dark Quark at QuarkStar

The Future of Lighting

Karyn Gayle
Vice President of Healthcare
Acuity Brands Lighting

The Future of Lighting

Kelly Sanders
Energy Solutions

The Future of Lighting

Joe Costello
Chairman & CEO
Enlighted, Inc.

The Future of Lighting

Levin Nock

DesignLights Consortium

Eric Bretschneider

QuarkStar

Karyn Gayle

Acuity Brands

Kelly Sanders

Energy Solutions

Joe Costello

Enlighted

Honest Metrics for Energy Efficient Lighting

Eric Bretschneider, Ph.D.
QuarkStar

The History of Lighting Sources and Fixtures

Gas

Incandescent

HID

LED

Evolution of A19 Lamps (and Airplanes)

Early models…

… Modern examples

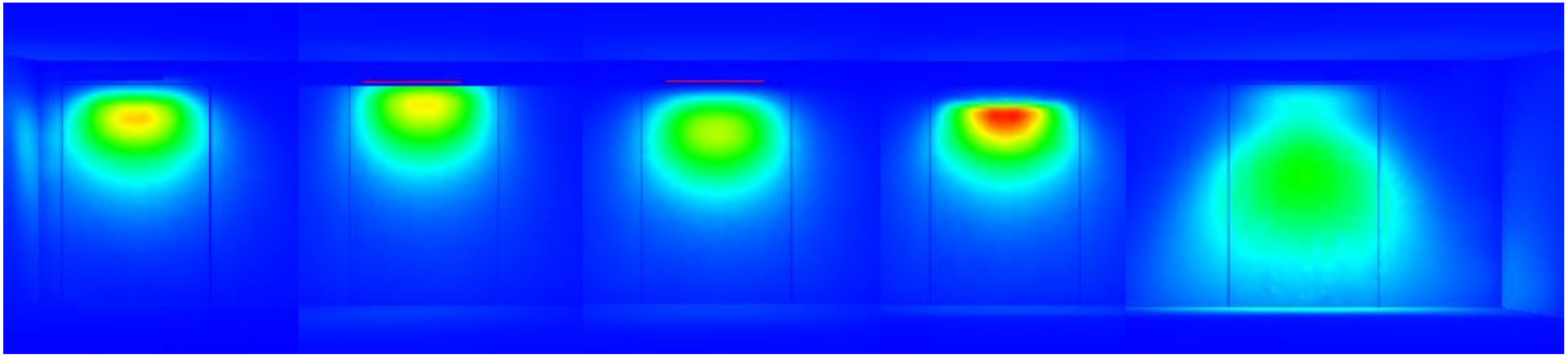





Key Points for Efficient Lighting

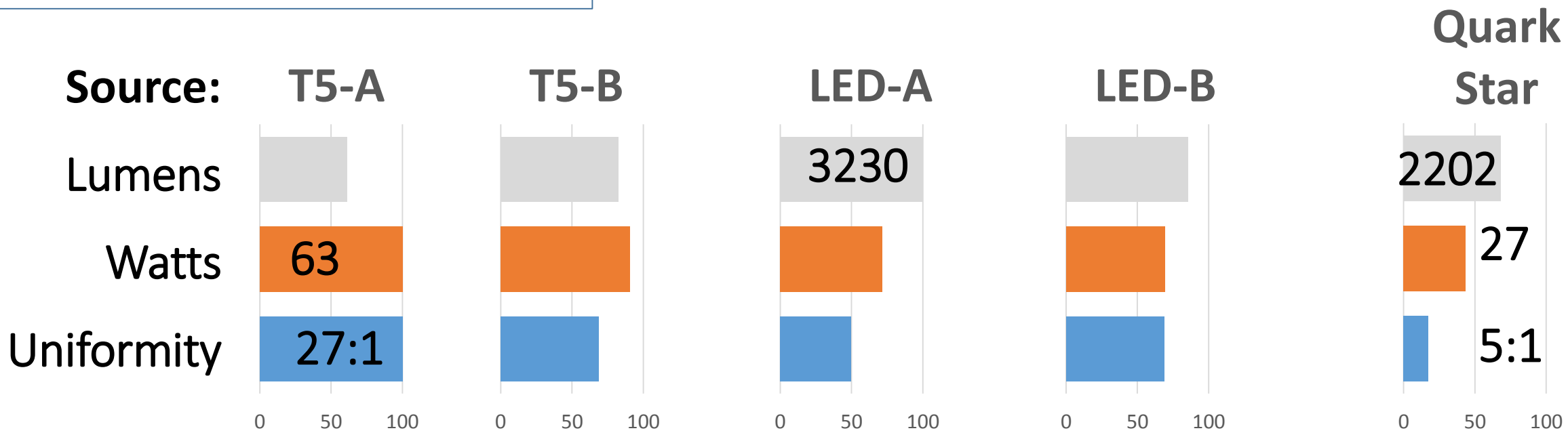
- Uniformity
- No light wasted on Trespass or Glare

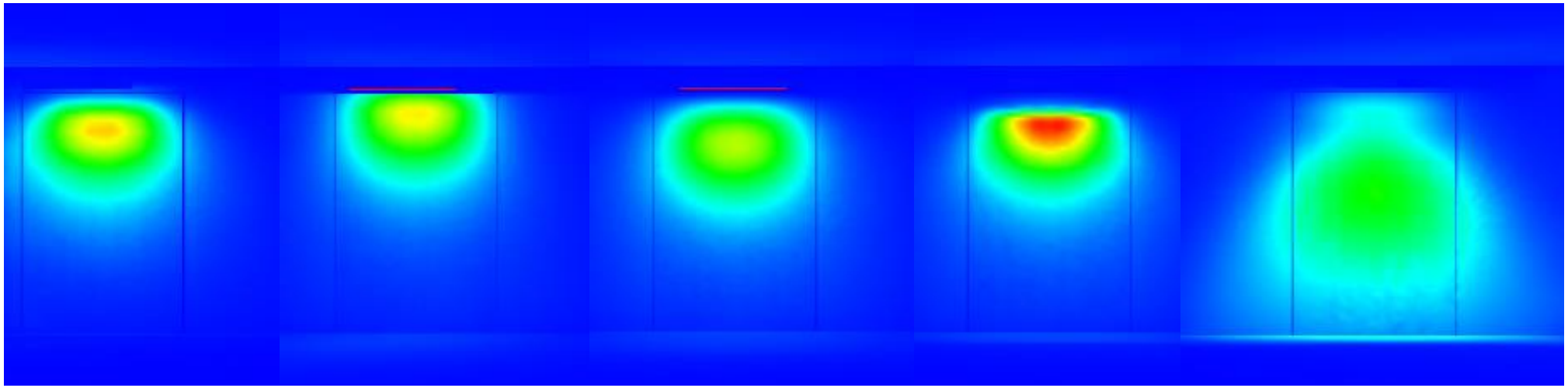
Importance of Uniformity



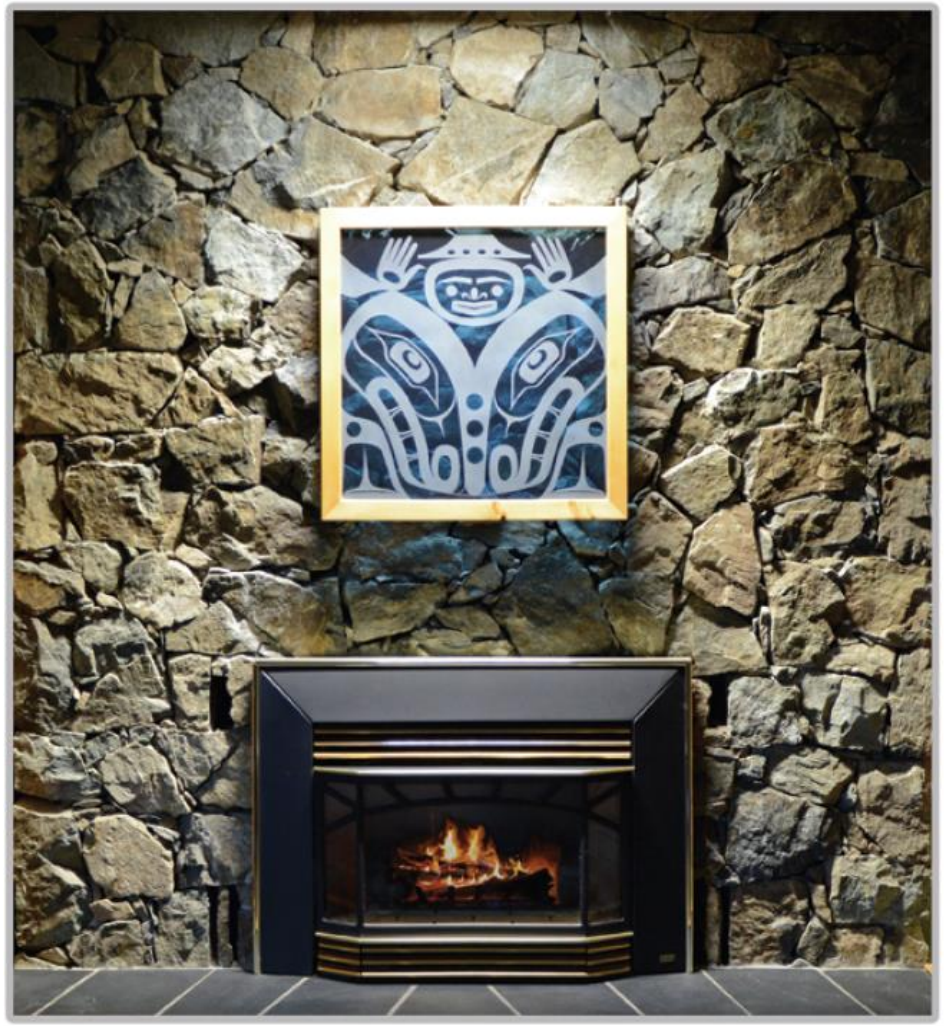
T5 - A | T5 - B | LED A | LED B | ***QuarkStar***

Bar charts show % of maximum across 5 samples





Real World Results



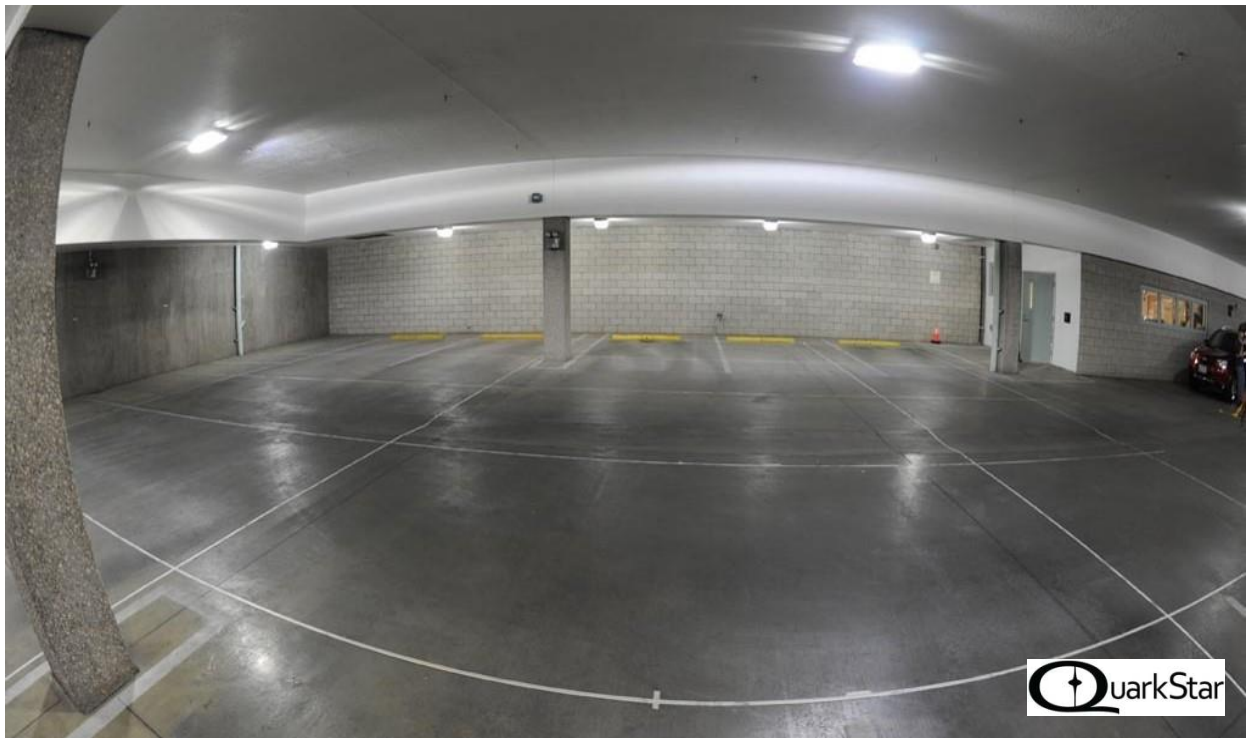
Next Generation LUMINAIRES 2016

"The [QuarkStar luminaire] is a completely new type of … luminaire that efficiently provides asymmetric glare free illumination from a very compact recessed housing … providing excellent uniformity on vertical surfaces."

- DOE Next Generation Luminaires comments

Real World Results

Uniformity doesn't just matter on walls …



** Patterns on wall and ceiling were for laboratory calibration and registration and are not in commercial products.*

The Consequences of Inefficient Lighting

The Importance of Control

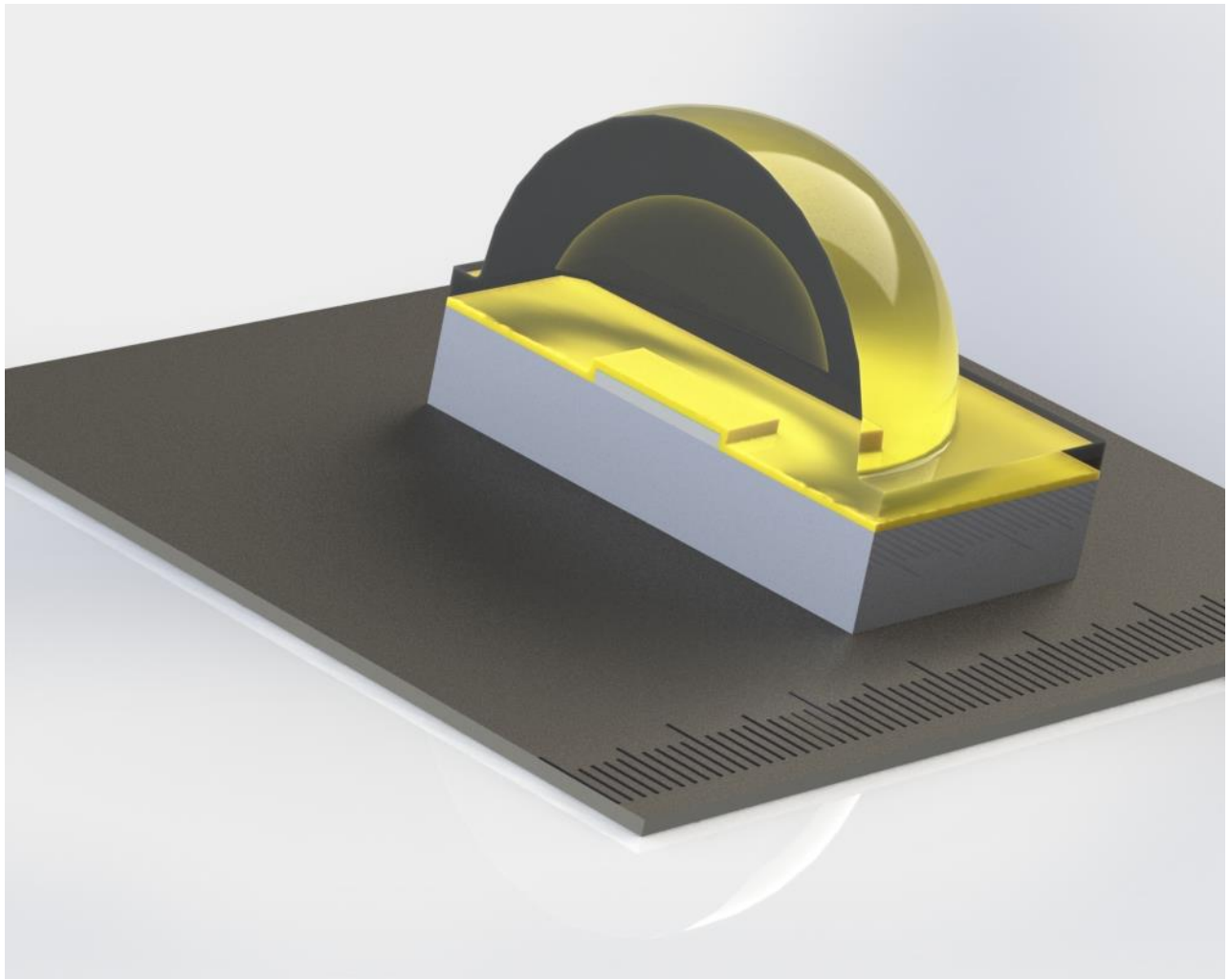
Control of lighting is important – in *all* directions

Street lights should light the street …

… the region around the sidewalk …

… NOT the houses behind them

Drops of Sunlight



Equivalent Glare in Nature

How Do We Measure Glare

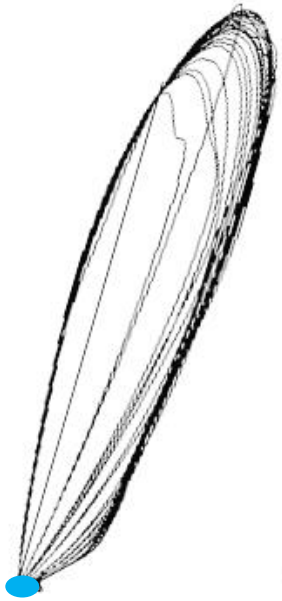
Type C goniophotometer: Intertek, Cortland, NY

Imaging photometer 1,370 x 1,020 pixels

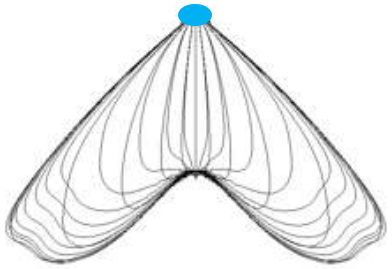
How Do We Measure Glare

What We Gain From Optical Control

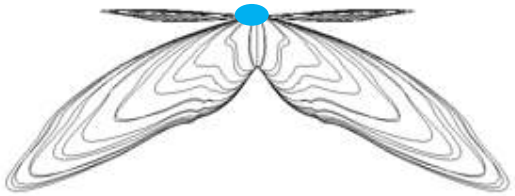
LEDs are among the most compact light sources we have ever created ... why aren't we taking **full** advantage?



Signage

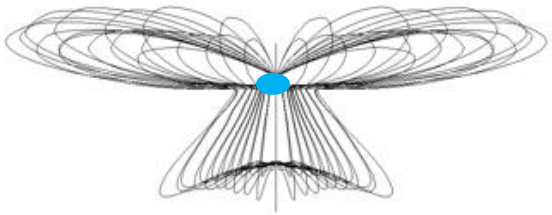


Institutional

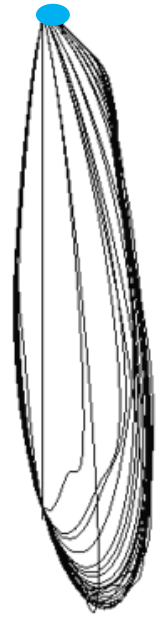


Garage Lighting

Office/School



High End Office



Stacklighting

** All distributions are laboratory measured from real world prototypes*

How to Save Light (and Lighting)

Future metrics to increase energy savings should:

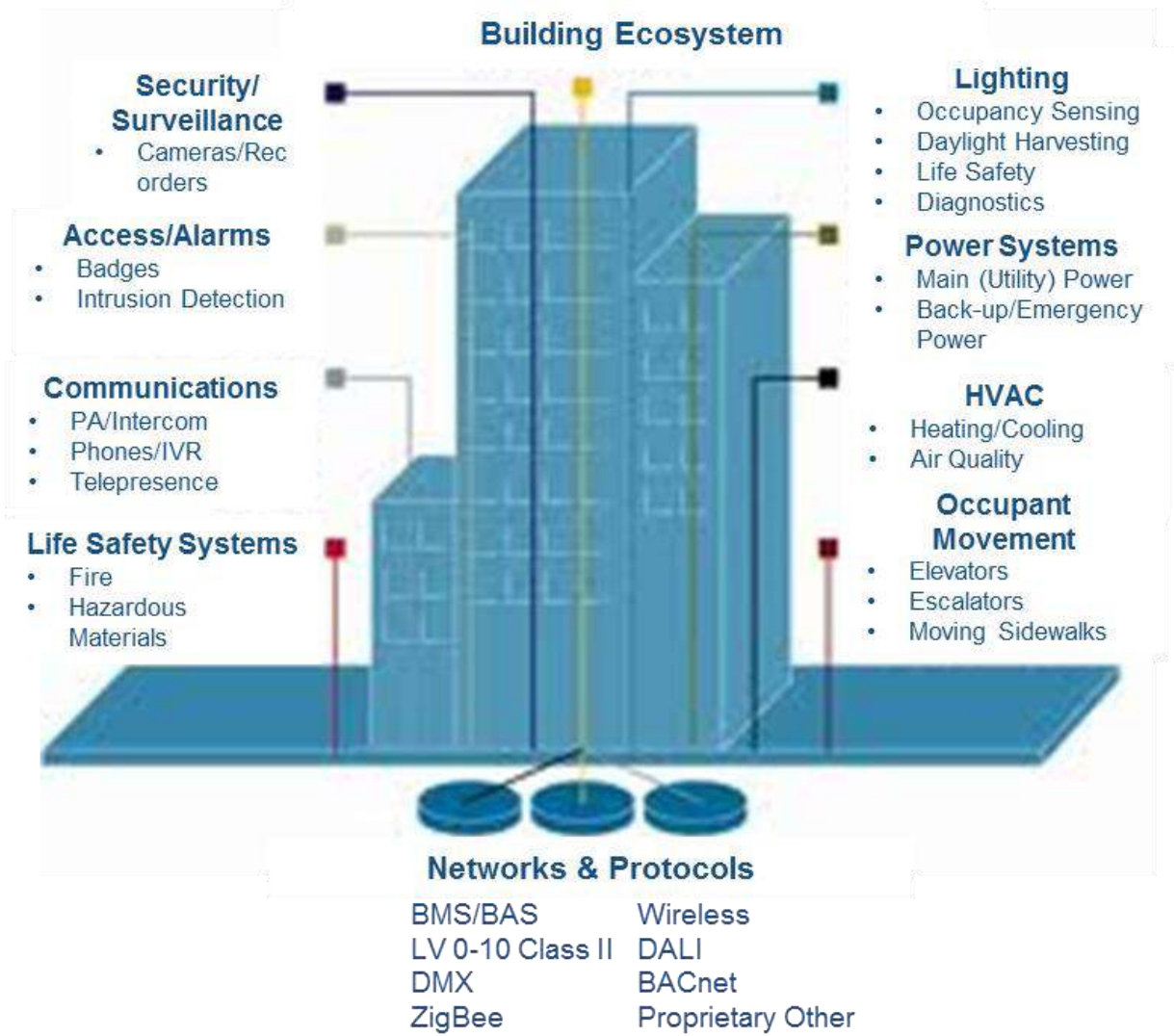
- Consider Uniformity, especially for minimum illumination levels
- Reward fixtures that deliver light to the target & minimize light trespass
- Measure Glare the way we experience it

Haitz's Law will only continue to drive the glare problem –
we have to find a solution for managing the extra photons NOW

The Future of Lighting

Karyn Gayle (Twitter: @karyngayle)
Vice-President, Healthcare, Acuity Brands

“Making Buildings Smart” is a common refrain…



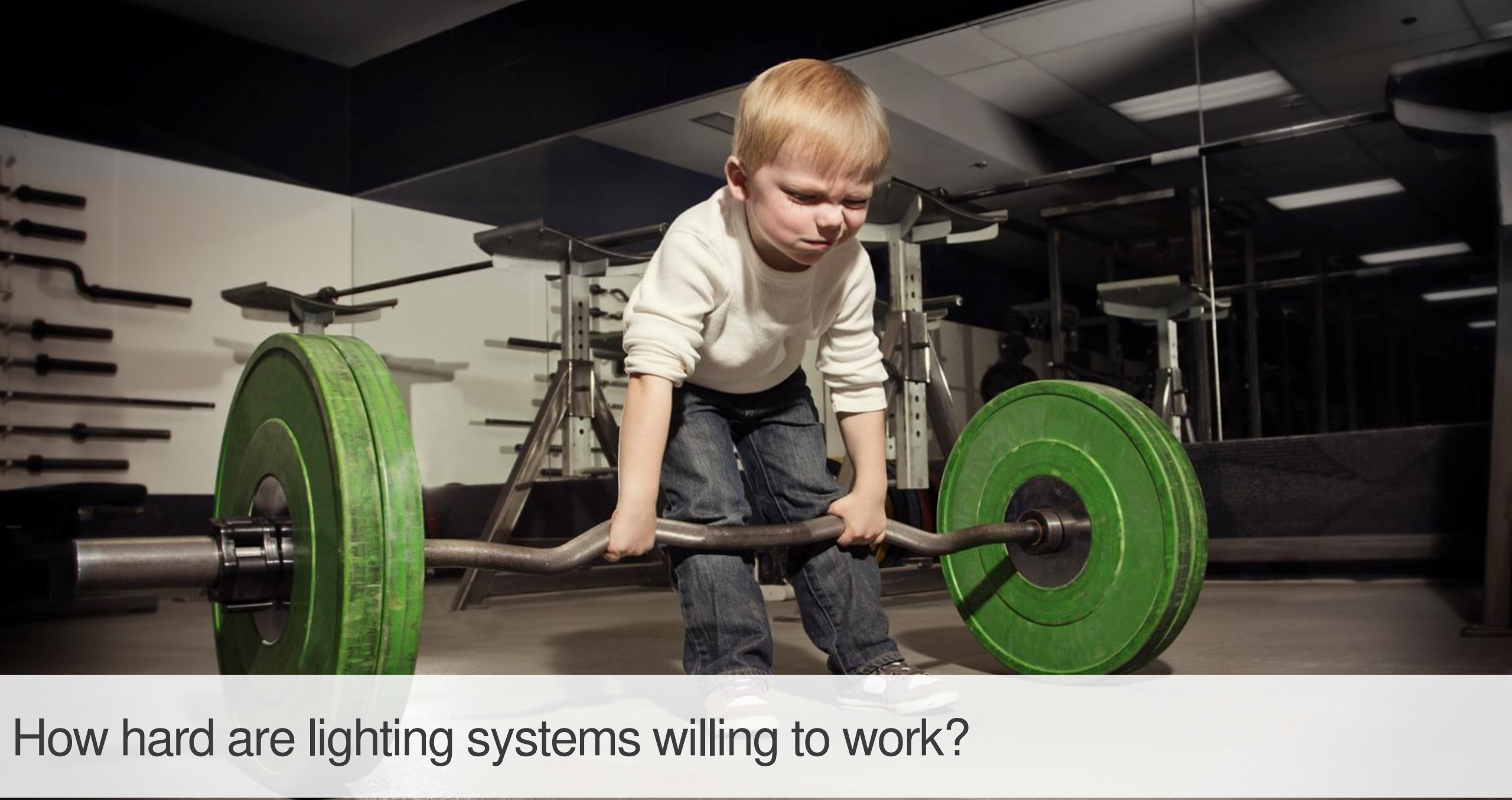
Smart-Building Technology Stacks can be daunting…

- Building Management Systems (BMS)
- Indoor Positioning (IP)
- Hurdles
  - Complexity
  - Coordination
  - Capability
  - Scale

Lighting has entered the networked age…

- Optimize Function
- Enhance Occupant Experience & Comfort
- Drive Energy Management & Sustainability
- Ensure Code Compliance
- Lighting and HVAC are the 2 largest consumers of electricity in buildings

As we distribute intelligence through our lighting systems, do we have a responsibility to do more than “simply” deliver light?

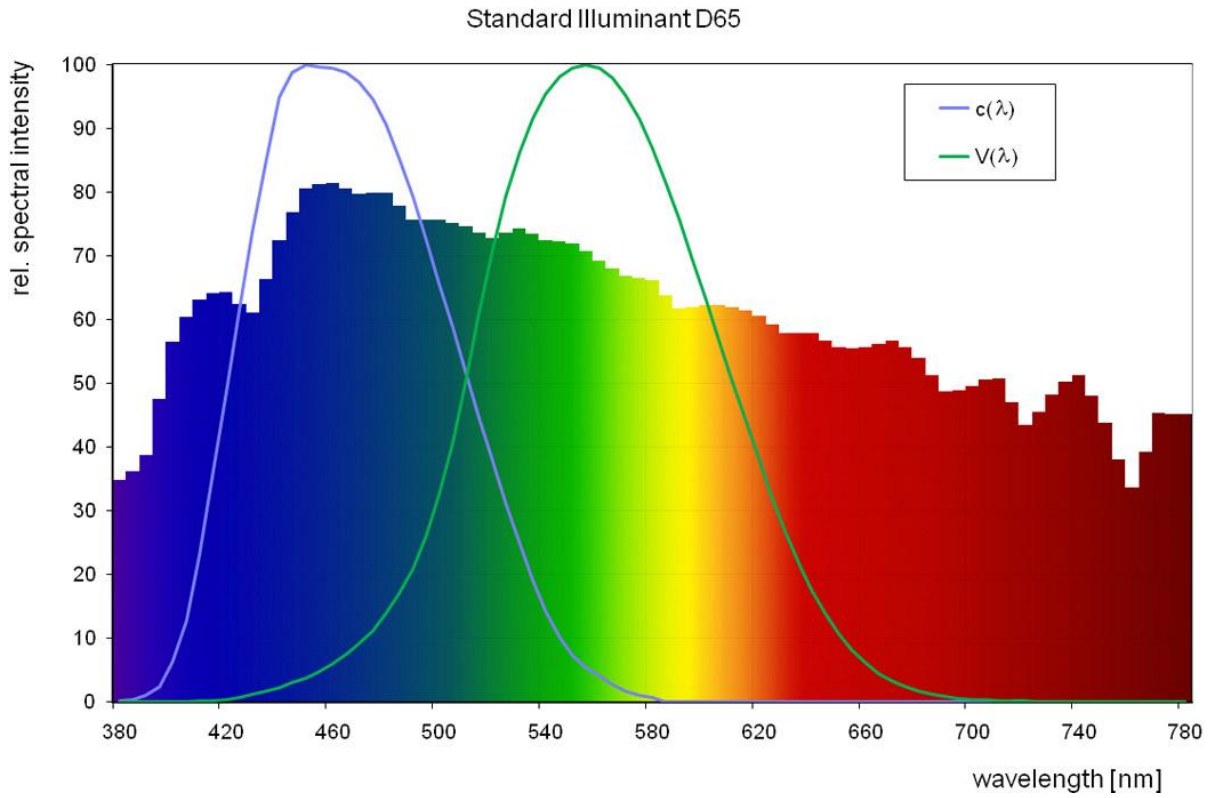


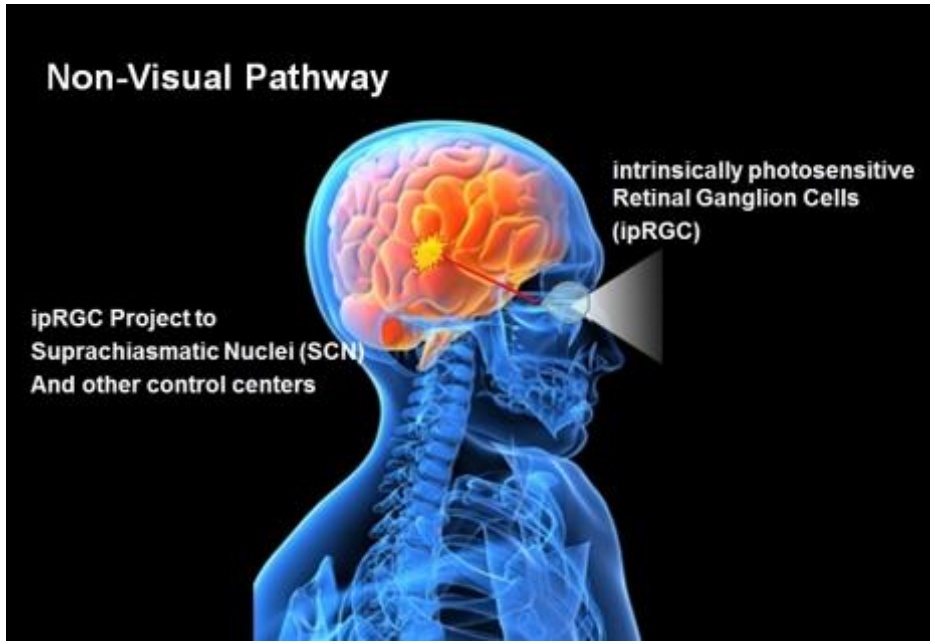
How hard are lighting systems willing to work?

Can smarter lighting make us healthier?

Lighting Impacts Our Visual & Biological Systems

- Rods and cones are photoreceptors for our visual system
- The **3rd photoreceptor**, the intrinsically photoreceptive retinal ganglion cell (IPRGC), impacts our circadian systems (peak sensitivity at 460-480nm, seeks blue light during the day)



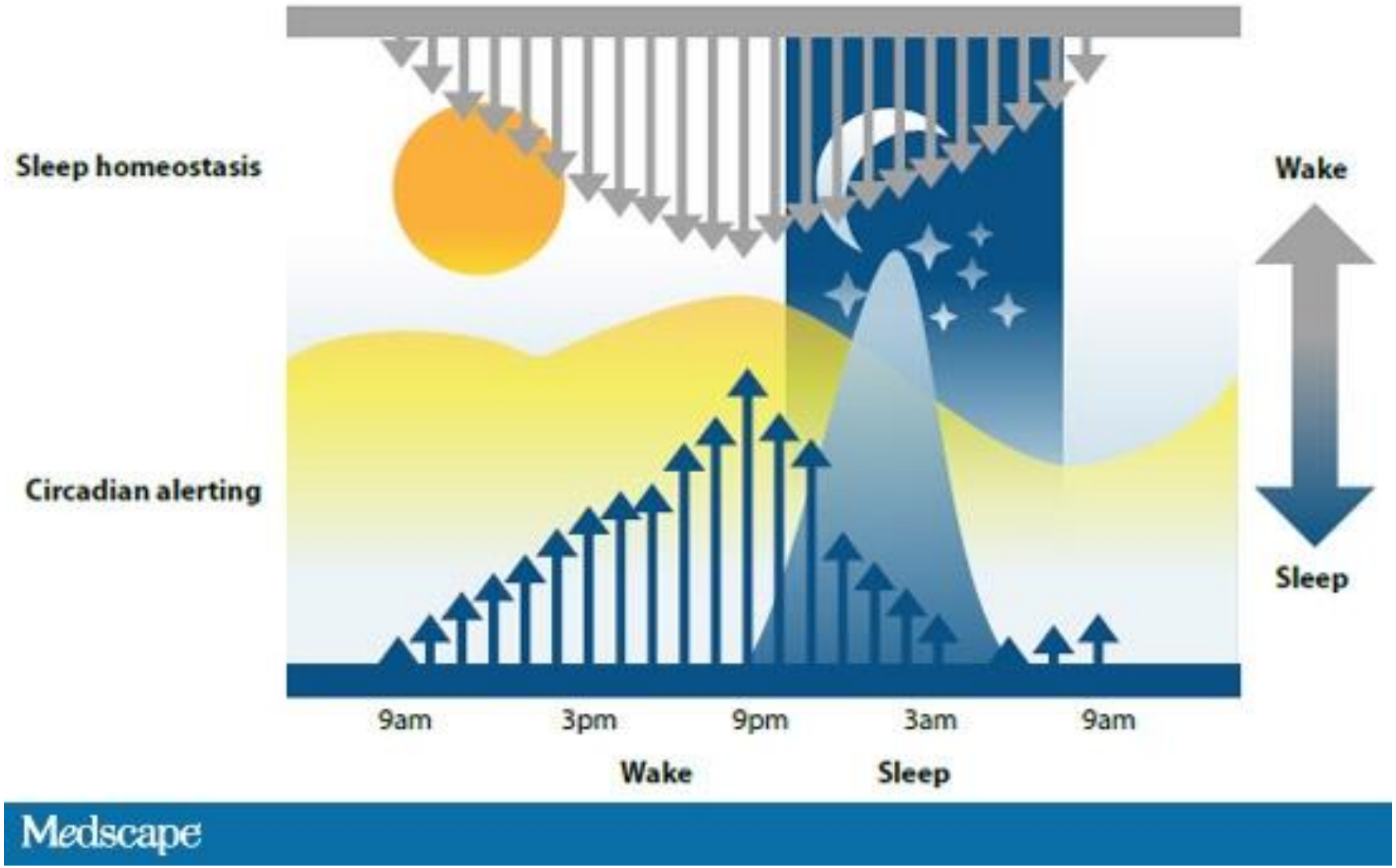


“Everyone wants it, but nobody is getting any…”

- Anonymous

The Importance of Sleep

Sleep…the perfect storm.



Some Less-Obvious Implications of Sleep…

- People who get sufficient sleep have increased gray matter in their brains, which is connected to psychological health. (Harvard Medical School Study)

- Brain clears out waste proteins between cells, and this waste product is linked to Alzheimer's disease, (Dr. Maiken Nedergaard, University of Rochester, 2013)

- People who are chronically sleep-deprived are 7 times more likely to feel helpless and 5x more likely to feel alone (Great British Sleep Survey)

Source: http://www.greatbritishsleepsurvey.com/

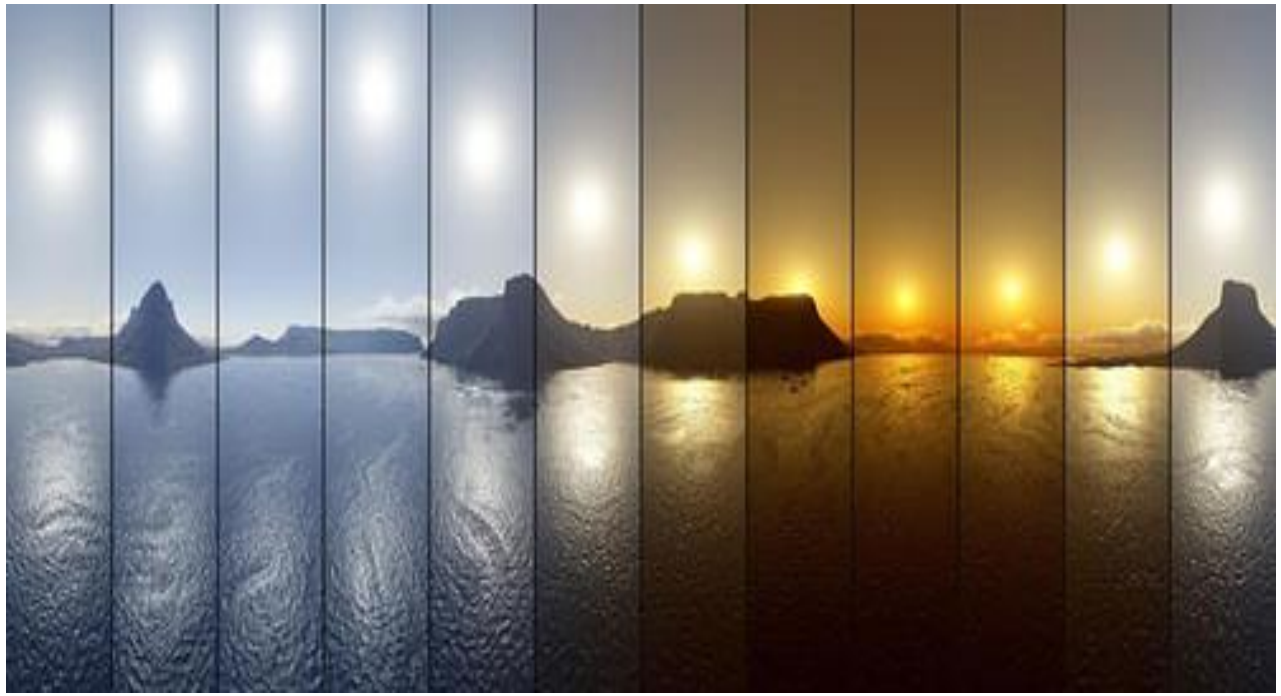
Sleep deprivation is the “epidemic of the 21st century”

Obesity	• Higher BMI with insufficient sleep • Disruption of appetite hormone secretion (leptin & ghrelin)
Diabetes	• Slower processing of glucose
Hypertension	• Elevated blood pressure • Link to heart disease & stroke
Mood Disorders	• Sadness, irritability, negative outlook, reduced sociability
Immunity	• Increased susceptibility to infection
Self-Medication	• Potential for increased alcohol consumption, dependence on sleep aids
Life Expectancy	• Sleeping 5 hours or less increases mortality risk by 15%

Source: Division of Sleep Medicine at Harvard Medical School

Regulating Circadian Rhythms

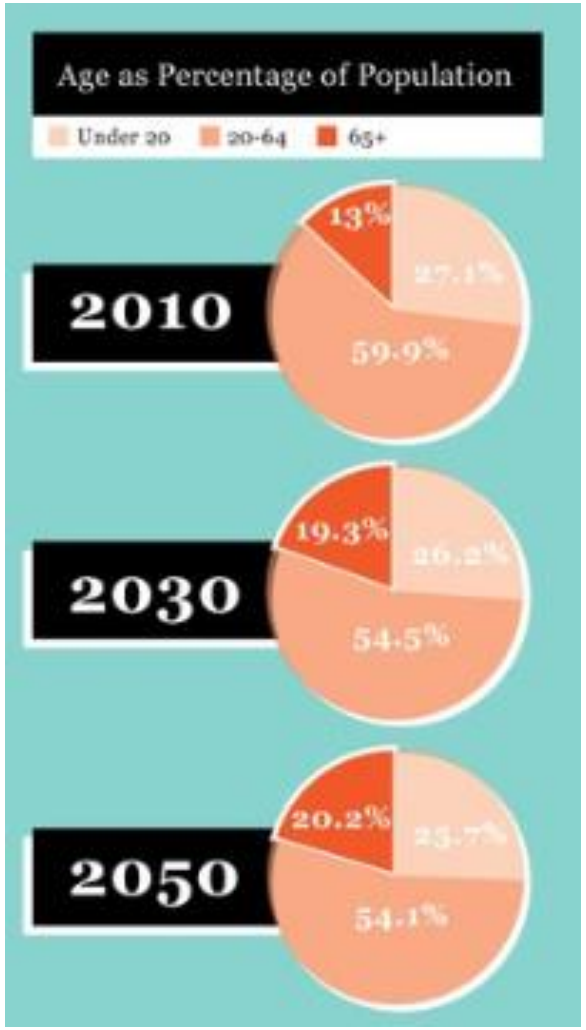
- Early morning exposure to higher light levels, especially in the short wavelength region of the visible spectrum (460-480 nm)
- Warmer, long-wavelength light in late afternoon and evening
- Dark at night to allow for melatonin production



People Are Getting Older, Living Longer…

- US: The “oldest” baby boomers turned 65 in 2011

- Life expectancy:
  - US is 78 years (76 for males, 81 for females)
  - Canadians & Spaniards can expect 81 years
  - 80 years in the UK
  - 76 years in Mexico

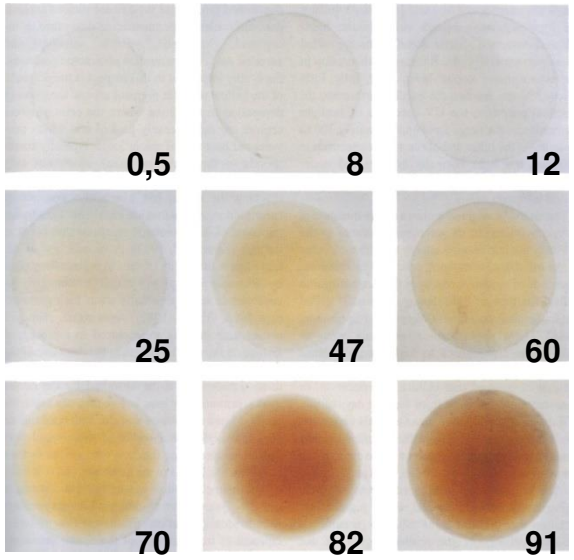


Can we make life easier for our aging population?

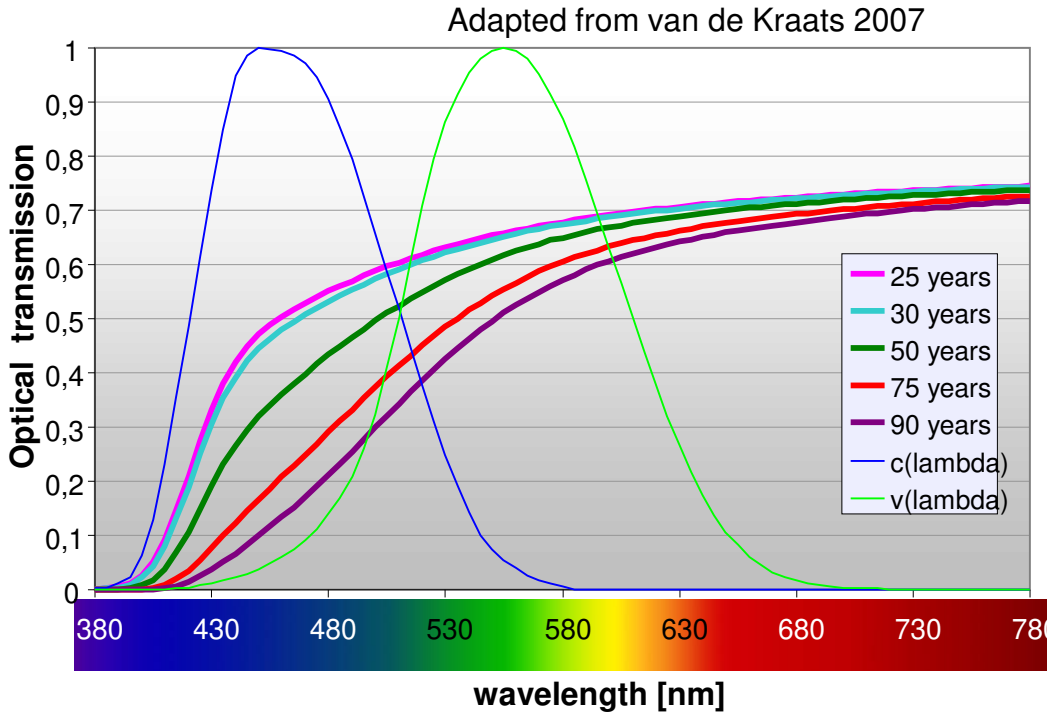
- Less light is transmitted to the retina – from 100% at age 25, to roughly **25%** at age 75
- Pupils become smaller, less able to adapt
- Lenses darken over time
- Increased prevalence of eye diseases (aging and related to other chronic conditions)

Spectral Transmission in Human Eye Lenses

Aging reduces transmission of short wavelength light to the retina



Lerman, 1980



Known age effects in eyes:

- Haze in dioptric apparatus
- Yellowing of lenses
- Reduced performance of iris

→ Reduced biological stimulus

→ Rhythm problems

Courtesy: Osram Sylvania

Can smarter lighting make us more aware of the world around us?

Borrow from other industries IoT breakthroughs...

Real-time location tracking services (RLTS) for wayfinding, asset tracking, patient safety?

The Energy of Things

A Quantified Path Forward

August 3rd, 2016

PRESENTED TO

DLC Stakeholders

PRESENTED BY

Kelly Sanders, Senior Technology Director
Energy Solutions

ENERGY SOLUTIONS

Technology Trends

A.R.

Big Data

A.I. / M.L.

Value…

Mist

DER's

Storage

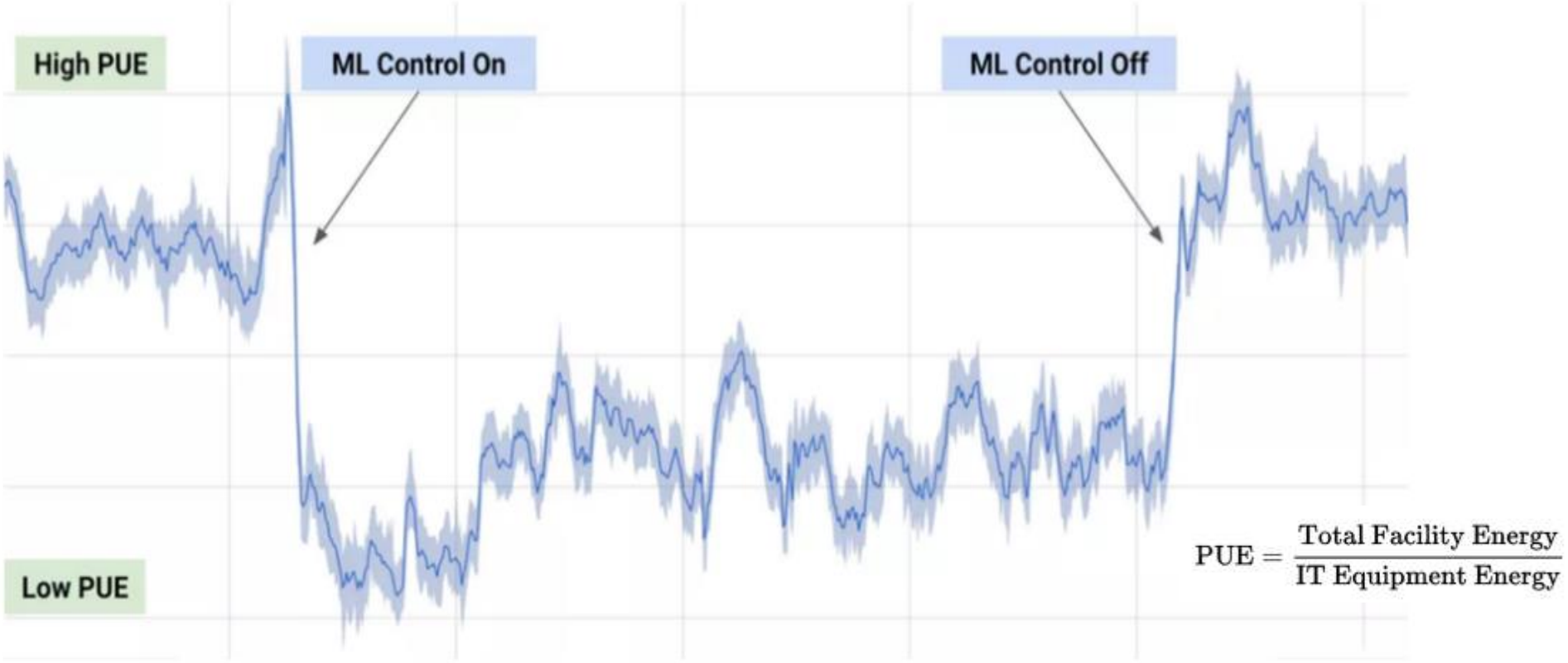
VLC

Cloud

The Energy of Things: energy portion of the IoT

Idea! EoT is valuable, quantifiable, and simple to explain.

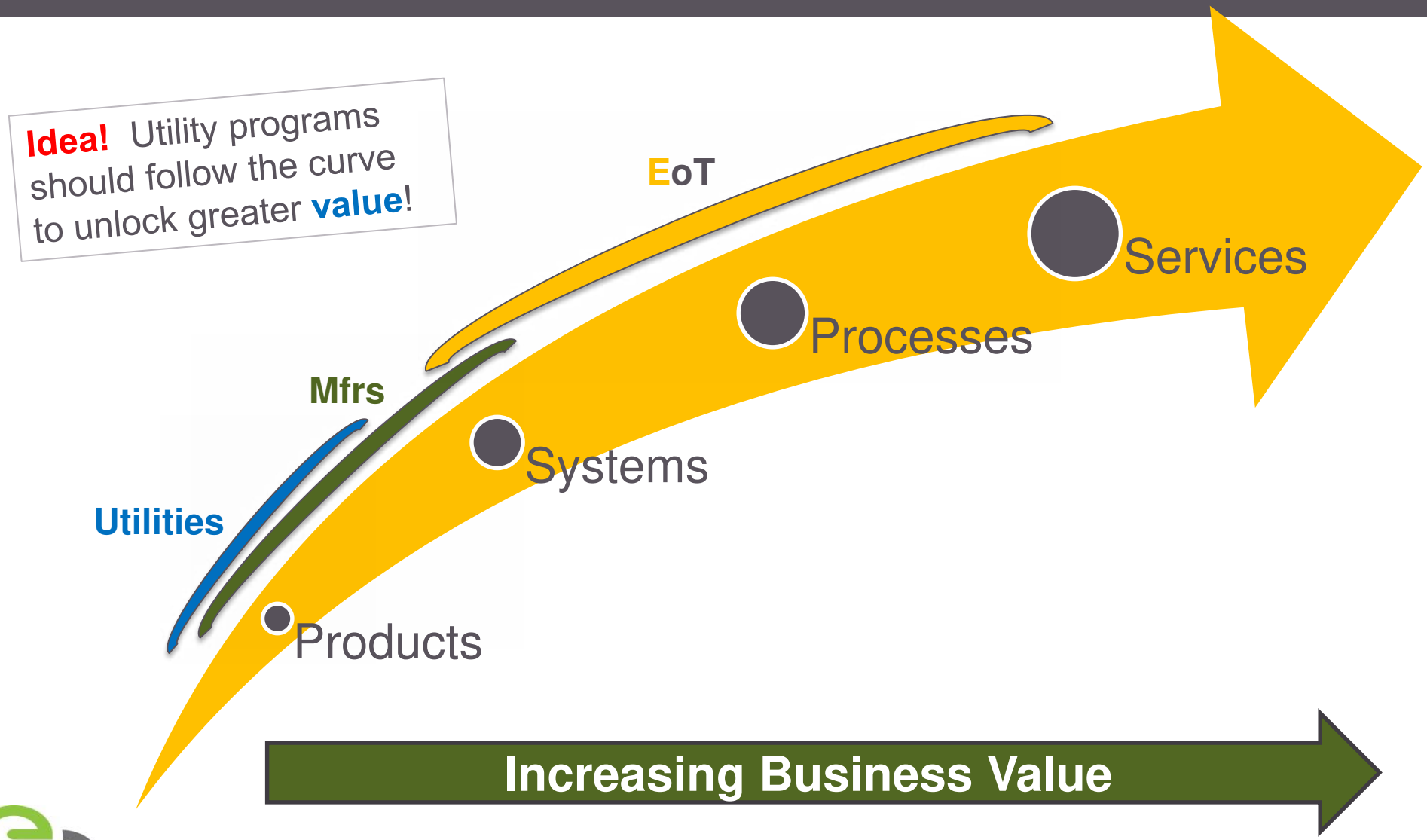
Energy Example: M.L. at work at Google



A rough graph showing how using machine learning (ML) helped reduce power consumption in Google's data centers.

(Image credit: DeepMind)

Maturity Lifecycle of a Smart Device



What Value?

Products

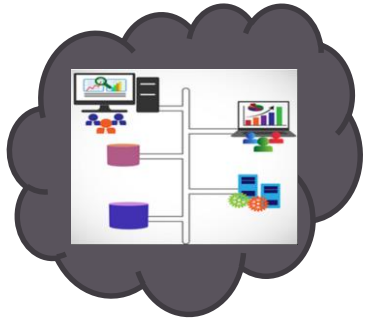
Traditional Utility Programs

Systems

- ☐ Energy monitoring
- ☐ Occupancy trends
- ☐ Main. Efficiencies
- ☐ Micro-zone Controllability

Processes

- ☐ **Dynamic Pay for Performance**
- ☐ Automated M&V
- ☐ Facility Optimization
- ☐ NEB's
- ☐ D.R. Grid Visibility
- ☐ Edge Device Analytics



Services

- ☐ Cognitive Services
- ☐ **LaaS / EEaaS**
- ☐ Energy Services Bundle
- ☐ Productivity
- ☐ Health & Wellness

A Quantified Path Forward

EoT

Maturity Validation
Performance Data
Open Standards
Influence ET

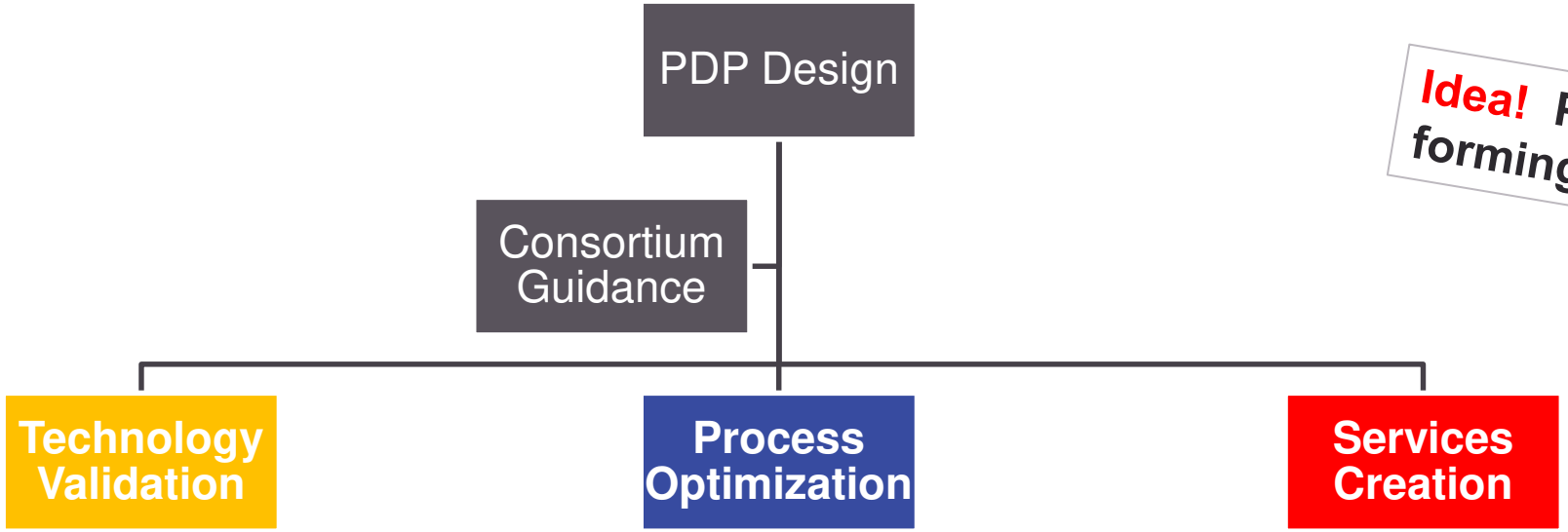
…Help Define EoT

Value

BE the Trusted Advisor
Real-time Data Programs
Grid Services
Support Best Practices
Services Model Focus
Quantify Business Value

Performance Data Program (PDP)

- A program to quantify the business value of EoT performance data to utilities and their customers.



Idea! **PDP consortium forming now!**

Consolidate/define/pilot activities and best practices to validate product/system maturity and focus investments.

Baseline and gap analysis of utility processes needed to support EoT integration and quantify value.

Evaluate/design/test emerging service offerings that leverage performance data, for utilities and their customers.

Why EoT Now?

- IoT is confusing, Energy is not!
- Performance data unlocks new services
- Utility/Industry partnerships can reduce the noise and accelerate adoption.

…our contribution to IoT is to *define and deliver* on the ***Energy*** *of Things*.

CONTACT

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ENERGY SOLUTIONS

The Future of Lighting as the Enabler for IoT

Joe Costello, CEO, Enlighted

Design Lights Consortium – 2016 Stakeholder Meeting, August 3, 2016

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Let’s Dream Together, Work Together


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Thank You
Enlighted. Changes Everything.
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