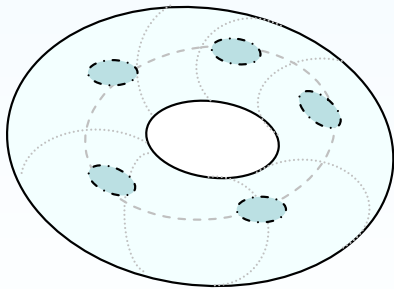
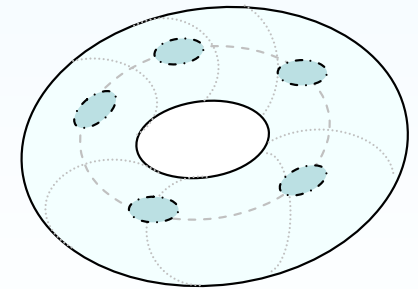


Joule Centre Conference 2009

Luminanz LED Lighting {Ultra-efficient lighting (UEL) Technology}



***Dr Neil R Haigh & Morton Graham
Luminanz Ltd
3rd March 2009***



About Luminanz

- Established 2007
 - SME < 4 people employed
 - History of LED based innovation
 - Edge-lighting, air-gap technology, waveguiding
 - Inventors: Morton Graham & Robert Walker



*Luminanz Ltd
Bolton, UK*

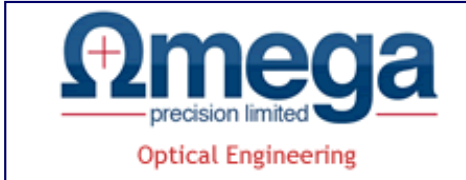


Luminanz Lamp-Lite



Luminanz Contour-Lite

Luminanz: UK Technology Support



Joule Project (Dr J Methven, Manchester University)



NWDA Photonics Mapping Study – Co-authored by Dr N R Haigh (Luminanz)



Luminanz Innovation Gallery



Luminanz LampLite



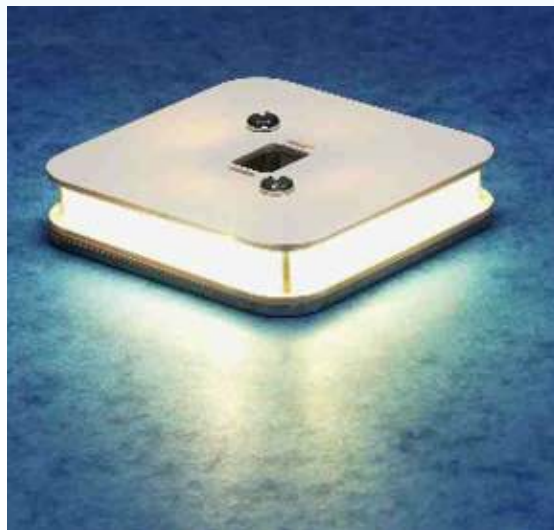
Luminanz ContourLite



Luminanz CorniceLite



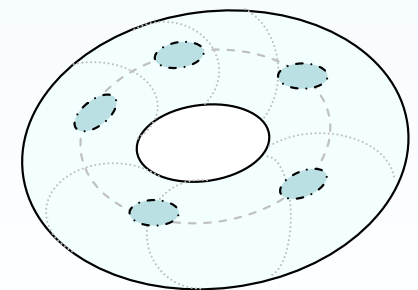
Luminanz TileLite



Luminanz QuarterLite



Luminanz TorusLite



Photonics = Revolution

- Photonics solutions tend to be totally disruptive



Photonics = Revolution

- Photonics solutions tend to be totally disruptive



Lighting & Energy Consumption

- UK electricity consumption for lighting purposes
 - $\approx 20\%$ of total energy
 - ≈ 75 TWhrs of electricity
 - 18 TWhrs = domestic lighting
- Ultra-Efficient Lighting (UEL)
 - $\approx 50\%$ energy saving target
 - ≈ 37 TWh of electricity
 - 9 TWhrs saved in domestic lighting
 - 4 Million tonnes of CO₂
 - $\approx > 2 \times 1,000$ MW coal-fired power stations

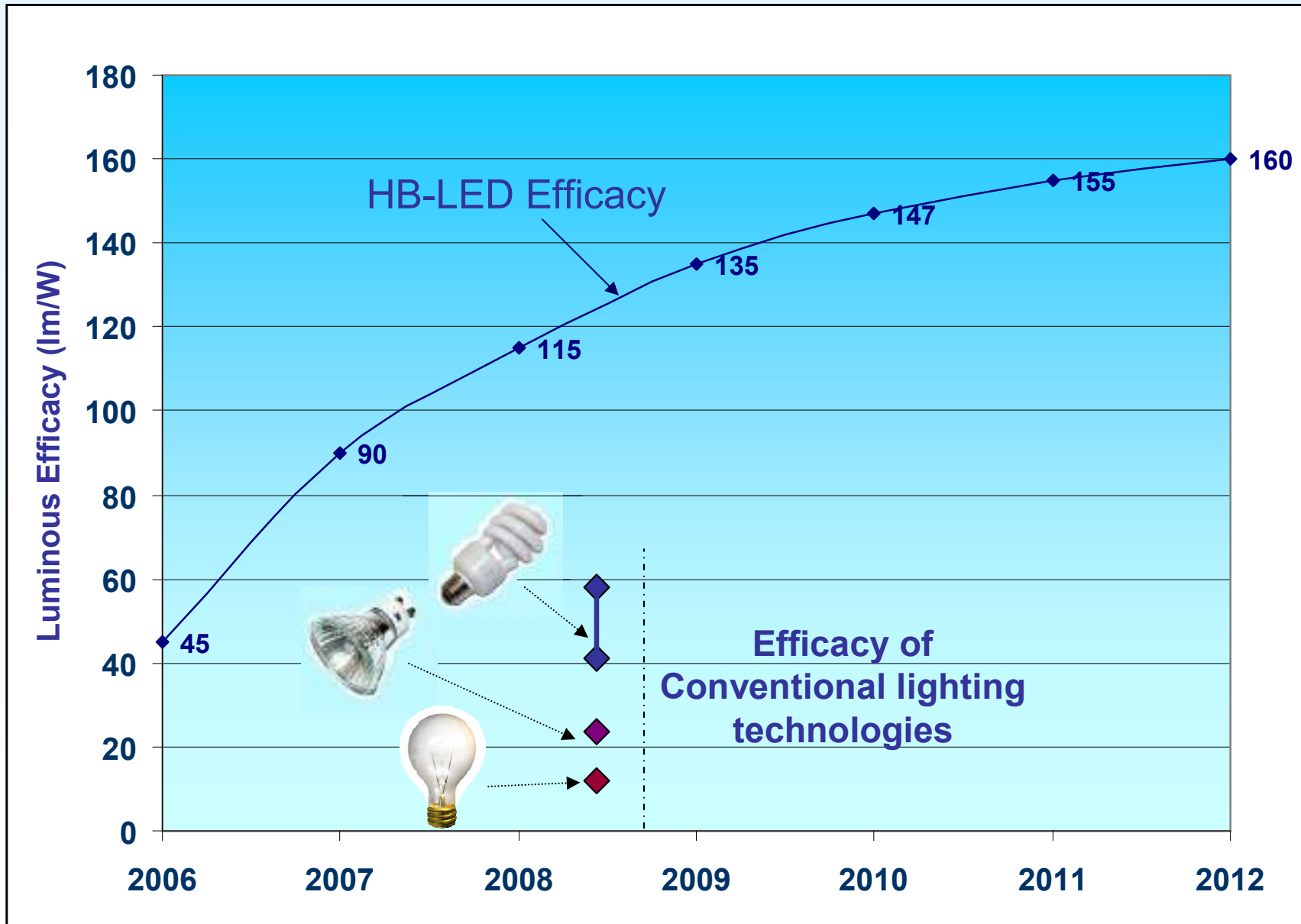


Key Metrics

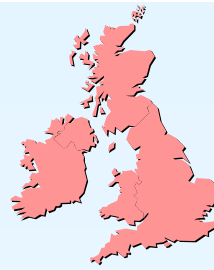
Light Type	Typical Efficacy (lm/W)	Usable optical Light (lm/W)	Lifetime (hours)
Incandescent	17	10-17	3000
Halogen / HPL	20 / 25	12-20	10,000
T12 fluorescent	60	45-50	20,000
Compact Fluorescent	62	31	10,000
Metal halide	70	<40	< 15,000
T8 fluorescent	74	55-60	20,000
High-pressure sodium	91	<50	< 24,000
T5 fluorescent	100	80	20,000
Best High Power white LED in 2007	105	85	> 50,000
Low-pressure sodium	120	65-70	18,000
Record LED - Research	150	120	TBD

- Source: Geoff Archenhold (Mondo Dec 2007)

LED Lighting: *Efficacy Roadmap*



Energy & Carbon Saving



- 25 million homes in UK
 - 200 million incandescent (GLS)
 - 175 million Tungsten Halogen
- Plan to replace all incandescent GLS by 2011
 - CFL or TorusLite @ 60 lumens per watt
 - 24% decrease in energy expenditure on lighting inside the home
 - Will save 3.8 TWhrs of energy
 - 1.6 million tonnes of CO₂ (1 kWh = 0.43 kgCO₂ c.f. www.nef.org.uk)
 - TorusLite technology @ 100 lumens per watt
 - Will save 4.3 TWhrs of energy
 - 1.9 million tonnes of CO₂



LED Lighting (*Conventional*)

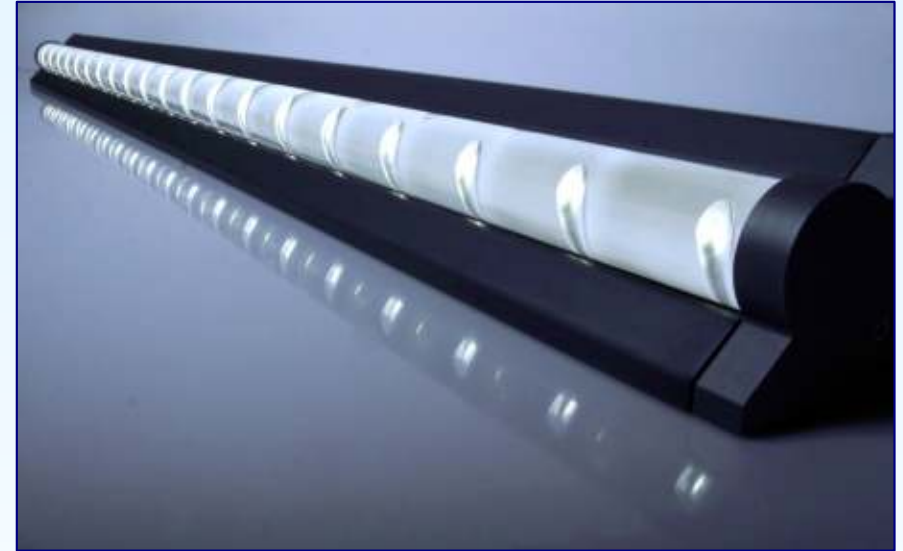
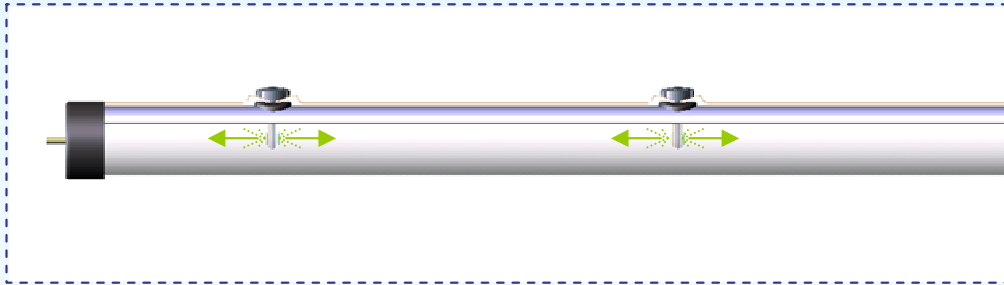
- Clustered LED Solution
 - LEDs ‘ganged’ onto a PCB
 - Inelegat & costly
 - Brightness limited!
 - If LED output is increased...
 - ...LEDs suffer thermal problems
 - ...cause eye discomfort and glare
 - possible retinal hazard!



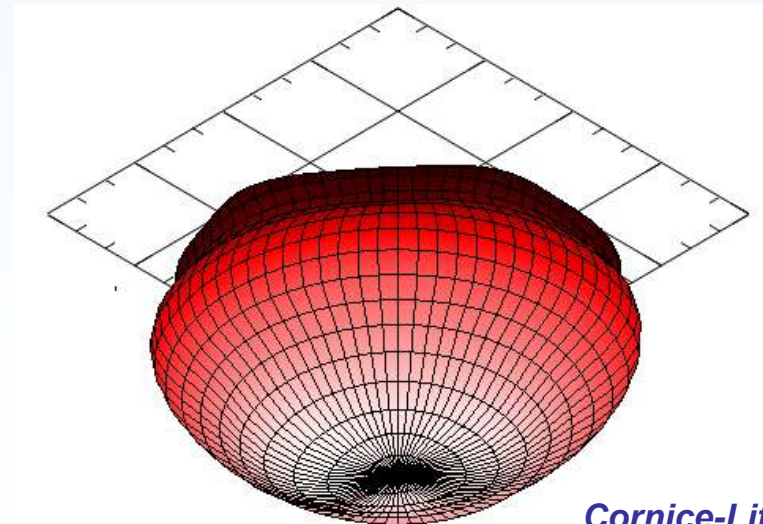
Ref: *LED Safety: Blue Light Hazard Analysis*
by N Haigh (Luminanz) & S Hall (NPL), Invited paper, China SSL 2008

LED Lighting (*Luminanz Rod-Lite*)

- LED light is *directed sideways!*



- Light diffusely emitted from reflector affixed to rear of Rod-Lite
- Uniform source of ambient light
 - Perfect for corridor and room illumination
- Harness full power of today's brightest LEDs
 - Glare & Discomfort free LED luminaire
 - 62 lumens per watt measured efficacy!



Cornice-Lite
Test Data

Luminanz Torus-Lite



The UK Downlighting Trend



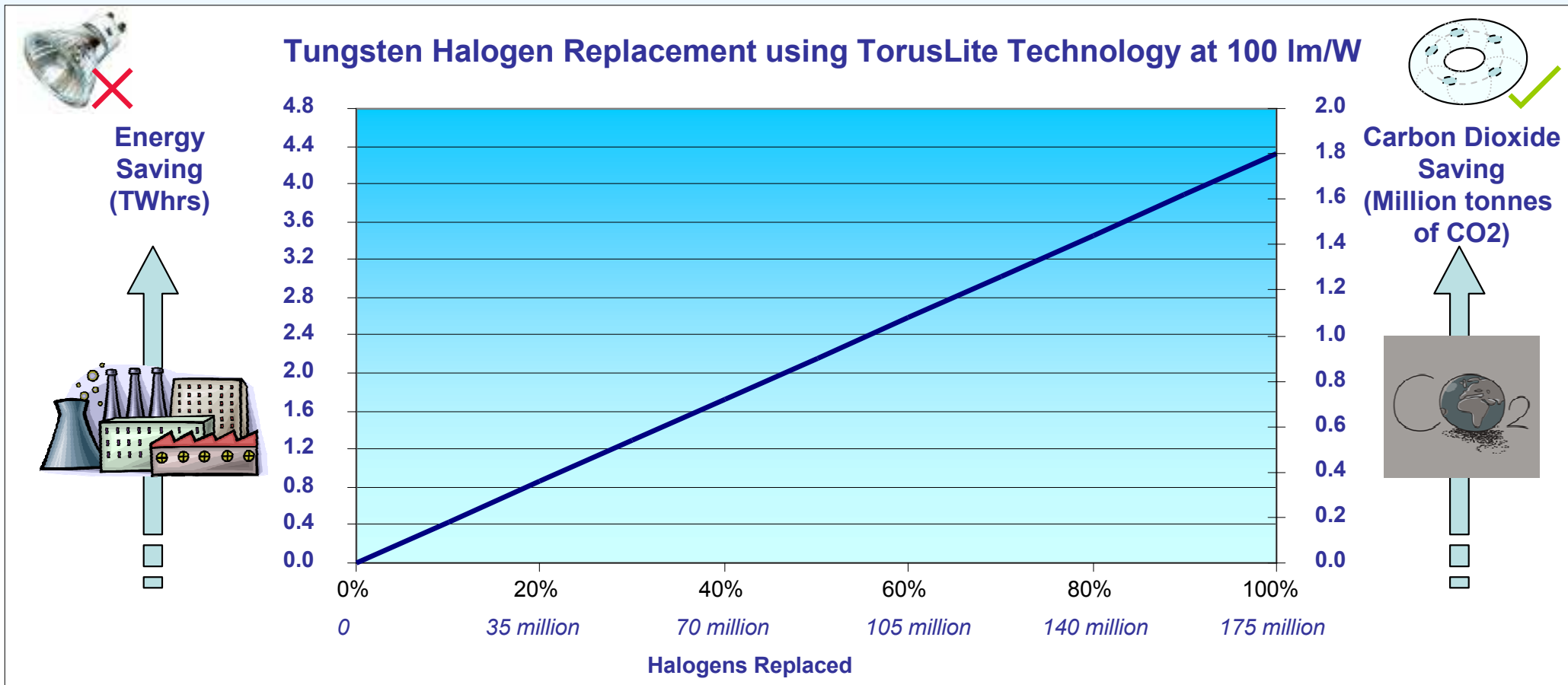
- Downlighting is *very fashionable*
 - e.g. kitchens, bedrooms, bathrooms
- Downlighting can be *highly ineffective*
 - A ‘task’ light deployed for ‘ambient’ lighting
 - e.g. 5 to 20 Halogens per room!
- Downlights are *not energy efficient*
 - Halogen efficacy ≈ 20 lumens per watt
 - (c.f 100 watt incandescent ≈ 15 lumens per watt)
 - CFL downlight effective efficacy ≈ 40 lumens per watt



Halogen Replacement



- 178 million halogen light sources in UK homes
 - Typical Efficacy \approx 20 lumens per watt
 - Cannot replace with Compact Fluorescent Lamps (CFL)
 - But we can replace with TorusLite @100 lumens per watt!



Thermoelectric Challenge?

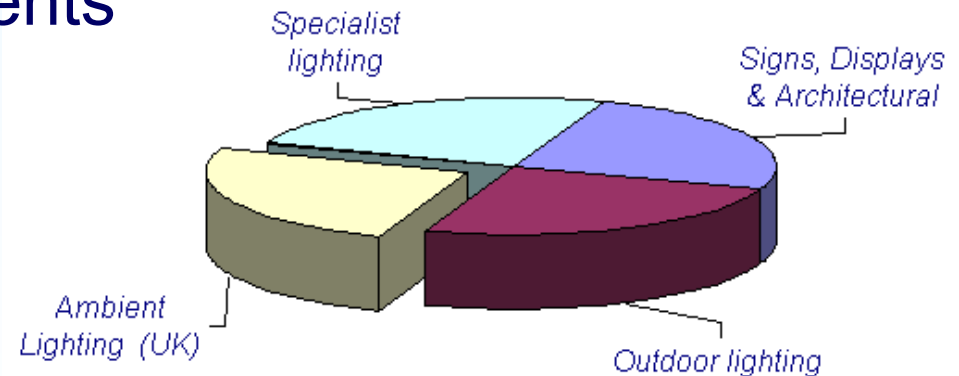
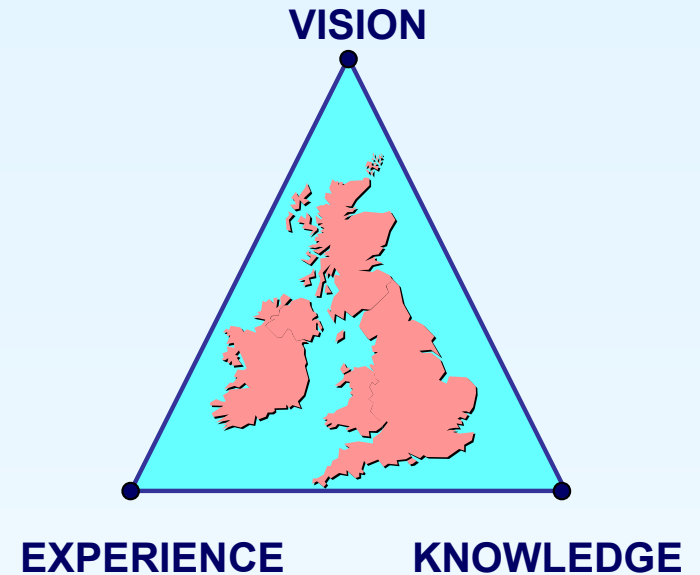
- LED wall plug efficiency
 - $\eta_{\text{elec}} \approx 30 - 50\%$
- Lumen efficacy
 - $\eta_{\text{lum}} \approx 100 \text{ lm/W}$
- 40 watt LED lighting fixture
 - 4000 lumens visible light
 - ≈ 12 to 20 watts radiant optical power
 - ≈ 28 to 20 watts non-radiant heat

*Question: Can you help
Luminanz re-use the local heat
energy in a useful way?*



Summary

- LED lighting revolution is underway
- Dramatic energy & carbon savings are possible
- Luminanz have key IPR & patents
- Opportunity for UK to play a significant part
- UK manufacturing is still viable
 - Opportunity exists to reverse the trend



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Thank You For Your Attention

