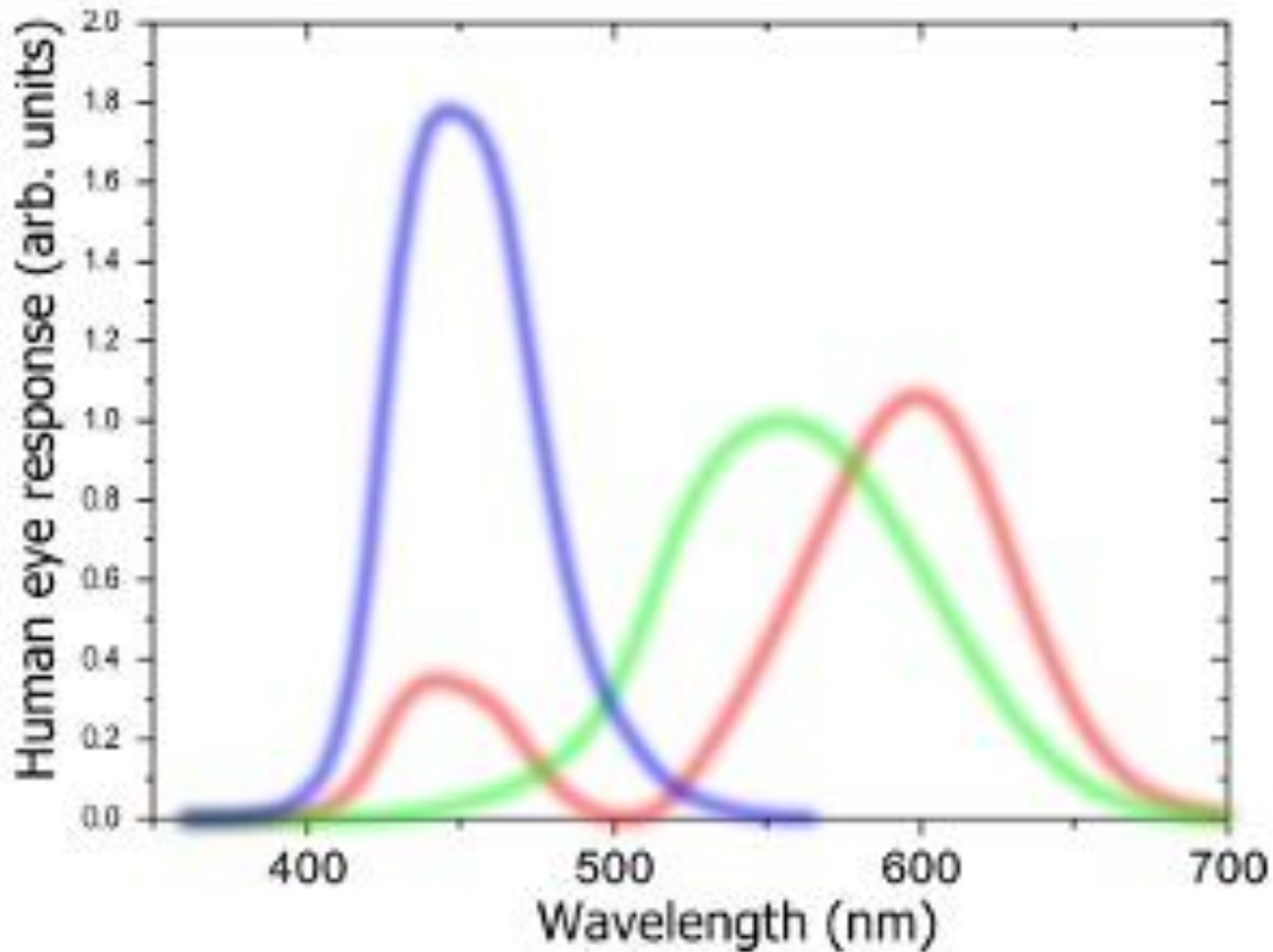
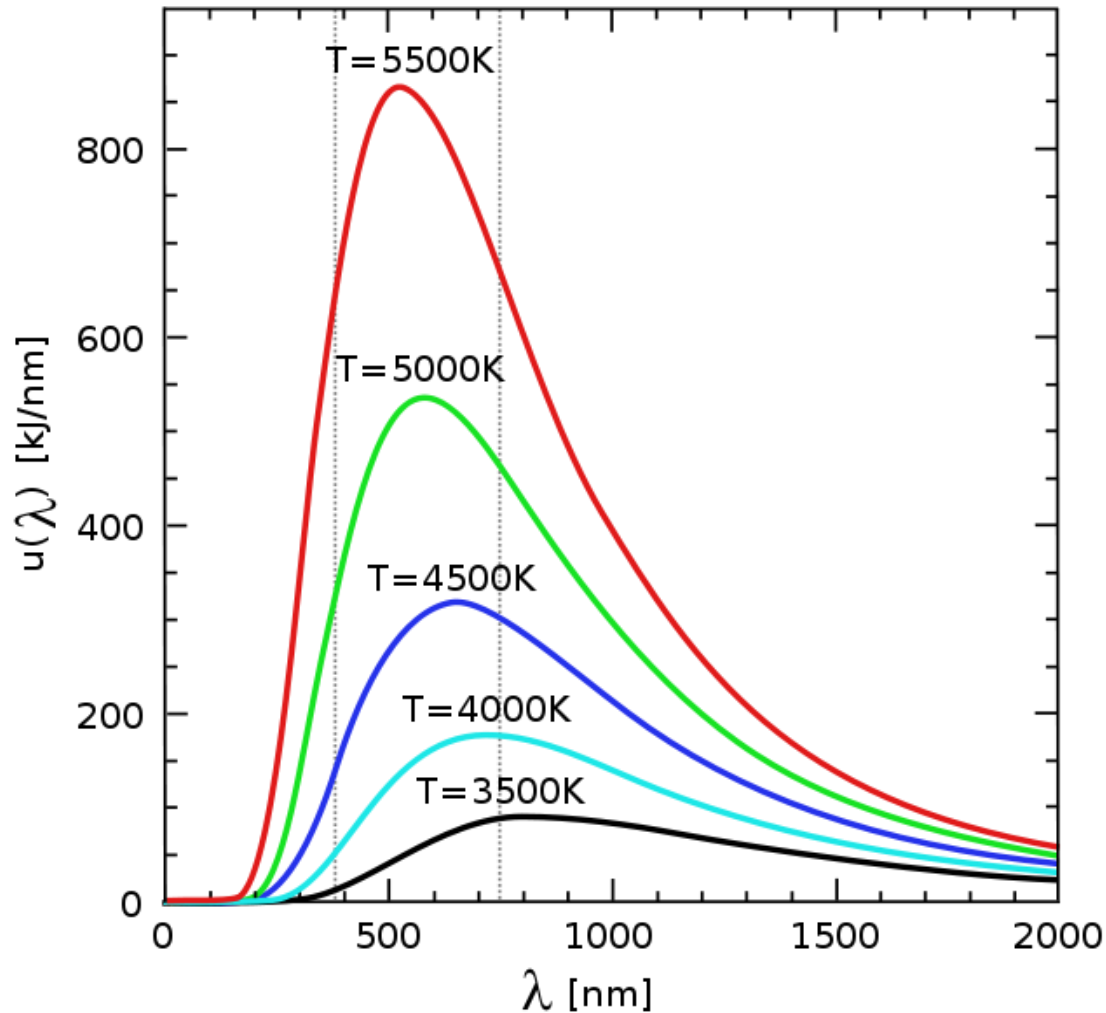


Response of Human Eye

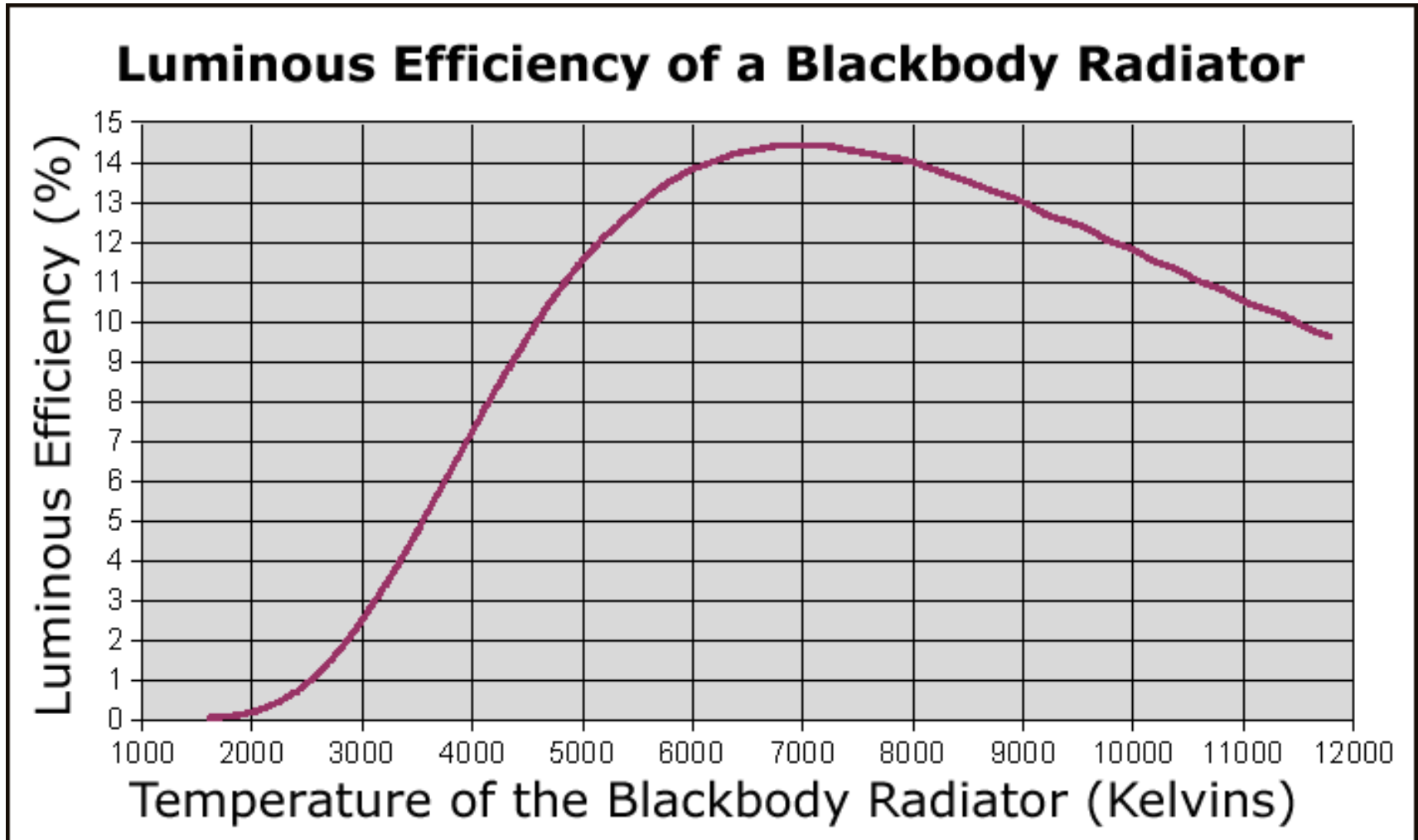


<http://www.st-andrews.ac.uk/~osc/oleds.shtml>

Sunlight (the “Gold Standard”)



“Efficiency” of Sunlight



Luminous Efficacy (light efficiency)

- Measure: lumens/watt
- Lumens: luminous flux weighted for the response of the human eye
- One watt of pure green light (555 nm)
= 683 lumens (definition)
- 683 lumens/watt is “100% efficient”

Efficiencies (ball-park numbers)

- Candle 0.3 lm/W (0.04%)
- Gas mantle 2 lm/W (0.3%)
- Incandescent bulb 20 lm/W (3%)
- Compact fluorescent 100 lm/W (15%)
- LED (SSL) 100 lm/W (15%)
- Sunlight 90 lm/W (13.5%)

Solid-State Lighting: a no-brainer, right?

but...

- “new performance attributes associated with SSL [LEDs] have the potential to unleash new and unforeseen ways of consuming light.”
- “The amount of electricity needed to generate that light [from all the new LEDs] would more than double. Only if the price of electricity were to triple would the amount of electricity used to generate light start to fall by 2030.”

J Y Tsao *et al.*, J. Phys. D: Appl. Phys. **43** (2010) 354001

- “for those who truly wish to reduce the amount of energy expended on lighting the answer may not be to ban old-fashioned incandescent bulbs, as is the current trend, but to make them compulsory.”

The Economist, 2010/08/26

The Jevons Paradox

“Technological progress that increases the efficiency with which a resource is used tends to *increase* (rather than decrease) the rate of consumption of that resource”

(William Stanley Jevons, 1865. He was thinking about steam engines, but consider automobile engines, jet engines, etc.)