

UNIVERSITY OF
CAMBRIDGE

Department of Plant Sciences

LED in Labs - Plant Growth

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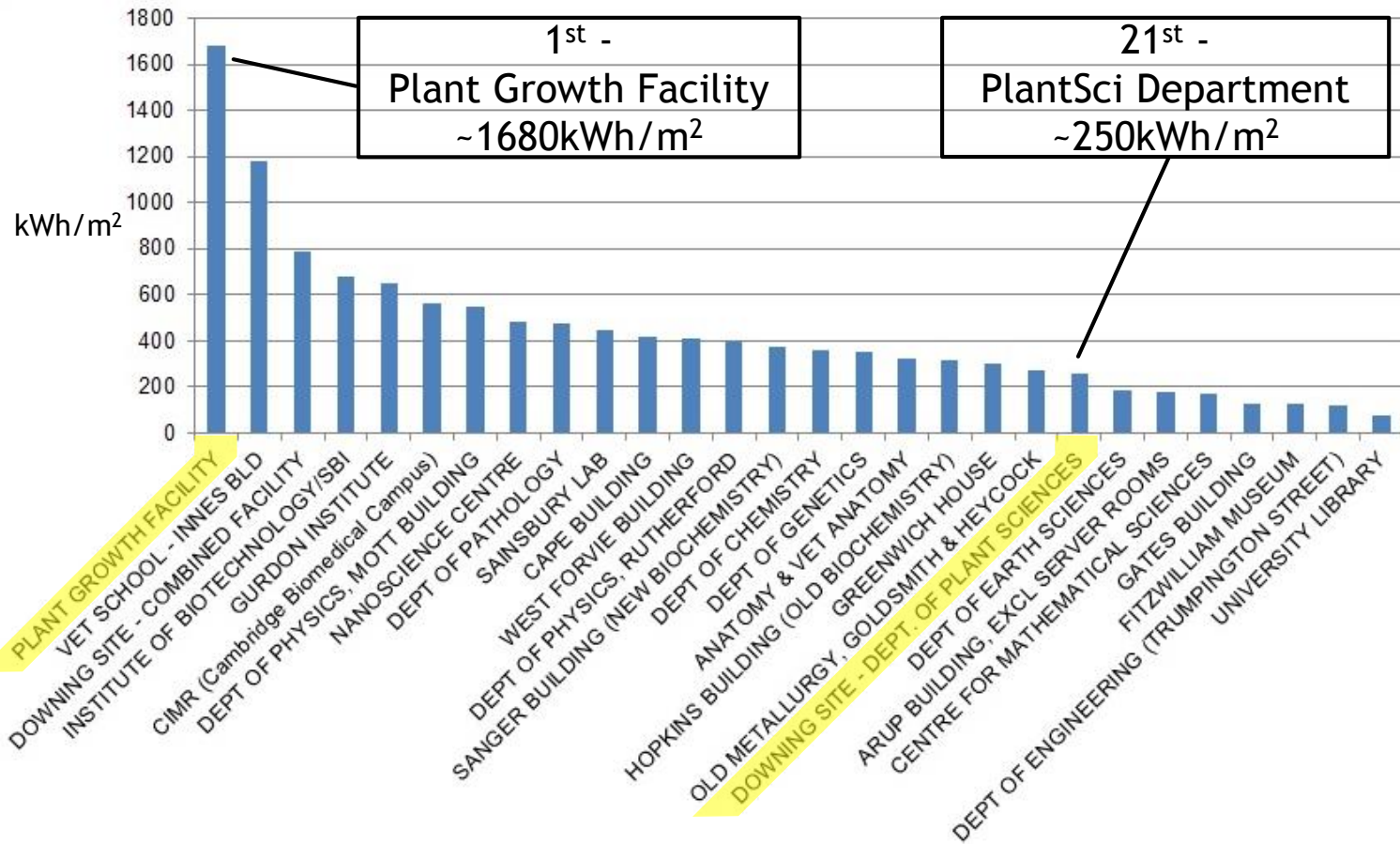
Outline

- ▶ Background
 - ▶ Department of Plant Sciences
 - ▶ Energy & Plant Growth
- ▶ 1) LEDs in Plant Growth Rooms
 - ▶ Biological Testing
 - ▶ Energy
- ▶ 2) LEDs in Algal Incubator Shakers
- ▶ Conclusion



Background

- ▶ The top University of Cambridge users of electricity, ranked by usage per m² (kWh/m²)





Background

- Department of Plant Sciences

- ▶ Facilities range from individual trays and algal incubation shakers to growth cabinets and rooms to greenhouses.
- ▶ Artificial lighting is used for maximum control.
- ▶ A significant portion of departmental electricity costs are for lighting and for chilling to counter the waste heat emitted by lights.





Background

- Energy and Plant Growth

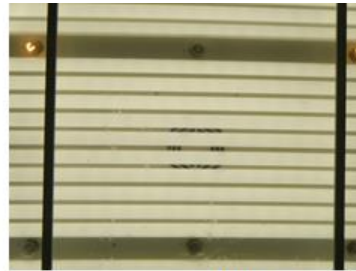
- ▶ Plant research is dependent on high quality lighting.
- ▶ For plant growth, Photosynthetically Active Radiation (PAR) light is needed.
- ▶ Plants can use light between 400-700nm in wavelength.
- ▶ The key is to deliver the right light intensity (amount of photons) of the right wavelength to the plants.





1) LEDs in Plant Growth Rooms

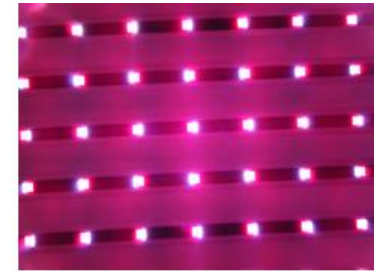
- ▶ Typical 'day load' is 8kW per room, not-including chilling provision.



FLUORO



LED 4



LED 1

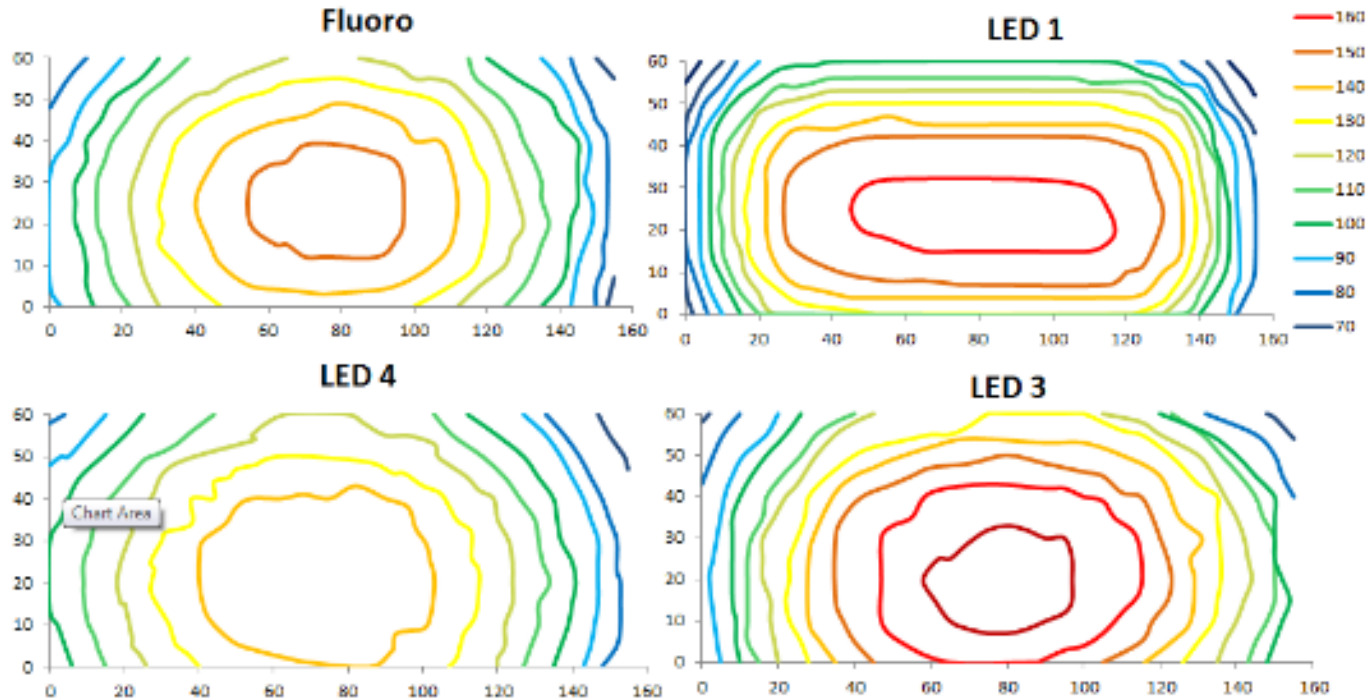


LED 3

- ▶ Trials began in 2012 with funding from the Energy & Carbon Reduction Project.
- ▶ We want a close match for the fluorescent lighting.



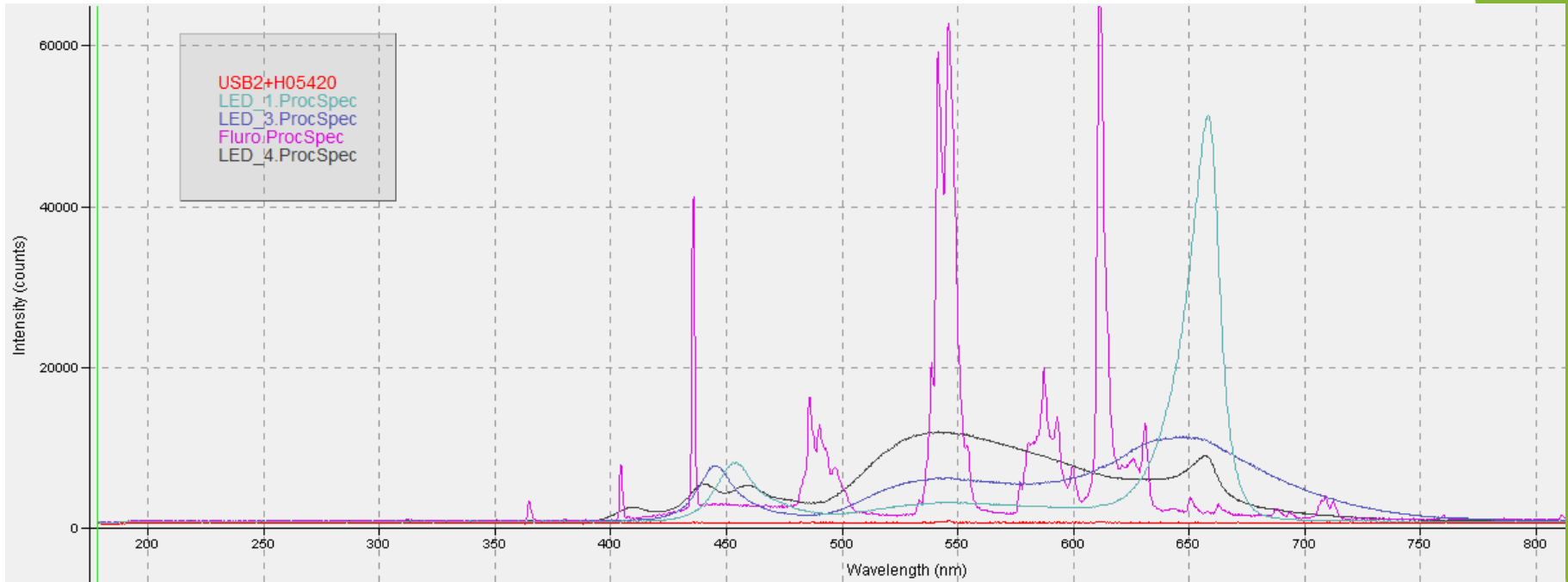
1) LEDs in Plant Growth Rooms Light Intensity & Coverage



- Isophote maps show intensity of PAR 5cm above the surface of the growth tray under different light treatments.



1) LEDs in Plant Growth Rooms Light Spectrum Delivered

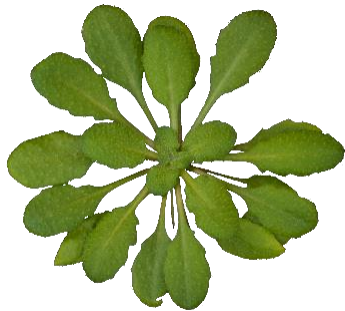


- ▶ Electromagnetic spectra showing relative intensity of different wavelengths for the different light treatments



1) LEDs in Plant Growth Rooms Biological Testing

- ▶ Experiments used mainly Arabidopsis, wheat, tobacco and tomato.
- ▶ Results imply that despite the differences between the spectra of fluorescent lighting and LED lighting, plant growth is determined by overall intensity.





1) LEDs in Plant Growth Rooms Energy & Current Status

- ▶ An LED array type has been decided upon to refit two whole Plant Growth Rooms with.
- ▶ From trials, a >50% reduction in electricity required to light rooms is expected. A conservative 4kW reduction per room would equate to over £60,000 saved per year.
- ▶ Further savings will come from reduced demand for chilling and reduced expenditure on light replacement.



2) LEDs in Algal Incubator Shakers

- ▶ Infors Incubator Shakers are fully climate-controlled chambers for cultivating algae.
- ▶ Each unit costs around £6000 per year to run in electricity and tube replacement costs.

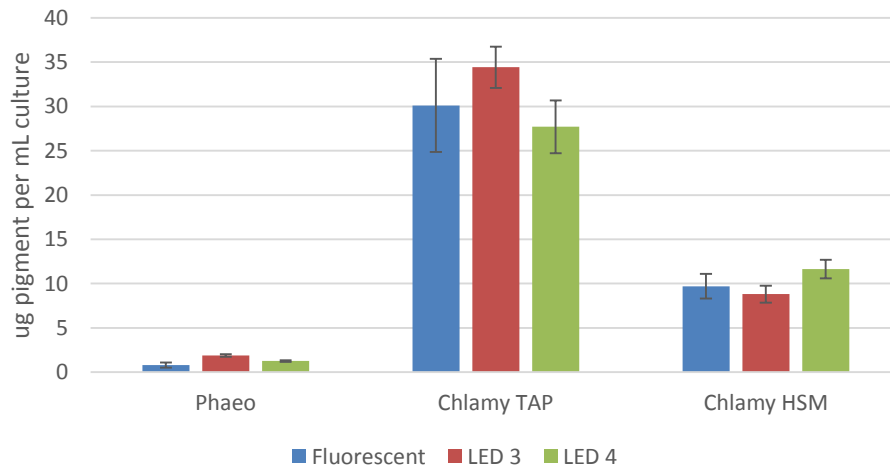




2) LEDs in Algal Incubator Shakers - Biological Testing



Chlorophyll-a

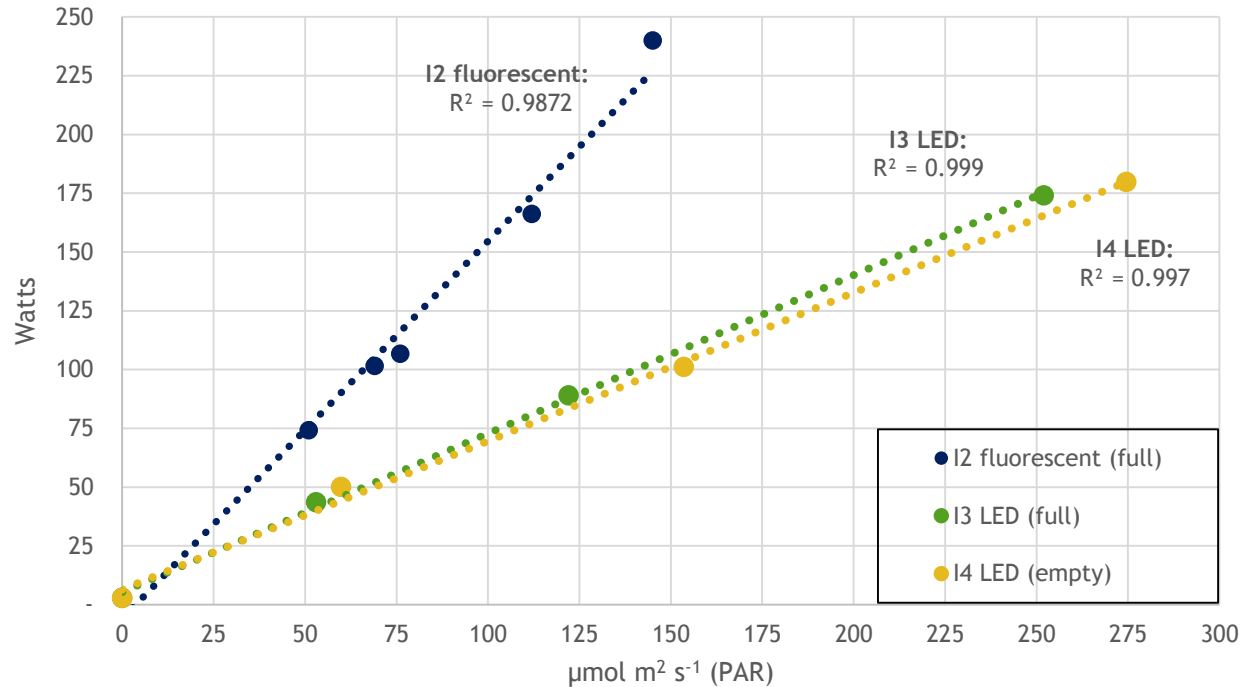


► No significant differences have been found in algal growth between LEDs and fluorescent lighting.



2) LEDs in Algal Incubator Shakers - Energy

Relationship of light PAR generated by the unit and the power used for the lights alone - Lab 220



► LEDs are:

- Over twice as efficient.
- Capable of producing nearly double the light intensity.



2) LEDs in Algal Incubator Shakers - Energy

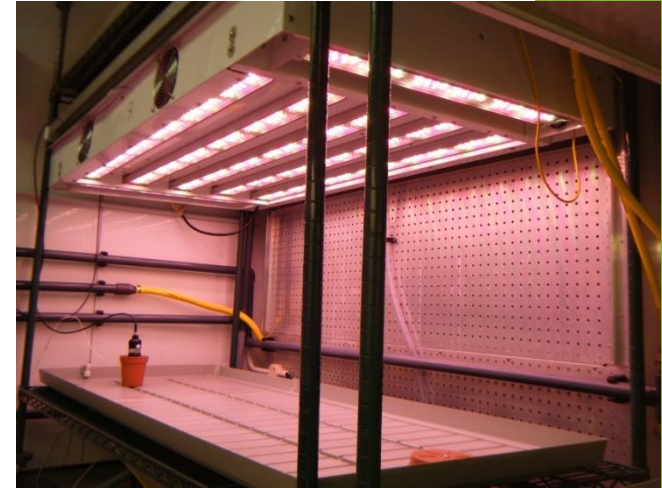


- ▶ Unit capability is improved.
- ▶ LEDs emit less heat which reduces chilling demand. A further ~55W is saved under normal operating conditions.
- ▶ Expected lifespan of the LEDs is 10x better than the tubes (10-20 years instead of 1-2 years).



Conclusion

- ▶ LED technology is maturing quickly. It is efficient, powerful and flexible.
- ▶ Switching to LED cannot adversely affect research. It requires an ‘application-first’ approach.
- ▶ Refitting can improve the capability of existing equipment and reduce maintenance costs.
- ▶ Significant reductions in electricity consumption and expenditure are expected.





Thank You

Questions?

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