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GREEN LIGHT LABORATORIES LIMITED

Fluorescence Microscopy: Light Source Running Costs

A study using real-world energy measurements to compare the projected running costs of a metal halide illumination system with two different CoolLED LED illumination systems

Study Carried Out At:

Wolfson Bioimaging Facility,
Biomedical Sciences Building
University of Bristol

Study Overseen By:

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Metal halide versus LED illumination: What does it actually cost to run?

Light microscopy facilities rely on stable, high-quality illumination every day. When it comes to widefield fluorescence, mercury and metal halide bulb-based light sources have long been familiar choices, but they also bring ongoing costs through electricity use, replacement bulbs and routine maintenance, not to mention the environmental risks associated with mercury.

This case study uses real-world energy measurements to project the running costs of the metal halide system tested and two CoolLED LED Illumination Systems over 25,000 hours: the pE-300^{lite} and pE-400^{max}.

This comparison shows that running a metal halide light source can cost thousands of pounds more over time than LED illumination. The data can also help support equipment replacement plans, sustainability discussions and funding applications, particularly where institutions offer grants or internal support for energy-efficient laboratory equipment.

Key Findings

Reduced Energy Consumption

Over 25,000 operating hours, the metal halide system would consume 4,000 kWh. Based on the measured power consumption, the pE-300^{lite} would use 300 kWh and the pE-400^{max} would use 675 kWh. This equates to reductions of 93% and 83% respectively.

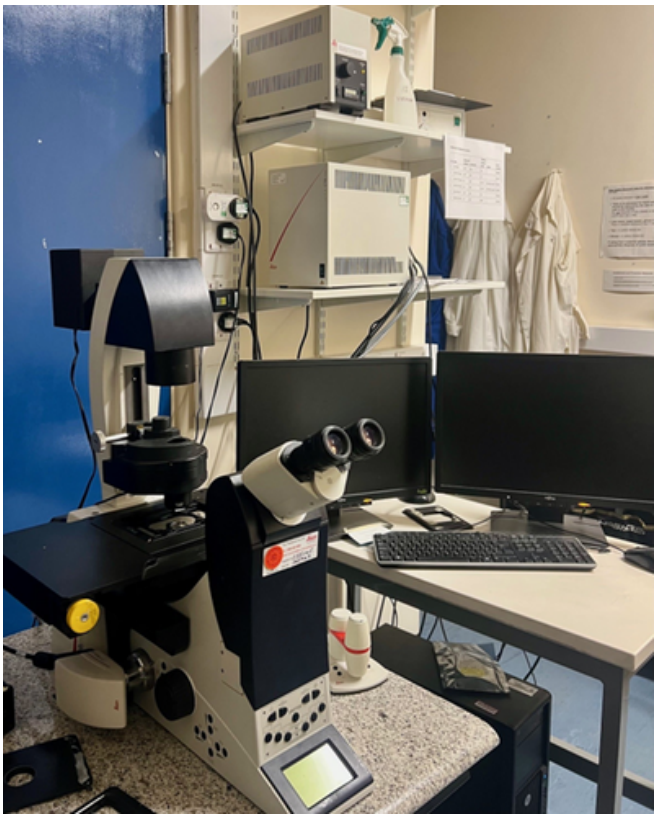
Reduced Running Costs

Over 25,000 operating hours, projected bulb and electricity costs were £6,100 for the metal halide system, compared with £67.50 for the pE-300^{lite} and £151.88 for the pE-400^{max}.
The metal halide calculation includes £5,200 in bulb costs. No replacement bulbs are needed in LED Illumination Systems.

Systems Compared

System	Illumination Type	Configuration
Metal halide	120 W metal halide lamp	Single bulb, broadband light source
CoolLED pE-300^{lite}	LED Illumination	1-Channel system using 3 LEDs
CoolLED pE-400^{max}	LED Illumination	4-Channel system using 4 LEDs

Potential saving based on exchange rate at time of publication, with each systems hypothetically tested over 25,000 hours. Actual monetary savings will vary depending on the LED light source selected, usage pattern, energy tariff and fluctuating bulb replacement costs after the EU RoHS exemption for mercury in metal halide lamps expires on 24 February 2027.



- **Location:** Wolfson Bioimaging Facility, University of Bristol, UK.
- **Microscopy testing:** Dr Daniela Franchini
- **Existing light source:** 120 W metal halide
- **LED systems tested:** CoolLED pE-300^{lite} and pE-400^{max}
- **Imaging approach:** comparable fluorescence images captured on all three systems
- **Metal halide operation**: lamp run at full power
- **LED operation:** exposure and gain kept consistent, with channel power adjusted to match brightness
- **Energy monitoring:** Logicall Wireless Monitoring system
- **Monitor accuracy:** ±1%

Featured image (left): Fluorescence microscope system used in the study, with the metal halide light source located on the top shelf

Comparison Assumptions

Comparison Period:	Electricity Rate Used:	Metal Halide Bulb Life:	Replacement Bulb Cost:
25,000 hours	**£0.225/kWh**	**2,000 hours**	**£400**

Energy Consumption and Projected Running Costs

Metric	Metal Halide HXP R 120 W Bulb	pE-300^{lite} 1 Channel On	pE-400^{max} 4 Channels On
Bulb Cost (25,000 hours) 13 bulbs, including 12 replacements	£5,200.00	£0	£0
Energy use per operating hour (kWh)	**0.160**	**0.012**	**0.027**
Energy Consumption (kWh for 25,000 hours)	4000	300	675
Electricity Cost (25,000 hrs)	**£900**	**£67.50**	**£151.88**
Operating Cost/Hour (Bulbs + Electricity)	£0.2440	£0.0027	£0.0061
Total bulb and electricity cost (25,000 hours)	**£6,100**	**£67.50**	**£151.88**

Conclusion

This study found that both of the CoolLED LED Illumination Systems tested produced fluorescence images comparable with those obtained using the 120 W metal halide system under the test conditions at the Wolfson Bioimaging Facility. Both LED systems also used substantially less electrical energy and had much lower projected running costs over 25,000 operating hours.

The pE-300^{lite} showed the lowest measured energy use, with projected consumption of 300 kWh over 25,000 hours, compared with 4,000 kWh for the metal halide system, a 93% reduction.
The pE-400^{max}, with all four channels operating, was projected to use 675 kWh, an 83% reduction.

Projected bulb and electricity costs over the same period were £6,100 for the metal halide system, compared with £67.50 for the pE-300^{lite} and £151.88 for the pE-400^{max}.
Approximately £5,200 of the metal halide total related to bulb costs, showing that the financial difference reflects both lower energy use and the absence of recurring replacement bulbs.

The pE-300^{lite} delivered the lowest energy use and projected running cost of the two LED systems tested. The pE-400^{max} consumed more energy in the four-channel configuration used here, but remained substantially below the metal halide system.

Overall, the findings indicate that, under the conditions tested, LED illumination can reduce energy use and projected running costs while maintaining comparable fluorescence imaging results.
The exact benefit for another facility will depend on its equipment, usage patterns, electricity costs and replacement-bulb requirements.

Interpretation and Limitations

The comparison in this study uses equal active operating hours. In practice, those hours may accumulate differently between technologies.

Metal halide lamps are commonly left running throughout an imaging session to avoid repeated warm-up cycles, meaning operating hours continue to accumulate between image captures.

Some CoolLED Illumination Systems can be synchronised with a camera so that illumination is active only during image capture, while the pE-300^{lite} provides instant manual on/off control.
As a result, an LED system may take considerably longer in actual elapsed time to accumulate 25,000 operating hours compared to a metal halide system.

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