Fact sheet

The Rise of LED Screens on Performance Stages

Greener Live Performances

through energy efficiency

The LED Revolution

The quantum dynamics that create light in the LED semiconductor represent as much of a technological shift as the move from candles to incandescent lamps in the 19th century.

In the live performance industry LEDs are extensively used as house and stage lighting, and now we are seeing increasing application of LED screens on stages and at concerts and festivals.

Let's talk about LED screens

With increasing take-up of 'Dynamic Surface' in theatre, LED screens provide the potential for endless opportunities in visual experience.

Instead of presenting an image only one way, LED screens allow visual content to be integrated into the audience experience through movement, intensity change and colour. Screens can be transparent, curved and mounted further enhancing the possibilities available to the designer.

Will LED screens completely replace the traditional wooden, timber stage flat? No, it doesn't seem likely at the moment due to the cost associated with purchase and/or hire of the screen.

Will screens continue to be price prohibitive except for larger performances? Yes, but only for the time being. As with standard LED lighting fixtures, there is every expectation that LED screens will become more affordable over time.

The purpose of this fact sheet is to provide Lighting Designers with comparative information on use of traditional theatre flats, projection equipment and LED screens. There are numerous pros and cons for each of these aspects and their enhancement of the artistic piece, each profiled within. Our primary focus is the comparable difference in energy consumption of LED Screens versus Projection.

Integration of Projection into stage production has increased in recent years and designers have questioned the amount of energy used by the process, especially when used in conjunction with full lighting rigs. Industry Professionals are actively looking for ways to improve energy efficiency outcomes of staged productions and the use of LED Screens over Projection equipment is one consideration that has the potential to achieve that. The graph that appears on page 6 of this Fact Sheet displays the significant efficiencies available from LED Screens.

Lifecycle

As with all procurement decisions, the decision to utilise LED screens for a performance must also include consideration of the full lifecycle impacts of extraction, manufacture, transportation, use and end-of-life disposal.

Compared to the traditional stage flat, LED screens certainly have a more significant lifecycle impact and, at the moment, limited recyclability.

Further research and analysis is required of the time and materials used to build scenic flats, and their relatively limited life span, before a robust comparison of the life cycle efficiency of LED screens and scenic flats can be made.

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Flats of the future

Are LED panel screens replacing the need for standard theatre flats?

Imagine... a lightweight screen suitable for hanging on theatrical rigging points, a screen that becomes transparent when not used, a screen that doesn't fade in stage lighting but offers a see through screen when an image is not present.

Pros and Cons of LED Screens v Standard Theatre flats

	Standard Theatre Flat	LED Panel Screen
Pros	Custom made to suit production requirements. Modular for extension. Currently, the most common due to cost efficiencies	Cross section of sizes and weights Can be easily transported by one person Available as single series or grouped Can be used in horizontal or vertical orientation Can be floor mounted, suspended or off-floor configuration Lighting fixtures can be mounted to all sides of the panel for additional effect Provides direct light onstage significantly reducing the need for reflective lighting rigs Specified life of product is 100,000 hrs
Cons	Volume of product by mass can be significant Limited serviceability and application Requires additional materials (paints, textures) to fulfill artistic brief Time consuming erecting set – increased labour costs and bump-in allowances Requires reflective lighting application to sufficiently light a show	Consumes energy throughout show Current financial impact of purchase / hire is considerable, though will decrease in price over time

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Digital Projection

Digital projection is regularly used for stage effect and offers a more traditional operational method when compared to LED screens.

Whilst projectors are exceedingly simple to set up, they are more limited when attempting to achieve a fully integrated audience experience. The simplicity of projection is the presentation of a replicated image via reflected light.

The Pros and Cons - LED Screens or Projection

	LED Screen	Projection
Pros	Bright Robust Doesn't suffer from light spill onto screen Low maintenance Power efficient Efficiency based on content Equipment does not get superseded quickly	Bright High resolution Large range of products Very large screens through blending and convergence of multiple projectors Constant power technology
Cons	Colour balance and colour inconsistencies between batches Moiree effects when viewed by cameras High power draw at times Long setup for big screens Low resolution compared to projection (2-3mm pixel pitch currently highest resolution available)	Suffers from contrast issues from ambient light Constant power technology Screens suffer from light spill Requires regular bulb changes – 1,000 to 2,000 hours Large infrastructure for large scale projections

Further Considerations

As well as visual and design aspects, it is important to determine where along the curve is the cost benefit for using either technology, and how do we calculate it?

LED screens throw direct light and therefore reduce the need for equipment heavy lighting rigs that throw much less effective reflective light.

The final choice will depend on the visual goal of the lighting designer and the creative team, and what is most effective. In the next section, we consider what benchmarks should be developed and tested.

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Energy Consumption Comparison

Projection equipment versus LED Screens

Projection equipment versus LED Screens

The graph on the following page is a visual representation of calculated energy efficiency of 44 different pieces of equipment. Of those 44 machines assessed there are 22 of each equipment type profiled. The standard industry assessment metric for performance measures is Lumens output / Watt of electricity (l/W) used and is represented on the vertical axis of the graph. The model numbers of each equipment piece have been included as a data label, with LED Screens depicted as the green data points and Projection equipment blue.

First impressions of performance outcomes include:

- Over 50% of the LED Screens assessed out perform projection systems.
- Greater variation between individual LED Screen models with performance ranging from 3.5 l/W up to 27 l/W.
- All projection stock is grouped within 8 data points of each other, suggesting that there is very little variation between stock models.
- Comparatively, the most efficient LED Screen assessed is 16 data points better than the most efficient projection device – M20-IM assessed 27.4 l/W against RLM-W12 assessed 11.5 l/W.

It is important to outline that no two production requirements are the same; therefore it is difficult to draw a direct like-against-like comparison, especially when the operational output of LED Screens and Projection equipment can be so vastly different. But for the purposes of this exercise, which is to determine assessed energy efficiency, LED Screens are by far the better consideration.

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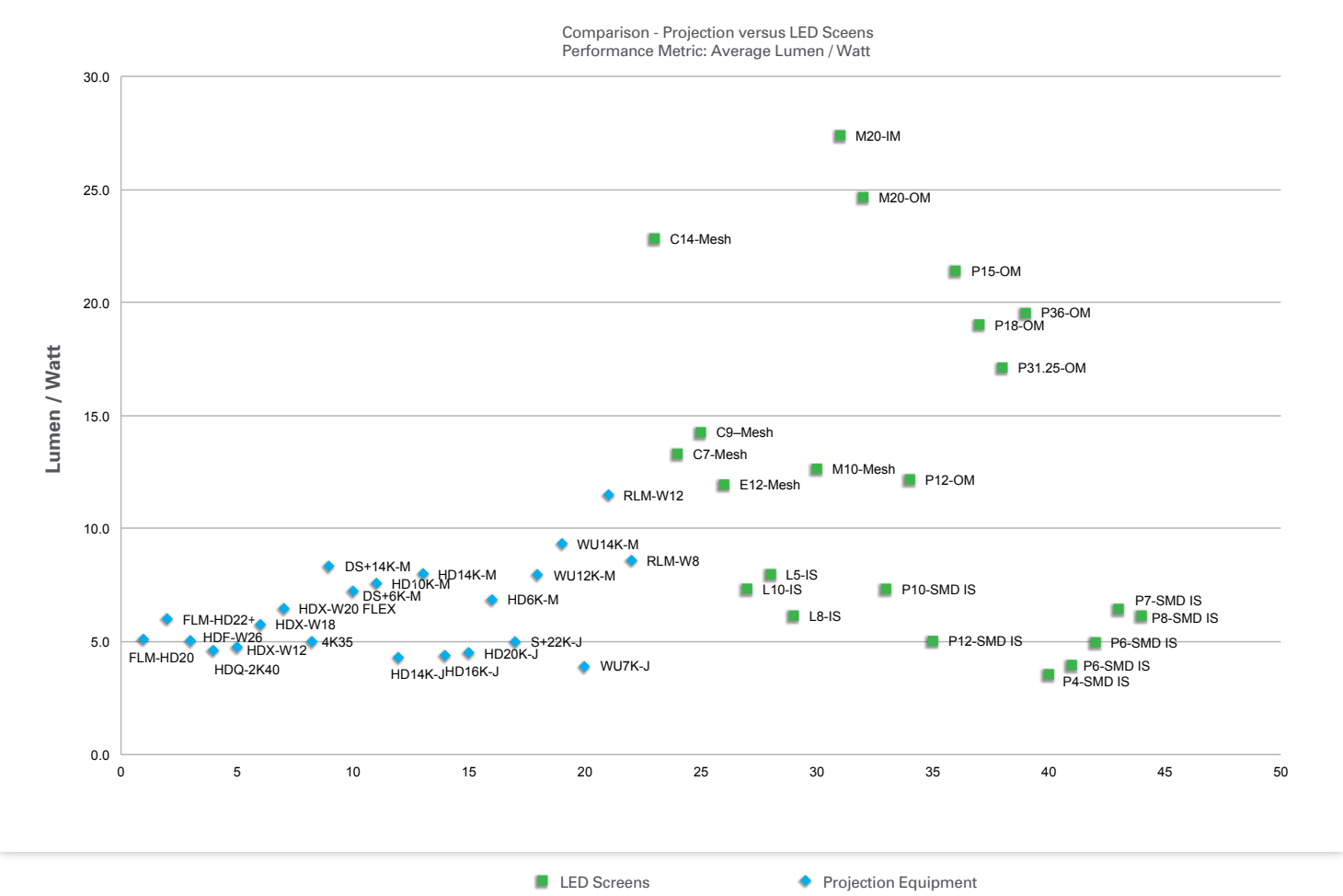
Energy Consumption Comparison

Graph: Comparison of Projection equipment versus LED Screens, performance metric is Lumen of output per Watt of electricity (I/W).



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Energy Consumption Comparison

LED Panels (continued)

It is important to note that the technical specifications for LED panels offer the following:

- NITS rather than lumens
- Watts per m2 rather than Watts

For the purposes of this activity, NITS have been converted to lumens using the formula outlined in"the Calculating measurement section, and power consumption is presented as watts.

Calculation Explanation:

Both ANSI and NIT are measurements of light. The NIT is a measurement of direct light while a lumen is a measurementof reflected light.

ANSI Lumens (ANSI) are used to describe projection devices and NITS are used to describe displays. Both light measurements are based on a candela, the basic unit of measurement of total light output from a source (also known as Luminous Intensity).

An ANSI lumen is the amount of light energy reflecting off one square metre area at a constant distance of one metre from a one candela light source. A NIT (cd/m2) is an amount of emanating light equal to one candela per square metre.

To illustrate the difference, think of a light bulb and a wall. If you look directly at the light bulb, it is very bright (think NITS). If you hold the light bulb one metre from the wall and look at the same size area as the bulb on the wall it will be significantly less bright (think ANSI). The reflecting light is simply not as strong as the bulb itself.

A foot-lambert is a measurement of brightness equal to one lumen per square metre. One NIT is equal to approximately 0.292-foot lamberts, or 3.426 NITS equal one single foot-lambert. Thus, for the same surface area, a NIT is much brighter. The direct source (NIT) is always stronger than a reflection (ANSI), so one candela over one square metre (NIT) is brighter than the light reflected by one candela onto one square metre at a distance of one metre (ANSI Lumens).

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