

PROVING THE CAPABILITY OF THE PANASONIC RZ670:

LASER PROJECTOR FOR PROFESSIONAL
USE IN THE 6,500LM CLASS



WHITEPAPER CREATED BY ROI TEAM

EXECUTIVE SUMMARY

TASK

Evaluate the performance of Panasonic's latest laser projector the RZ670 (rating 6,500lm) against a range of the best selling lamp-lit projectors in three key verticals:



Museums & Galleries



Higher Education Organisations



Rental & Staging

Evaluation across a lifetime of 20,000 hours in the first two sectors, and a lifetime of four years in the rental & staging sector, and against same two performance measures:

Financial – Lifetime Cost of Ownership

Environment – Lifetime Carbon Emission

TECHNICAL SUMMARY

The latest generation of laser-light projectors delivers much enhanced brightness (now up to 6,500lm), making laser projection a reality for the largest halls in museums, galleries and education settings. The technology also enters the Rental & Staging sector with sufficient power for live public-facing performance in almost any indoor setting.

ROI team has already demonstrated the operational superiority of laser technology in various aspects including:

- Superior cumulated light output
- Maintenance free lifetime of 20,000 hours or more
- Power consumption adjustment
- Instant on/off capability
- Installation versatility
- Reduced environmental impact

In addition to these attributes the recently launched Panasonic RZ670 incorporates:

Flexible operational mode – Operator can now select to maintain brightness at a desired level

Superb colour and brightness – Across the colour spectrum, not just for white projection

Automated Geometric Alignment function – Saving the technician time at location (optional upgrade ET-CUK10)

Computer driven colour/brightness adjustment function – Again saving technician time at location (optional upgrade ET-CUK10)

COMMERCIAL ANALYSIS

ROI team's evaluation has highlighted important operational and commercial gains for the three sectors under analysis by adopting laser projection systems:

Museums & Galleries

- Minimise disruption or closure of galleries to allow for maintenance
- Reduce environmental damage
- Safer and more comfortable room conditions for visitors

Higher Education

- Instant on/off function maximises room sharing arrangements
- Maintain comfortable room conditions for attention and learning

Rental & Staging

Enhanced brightness now makes laser projection a reality for this sector, where our work highlights opportunities for significant changes to the historic business model:

Replace hot back-up with 'at location cover'

- Huge savings for the sector

Point to Point hiring

- Why should your projector fleet spend half its life travelling on motorways?

New model for Fleet Management

- Re-sell projector after four years into a less brightness-hungry sector with 15,000 maintenance free hours remaining on the clock

LIFETIME PERFORMANCE EVALUATION

Museums & Galleries and Higher Education sectors

Lifetime Cost of Ownership

Taking into account all costs associated with the purchase and effective operation of a projector for these sectors we find a clear advantage for the Panasonic RZ670 compared with a range of lamp-lit projectors:

- Panasonic RZ670: €13,551
- Conventional projectors: €15,259

Although the initial purchase price may be higher, lifetime freedom from maintenance and lamp changes gives the Panasonic RZ670 a Lifetime Cost of Ownership **11% lower** than a range of conventional projectors of equivalent brightness.

Lifetime Carbon Emissions

In terms of carbon emissions the lifetime comparison between the two projector types shows:

- Panasonic RZ670: 4.76 tonnes
- Conventional projectors: 6.40 tonnes

Across its lifetime the Panasonic RZ670 produces only **74% of the carbon emissions** of a conventional projector of equivalent brightness.

Rental & Staging sector

Lifetime Cost of Ownership

Taking the Rental & Staging sector, and a lifetime duration of four years before re-sale out of the sector, the advantage delivered by the Panasonic RZ670 is still more striking:

- Panasonic RZ670: €13,140
- Conventional projectors: €28,376

The Panasonic RZ670 delivers a Lifetime Cost of Ownership **54% lower** than for the range of lamp-lit models.

Lifetime Carbon Emissions

In terms of carbon emissions the lifetime comparison is:

- Panasonic RZ670: 2.18 tonnes
- Conventional projectors: 3.78 tonnes

Across its lifetime the Panasonic RZ670 produces only **58% of the carbon emissions** of conventional projectors of equivalent brightness.

1. BRIGHTER, FASTER VISUAL COMMUNICATION – LASER PROJECTION STEPS UP TO A NEW LEVEL



In our Whitepaper Clear Advantage for Lamp Free Projectors, released at ISE 2013, we evaluated the benefits and prospects for an interim generation of projectors, represented by the Panasonic PT-RZ370. This hybrid combines the best available attributes of both lamp-lit and laser technology, to provide a laser-lit projector with an extended maintenance-free life of 20,000 hours. Brightness capability is a convincing 3,500lm, making this the first laser-lit projector with sufficient brightness to operate in public access environments such as universities, colleges, museums and galleries.

Since that study Panasonic have taken laser technology to a new level, introducing the RZ670 family in 2014. This projector boasts all of the attributes and features seen in the PT-RZ family, but with initial brightness of 6,500lm laser technology, is now suitable for professional use in all but the largest arenas and for the whole range of indoor halls.

This progress into larger spaces indicated the sectors for our evaluation in 2014/2015:

HIGHER EDUCATION

Where projectors are a required tool to assist teachers and lecturers to bring visual stimulus and explanation to their subjects. The value of the projector as an aid to teachers has been balanced by the tendency of historic lamp-lit projectors to imply darkened rooms, discomfort from heat dissipation, and the inability to provide projection-on-demand, because of the need to warm up /cool down the machine to prevent serious damage.

In this sector the breakthrough is that the Panasonic RZ670 has sufficient brightness to support teaching in even large halls and auditoria, whilst retaining all the features that make the PT-RZ series so valuable to lecturers, students, and estate managers.

MUSEUMS & GALLERIES

Where projectors are sometimes used in combination to convey key background information to support exhibitions, and more and more to recreate an 'experience' of an era or location to bring alive an exhibition. Projectors in this setting need sophisticated features to enable them to be used in combination to create a concerted effect.

Here the gain in brightness enables projectors to be used in entrance halls and main galleries and in near daylight conditions to enrich the visitors' experience.

RENTAL & STAGING SECTOR

Where projectors create the backdrop that enhances the ambience and drama of events and performances. Projectors used in this environment need exceptional brightness, colour, clarity and dependability. Rental & Staging professionals look for ultra-reliable projectors, robust enough to sustain constant handling and transport, and offering swift and straightforward calibration and alignment capability.

The huge brightness gain exhibited by laser technology now makes laser projectors usable in the Rental & Staging sector for the first time.

Panasonic's latest laser models ship with all the features below designed for use in professional arenas:

- Posture agnostic
- Filter free / dust resistant design
- Reduced heat output
- Reduced noise output
- Quartet Colour Harmoniser
Pure clear colours across the spectrum
- Dynamic contrast + flexible brightness setting
Reduced power consumption
- Built-in/Auto Brightness/Colour/Geometric Adjustment

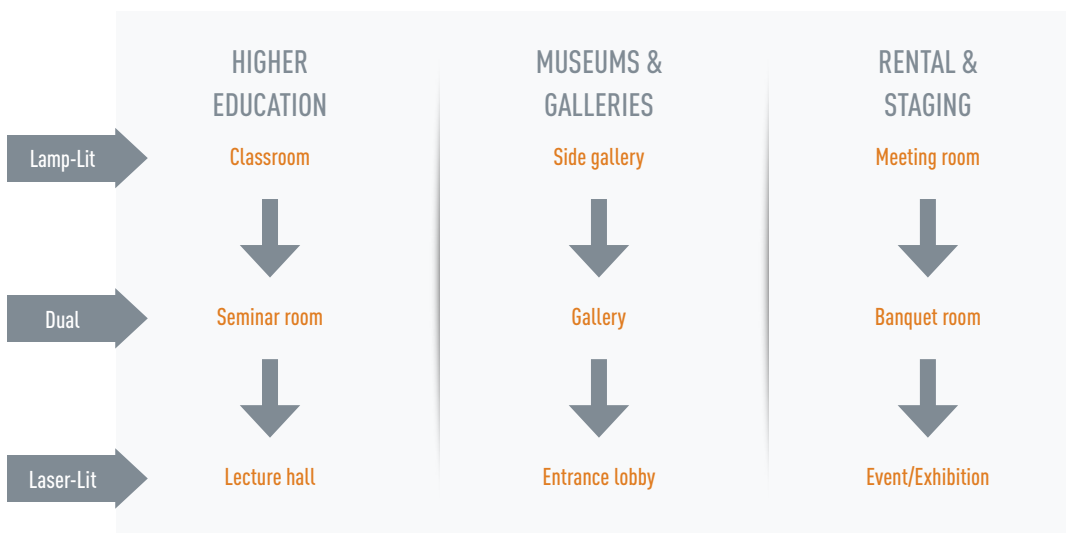
I. TECHNICAL ANALYSIS

2. ADVANCE OF LASER-LIT TECHNOLOGY

Laser-lit technology has already proved its superiority to lamp-lit in many ways. Now it is suitable for professional use in bigger and bigger spaces.

TECHNICAL ANALYSIS

The latest laser technology, in the form of the Panasonic RZ670, has clear advantages for each of these sectors, which will be detailed in sector specific sections appearing later.



ADVANTAGES OF LASER AS A LIGHT SOURCE

The use of the projector as a tool for public-facing visual communication and teaching has been restricted by performance limitations of the conventional lamp-lit projector including:

LAMP LIFE

A projector requiring a lamp is subject to the decay curve associated with the conventional bulb. Manufacturers recommend that a bulb is no longer functional and must be replaced when brightness falls to 50% of initial output meaning that, according to their recommendations, the bulb must be renewed at some point between 1,500 and 6,000 hours depending on the model.

In a higher education setting a projector might be in use 60 hours per week for 45 weeks a year, it can be seen that the university must budget for a lamp-change at least yearly – or face deterioration and possible failure of essential teaching equipment. It is also relevant to consider that, as the Panasonic RZ670 has a life of 20,000 hours, this estate manager may need to budget for 10 or more lamp changes to keep their lamp-lit projector operational for the same period.

WARM-UP / COOL-DOWN TIME

Conventional lamps need to be operated within a very specific temperature range to avoid damage to the lamp. For this reason a conventional projector needs a warm-up time of up to two minutes before it can achieve operational brightness; it's also essential that it must remain connected to the power supply during cool-down time to ensure its fans continue to cool the bulb.

Not surprisingly these requirements make the conventional projector cumbersome in the context of a fast-moving teaching session. The tutor must either keep the projector switched on throughout his lecture, and accept an uncomfortably hot and possibly darkened room – or accept a pause of two minutes before he can respond to a student's question. Either way he must switch off the projector five minutes before the end of the lecture to ensure it can be fully cooled before he vacates the lecture room for the next class.

A laser projector on the other hand operates at a much lower temperature and provides instant-on/off and power-saving shutter technology.

POWER CONSUMPTION ADJUSTMENT

Conventional projector lamps run at 100% of their power requirement, producing 100% of their brightness capability, regardless of the brightness of the image they are projecting. For darker contents the additional light projected to the screen is either absorbed within an optical engine, or reflected away from the light path. Both systems produce additional heat which is dissipated from the projector.

Laser diodes on the other hand are dimmable light sources for a superior contrast ratio. They use 100% power only when full brightness is called for – i.e. a 100% white picture. To project a typical mixed output of darker pictures a laser light source will automatically reduce its power consumption – and heat output.

It can rapidly be seen that the laser projector represents a major advance in operational efficiency and flexibility.

LASER LIGHT SOURCE

- Light source life span will last more than 20,000 hours
- 20,000 hours maintenance free lifetime
- Dust-resistant optical parts do not require filters
- Operates at much lower temperature, requiring less energy
- Instant-on/off technology reducing power consumption and making projector instantly usable
- More eco-friendly
- Adjusts power consumption according to room lighting and brightness of the image

LAMP AS LIGHT SOURCE

- Bulbs no longer functional after brightness falls to 50%
- Lamp-life range: 1,500 to 6,000 hours
- Needs up to 13 lamp changes during 20,000 hrs lifespan
- Need to change or clean filter to keep optical parts free of dust
- Needs up to 20 costly maintenance visits during 20,000 hrs lifespan
- Warm-up time up to two minutes
- Cool-down time five minutes or more
- Remains connected to power supply during cool-down time, increasing power consumption
- Bulb contains mercury and other toxic materials
- Runs at 100% power requirement at all times, causing additional heat output



3. BRIGHTNESS DECAY AND ITS IMPACT ON BULB LIFE

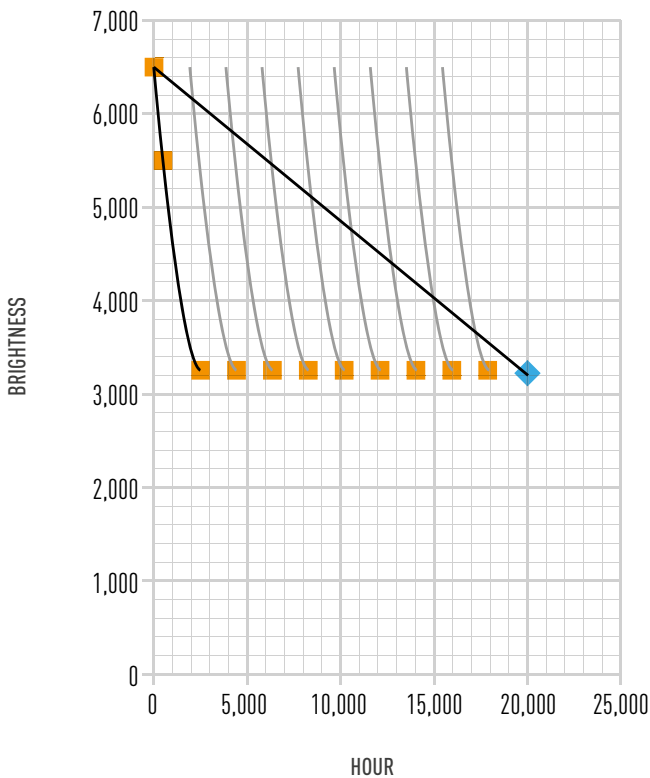
All types of light source (car headlights, household bulbs etc.) exhibit brightness decay and a limited lifetime. They are consumable items.

Conventional projector lamps show a **Regressive Decay**. This means that a lot of initial brightness is lost in the early hours of operation. The decay curve then flattens out before finally reaching 50% of initial brightness, at which point the bulb is no longer functional and must be changed. This means that a conventional projector bulb will spend as much as half of its life operating at close to half of its full capacity.

A laser light source on the other hand, displays a **Linear Decay** – so the projector loses operational brightness much more slowly and in a steady decline. This means that soon after starting its lifetime a laser projector will

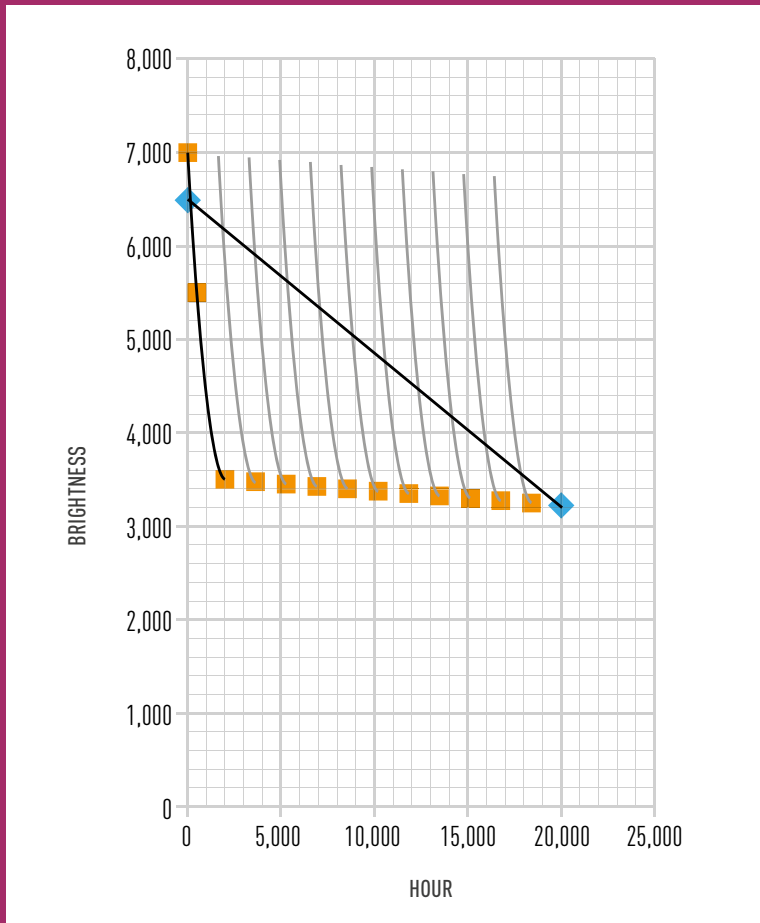
be providing more brightness than its equivalent conventional lamp-lit projector.

The latest Panasonic models incorporate a **Brightness Priority Setting** which enables near to full (above 80%) brightness to be maintained – albeit at the cost of shortening the operational lifetime of the projector. Panasonic are currently working to make this setting, currently available only as a factory setting, available to professional end-users. It will be seen later in this paper that this option is very valuable in the **Rental & Staging sector**, where high and uniform brightness are much more important than extended lifetime.



The graph opposite shows the brightness output of two projectors, both with an initial rating of 6,500lm: one a conventional lamp-lit projector, the other a laser projector. It can be seen that the brightness of the lamp-lit model rapidly falls below the Solid Shine model. Even after an expensive bulb change, the conventional model matches the performance of the Solid Shine model only for a short time.

- ◆ Series 1 = Panasonic RZ670
- LAMP = Lamp Projector



Where we compare the performance of a conventional projector rated at 7,000lm against that of a Solid Shine model rated at 6,500lm it can be seen that, because of the **Regressive Decay** pattern of the lamp-lit projector, after only a short period of use, the Solid Shine model is operating at a superior level of brightness. In the attached graphic, the brightness of the lamp-lit 7,000lm projector falls below that of the 6,500 lm Panasonic RZ670 model after just 159 hours of use – less than one month as used in a typical Higher Education location.

- ◆ Series 1 = Panasonic RZ670
- LAMP = Lamp Projector

4. CUMULATED LIGHT OUTPUT

The best known and most widely accepted method to measure projector brightness is the ANSI Lumen specification devised by the American National Standards Institute (IT7.227-1998) which considers not only brightness, but also the uniformity of brightness as projected on a screen.

However brightness ratings following the ANSI model or any other specification are time-specific measurements which cannot track differences in brightness decay. Historically, this limitation has been acceptable because all projectors used similar technology and so followed a similar **Regressive Decay** path.

However, as observed above, the development of the laser projector now introduces alternative technology and the entirely different **Linear Decay** path. This means that a laser projector delivers a higher level of brightness for a greater proportion of its operational life.

To make a meaningful comparison between projectors using such different light sources, we need to evaluate brightness output over the lifetime of the projector. The cumulated light output can be expressed by the equation:

$$\text{BRIGHTNESS (ANSI LM)} \times \text{HOURS OF OPERATION} = \text{CUMULATIVE LIGHT OUTPUT}$$

The Panasonic RZ670 with initial brightness of 6,500lm ANSI produces 12% more brightness than a conventional projector of the same initial brightness that may require four or more lamp changes within its 20,000 hours operating lifetime.

When benchmarked against a conventional projector with ANSI rating of 7,000lm, the Panasonic RZ670 (brightness rating of 6,500lm) still produces 10% more brightness across the same period.

A projector is chosen for a specific application (such as lecture hall, museum gallery, or theatre auditorium) according to lighting conditions, and the brightness required to run the material. Requirements may

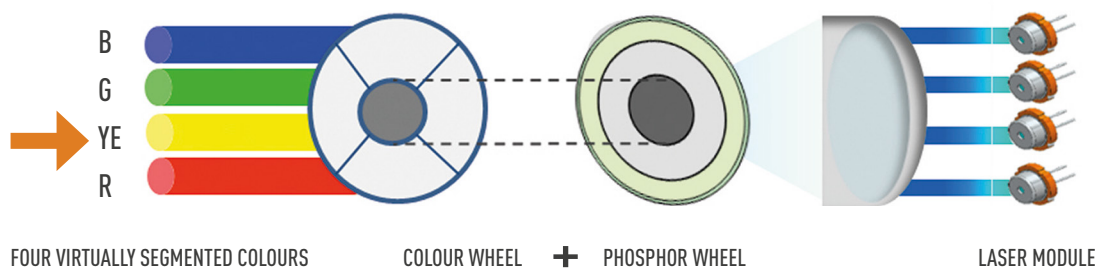
include comfortable and stress free attention to teacher presentations in daylight conditions, or maybe crisp and clear reproduction of content in a museum or performance context.

The Panasonic RZ670 projector with an initial brightness of 6,500lm ANSI produces more brightness over the same period than a conventional projector measured initially at 7,000lm. Therefore both are suitable for the same applications and can be considered equivalent models.

5. BRIGHTER AND CLEARER COLOUR REPRODUCTION

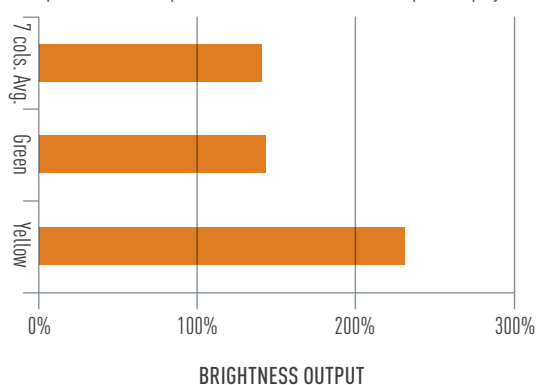
The Panasonic RZ670 surprises with a rating of ANSI 6,500lm providing outstanding brightness of natural pure white at a duv value of just 0.006 – just 1/4 the duv value of lamp-lit competitors.

Supplementing this white brightness the Quartet Colour Harmoniser (Colour Wheel plus Phosphor Wheel) ensures exceptional clarity right through the BGYR spectrum. Uniquely the Panasonic RZ670 uses a four colour wheel, with white created by combination of the four colours.



Not only does this make the colour more balanced it also contributes to a higher perceived brightness as the brightness output per colour channel is significantly increased. Another reason why the Panasonic RZ670 can perform well against projectors of a higher brightness category.

Exceptional Colour Improvement vs. Conventional 1-Chip DLP™ projector



II. COMMERCIAL ANALYSIS

Technical analysis of the capability and performance of the Panasonic RZ670, set out previously, is derived from sector analysis and in particular work and analysis by Panasonic engineers working in laboratory conditions.

To evaluate the performance of the Panasonic RZ670 in the commercial arena ROI team gathered data for the performance of the Panasonic RZ670 against a range of lamp-lit projectors most purchased for each of three key sectors:

Museums & Galleries

Higher Education

Rental & Staging

Data and understanding derives from various methods:

- 1 Questionnaire-based survey of sector professionals across 10 European territories targeting:
 - Resellers and dealers exposed to the museums, galleries and higher education sectors
 - Owners and managers of hire companies majoring on the Rental & Staging sector
- 2 Depth interviews with the above groups, especially with owners and managers in the Rental & Staging sectors
- 3 Performance and cost data was derived from manufacturers' product specification sheets
- 4 Futuresource (www.futuresource.com) provided data concerning sales volumes and actual selling prices for projectors in the relevant sectors

We now examine performance and contribution of the RZ670 to each of these three sectors.

6. BREAKTHROUGHS FOR THE MUSEUMS & GALLERIES SECTOR

In the Museums & Galleries sector projectors are used more and more widely to enhance the visitor experience, creating a facsimile of the landscape or historic environment against which exhibits are set. In some galleries the entire presentation is created by projectors with very few actual exhibits.

There is now an appetite to use projectors in large and well lit galleries as well as darker side rooms, and the new generation of laser-lit projectors rises to this challenge, with the Panasonic RZ670 achieving an ANSI rating of 6,500lm, sufficient for large galleries and near-daylight conditions.

ADVANTAGE OF LASER PROJECTORS IN MUSEUMS & GALLERIES

Key factors for use of projectors in a museum environment include:

MINIMAL MAINTENANCE

Many museums now open seven days per week and stretch opening hours into the evening; so opportunities for maintenance access are rare. The RZ670, offering maintenance free life of 20,000 hours (equating to 6.6 years at typical usage levels in this sector) offers a big advantage.

PROJECTOR LOCATION

The minimal requirement for maintenance access enables the Panasonic RZ670 to be installed safely and out of sight, with significant gains for space and visitor safety. Panasonic laser-lit projectors are also posture agnostic – so can be installed into small existing spaces where necessary.

REDUCING DISTRACTION FROM NOISE AND HEAT EMISSIONS

Emissions from laser projectors are less than half that of lamp-lit competitors.

In terms of noise emission the Panasonic RZ670 operates at between 35db to a maximum of 45db, largely because of a different cooling design; whilst operating temperature is a maximum of 45°C. Both of these factors are significant in maintaining a safe environment for preserving exhibits, and ensuring a comfortable and tranquil experience for visitors.

REDUCING ENVIRONMENTAL DAMAGE

Museums & Galleries, especially those in public ownership, have a tradition of taking leadership in environmental responsibility. Unfortunately traditional lamp-lit technology has implied environmental hazard. Vans driving up and down the country to make scheduled and unscheduled maintenance trips plus the need to dispose of as many as 10 bulbs incorporating harmful metals and gases during the lifetime of a projector are all unavoidable factors of the historic technology. On the other hand a laser-lit model, like the RZ670, brings environmental impact to a minimum. The projector is designed to be maintenance free for 20,000 hours use with its original laser light source.

7. BREAKTHROUGHS FOR THE HIGHER EDUCATION SECTOR

The higher education sector becomes more and more commercial in its approach. As student numbers increase so do class and seminar groups, so that teaching takes place in larger rooms with some students further from the lecturer. Teachers and lecturers depend more on centrally produced material to deliver modules and subjects.

The ability for teachers and lecturers to swiftly illustrate a point or clarify an issue with reference to a visual or with use of video material is now a necessity, not a luxury. Projectors are being developed to deliver this important enhancement and to do so in larger rooms and in brighter conditions.

Laser models like the Panasonic RZ670 allow almost instant On/ Off operation, even in large lecture halls in bright conditions. No longer any need to close blinds or turn down the lights, nor to pre-schedule projector use to allow for warm-up time, and to end a lecture early to allow for cool down before the close of the session.

Now many Higher Education institutions are open for teaching throughout the week and throughout the year, with evening classes, weekend courses, vacation schools and conferences all reducing opportunities to close rooms for maintenance. Every closure reduces opportunity for the institution to run classes and maximise use of facilities.



ADVANTAGE OF LASER PROJECTORS IN THE HIGHER EDUCATION VERTICAL

Key factors for use of projectors in a higher education setting include:

OPTIMISE ROOM SHARING

Today Higher Education Institutions host a veritable merry-go-round as teachers and students circulate from room to room, often spending only an hour in a teaching room or auditorium before it must be vacated to make way for the next lecturer and class.

Lamp-lit projectors make this process cumbersome and inefficient as time is wasted at the start of a session to switch on and warm up the projector, with further time allowed at the end for the projector to cool down. Worse, if the projector is not allowed to cool under power it can suffer serious damage. Laser technology on the other hand offers virtually instant-on / instant-off process, as only minimal heat is accumulated in the light source.

COMFORTABLE ROOM ENVIRONMENT

Students will tell you it is hard enough to stay alert during a one hour lecture without the narcotic effect of heat and noise given out by a lamp-lit projector running in a darkened room.

The latest laser-lit projectors give out much reduced levels of both heat and noise and have sufficient brightness to operate in normal indoor light conditions. Today the Professor has no excuse if his students are nodding off; he needs to review his material!

REDUCING ENVIRONMENTAL IMPACT

Higher Education organisations, like Museums & Galleries, have a history of leading the way in demonstrating environmental responsibility. They will surely welcome a projector that requires no maintenance over a life of 20,000 hours and does not imply repeated disposal of environmentally harmful bulbs.

8. BREAKTHROUGHS FOR THE RENTAL & STAGING SECTOR

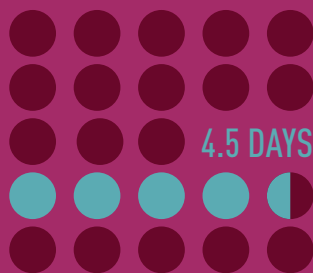
Public facing events and especially live performance require equipment to the highest technical standards, fully maintained, and so 100% reliable. Projectors are an integral part of the equipment in use at these public-facing events and must match the rest of the audio-visual kit employed.

This appetite for up to the minute, expensive equipment maintained to the highest standards and installed and tested by expert technicians has given rise to a dedicated sector called 'Rental & Staging'. This sector consists of companies who own and hire out the equipment wanted by entertainment and performance promoters. Some companies hire out the range of AV equipment wanted, others specialise in a sub-sector –

including projector hire. Some companies are 'dry hire' ie they simply maintain and hire equipment from their warehouse and do not get involved in transportation or installation. Others, the 'full service' hire companies will transport equipment to location, then provide expert technicians to set it up, and monitor it during performance.

KEY DYNAMICS FOR THE R&S SECTOR

AVERAGE HIRE PERIOD



RENTAL PAID FOR ONLY 1 OR 2 DAYS

PROJECTOR HIRED OUT APPROX 57 TIMES PER YEAR

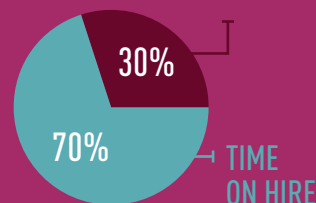
OWN PROJECTOR FOR BETWEEN



1368 HOURS

OPERATIONAL USE PER YEAR

TIME IN THE WAREHOUSE



AT RESALE RZ670 STILL HAS 15,000 MAINTENANCE FREE HOURS OF LIFE

The dynamics of this sector, where superb quality of sound and picture are at a premium, give rise to a micro-sector with unusual features for projector use and lifetime, which ROI team were able to observe during the course of this investigation.

UNUSUAL FEATURES INCLUDE:

PRE-HIRE MAINTENANCE

Projectors are routinely 'prepared' i.e. tested for effectiveness and quality checked before every hire event, a stage which is theoretically redundant when the Panasonic RZ670 has no 'working parts' capable of failure.

A projector may be operational only for a brief 'performance' window together with the testing and calibration that precedes it, meaning average in-operation time of just 24 hours per hire event.

The average hire event lasts 4.5 days from leaving the workshop to return to workshop, though typically the hire company will receive rent for only one or two days. It is self-evident that expensive equipment, expensively maintained is spending half of its useful life travelling up and down motorways.

An efficient company with latest equipment would expect a projector to spend about 70% of days out on hire and 30% in the warehouse. This indicates that a hire company will expect to hire out a projector approx 57 times per year on average, clocking up 1368 hours of use per year. This is very modest use compared with the 2700 hours average for the higher education sector, and the 3016 average in-operation hours in the Museums & Galleries sector. The dynamics of these sectors are very different.

The insistence on providing only the latest and brightest means that in the Rental & Staging sector a projector will not be retained until it is no longer functional. Instead the hire company owner will sell it into another professional sector after owning it for a period lasting from one year to eight years. Our sector survey indicates the average length of ownership to be four years, equating to 5,472 hours of life. At this point a Panasonic RZ670 model is judged to be no longer usable in the Rental & Staging sector – but still has some 15,000 hours of maintenance free life in another sector.

HOT BACK-UP

The anathema of equipment failure for live performance has triggered the strange phenomenon of 'hot back-up'. Put briefly this means that projectors will be provided with a 'double' which will be tested, calibrated, balanced, and will even be run 'hot' in tandem with the effective projector.

In 9 out of 10 instances this additional piece will not contribute any additional brightness or quality. It is simply there as instant back-up in the event of failure of the projector. We will examine this curiosity in some more detail below.

ACCELERATED BULB CHANGE

The need to replace the bulb in a lamp-lit projector has a substantial impact on both cost and environmental impact in all sectors. However it is of particular significance for the Rental & Staging sector, because here a level of brightness decay which would be acceptable in other sectors is not adequate for the sort of live performances supported by Rental & Staging hire companies. The upshot is that technicians in this sector working with lamp-lit projectors will typically change the bulb after just 25% of the hours of life recommended by manufacturers – which of course has significant impact for both Lifetime Cost of Ownership and for Environmental Impact.

Plainly a laser projector, where the light source decays slowly and consistently, implies significant savings in both these areas. Again, we will examine this factor in more detail below.

KEY AREAS FOR PERFORMANCE IMPROVEMENT IN THE SECTOR

The Rental & Staging sector is already an important and growing component of projector sales in Europe market. ROI team's observation of this sector indicates that the arrival of high rated laser technology can trigger some major gains for the sector:

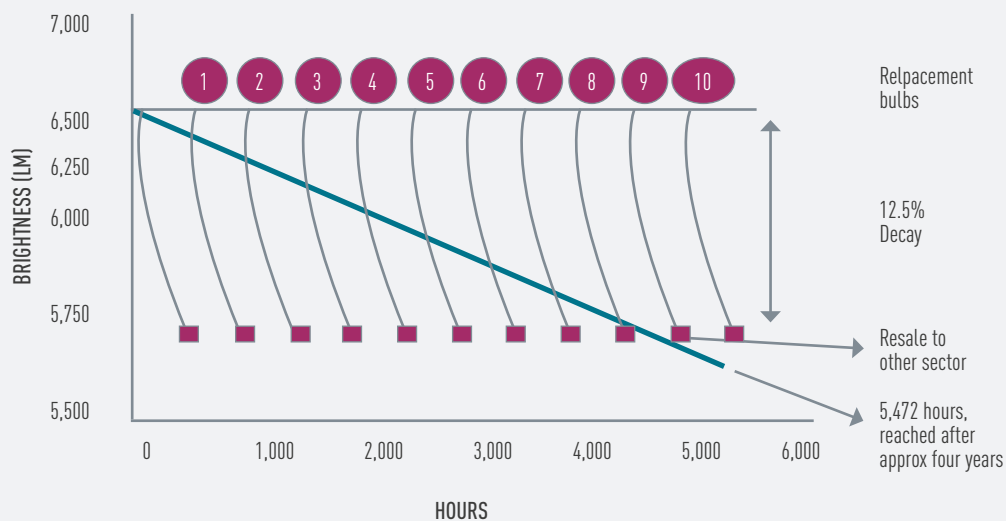
MINIMISE ACCELERATED BULB CHANGE

In most sectors manufacturers recommend the lamp should be renewed when its brightness falls to 50% of its initial brightness; this is the point where the lamp brightness is judged to become inadequate for professional performance. Bulb replacement recommendations as well as resellers' maintenance cycles are based on this curve.

However in the Rental & Staging sector the expectations of live events in front of substantial audiences impose a more demanding requirement. Research by ROI team of senior professionals working in this sector indicate that on average lamp brightness is judged to be inadequate

when it loses just 12.5% of initial brightness. This means that in this sector the bulb of a lamp-lit projector will need to be changed and disposed of after only 1/4 of the operational hours recommended by the manufacturer. So if for example a manufacturer recommends a bulb life of 2,000 hours for its lamp-lit projector, in the Rental & Staging sector that bulb would typically be changed after just 500 hours. In effect the costly and hazardous process of bulb change will happen four times more often than recommended by the manufacturer.

INTOLERANCE OF BRIGHTNESS DECAY IN RENTAL & STAGING



From the same research we discover that during a typical hire period of 4.5 days a projector will be operational for 24 hours. This equates to a total of 5472 hours of operation at full power during a typical lifetime of four years. Let us examine the projector with a recommended bulb life of 2,000 hours, on hire in the Rental & Staging sector for a total of 5472 hours across four years. To meet the elevated demands of this sector it will require a total of 10 bulb changes across this period, as opposed to two bulb changes demanded in any other sector for the same projector.

In the Rental & Staging sector the financial cost of these 10 bulb changes would lie between €2,500 and almost €9,000 – in some cases in excess of the initial purchase price! Nor should we ignore the significant environmental hazard in disposing of 10 bulbs incorporating poisonous metals and gasses.

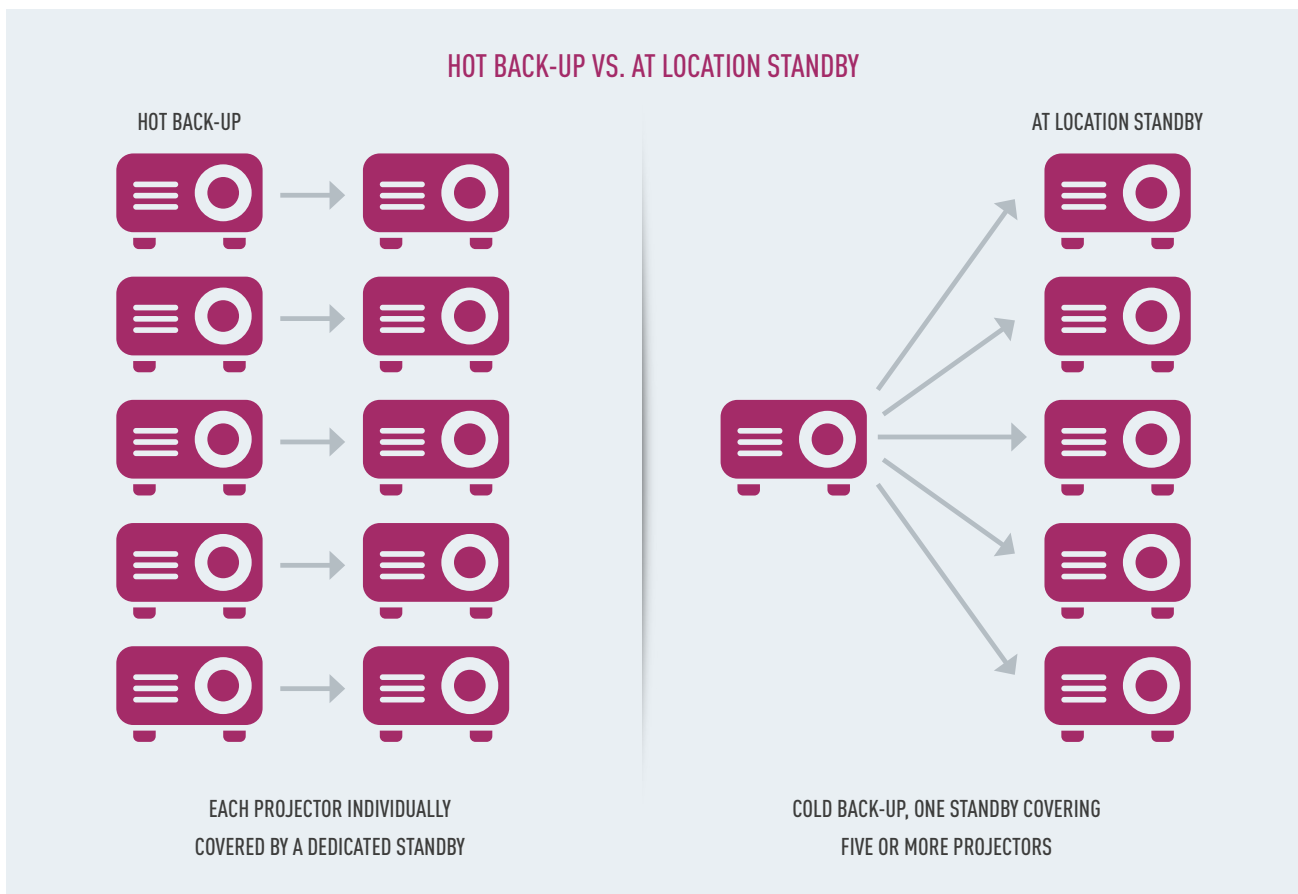
POINT TO POINT HIRING

Currently every projector out on hire will be returned to the originating warehouse so that it can be checked over and prepared for the next hire. The pre-hire check takes on average about 30 minutes – but the process of returning it to the warehouse takes typically a day in all. With huge advances in reliability and brightness triggered by laser technology, the pre-hire check could be compressed and carried out at the next hire location, triggering big savings in transport and storage. Most importantly we estimate a process of Point to Point Hiring would save some 86 redundant days per projector per year, the days that a projector currently spends travelling up and down motorways. Based on the current average hire period of 4.5 days, this would raise the number of hire events per projector per year from 57 to 76 – an increase in productivity of 33%!

ELIMINATING 'HOT BACK-UP' IN RENTAL & STAGING

We explained earlier about the use of 'hot back-ups' to prevent downtime. In the era of lamp-lit technology, worries about projector failure were understandable. Now, however, thanks to the reliability of Panasonic's laser/phosphor optical engines, that concern is eliminated. That is further strengthened by Panasonic's 'failover and fallback' technology, which guarantees the recovery of full visual capacity within two seconds.

With the prospect of failure for any single laser projector very unlikely, we believe that one back-up projector would be sufficient to cover 10 projectors in the front line. Clients would be charged for providing this additional kit to be on standby, but the hire company would achieve considerable savings by forgoing the unnecessary process of pre-checking, transporting, calibrating, testing and running redundant equipment. With sector professionals telling ROI team that one projector in every five is at location to provide 'hot back-up' the potential saving to the sector is evident – between 5% and 10% of hire costs.



In some cases the current inefficient 'hot back-up' model is subsidised by hire companies in the form of waived or discounted rates for back-up units. So an appropriate question may be: which hire company will be the first to abandon the wasteful practice of 'hot back-up'?

NEW BUSINESS MODEL FOR RENTAL & STAGING COMPANIES

In the case of the RZ670, it can be seen from the previous decay curve that the laser light source will decay by 12.5% of initial brightness at exactly 5,000 hours of operational use. Panasonic are now working towards opening factory settings which will enable professional users such as hire companies to boost laser light brightness in house to settings above 80% of initial brightness.

This will enable brightness to be maintained at whatever tolerance level is judged acceptable by that company (between 5% and 20% decay). The penalty is that the viable life of the projector will be shorter than the 20,000 hours currently indicated for Panasonic laser models.

But in a sector where projectors are no longer retained to the end of their functional use (ie at the point of 50% brightness decay), this is not an issue.

It means that the projector can be re-sold into another sector before its light source is judged inadequate for live performance, but at a point when it still has more than 10,000 viable operational hours available in other sectors before it will reach the 50% brightness threshold required by other sectors. ROI team's survey indicates that at this point the projector will re-sell for at least 25% of its original sale price.

OPTIMUM RESALE VALUE FOR LASER PROJECTORS IN RENTAL & STAGING SECTOR



This sounds like good business model! Our research indicates that already progressive Rental & Staging hire companies are moving away from the historic model of retaining a projector until the end of its functional life. Instead there is a point at which a maintenance-free projector can be sold advantageously when its brightness no longer matches the expectations of that business. Currently our research indicates this point is reached at some time between one and eight years, with a point of four years as the most favoured re-sell point.

RENTAL & STAGING

Changing to ultra reliable projectors like the Panasonic RZ670 can transform the performance of your business:

- Point to Point hiring – increase hire events per projector per year by 33%
- Replace 'hot back-up' with 'at location cover' – halving requirement and costs of back-up
- Minimise Accelerated bulb change – saving on average almost €6,000 across lifetime, with consequent reductions in environmental damage
- Early re-sell fleet management model – re-sale after four years with 15,000 maintenance-free hours remaining

9. CONCLUSIONS

Sector professionals such as resellers/dealers and experienced end-users welcome the user-friendly qualities of Panasonic's new lamp-free projectors:

- 20,000 hours maintenance-free lifetime
- Always ready for use, never in the repair workshop
- Instant ON/OFF capability
- Reduced environmental impact
- Heat sink means cooler and quieter running
- Flexible projection position

ROI team's evaluation over the second half of 2014 finds clear advantages for the Panasonic RZ670 against the projectors most purchased by the Higher Education and Museums & Galleries sectors:

- Brighter better projection: Cumulated Light Output 22% greater
- Environmental stewardship: Carbon emission reduced by 26%
- Lifetime Cost of Ownership: More than 11% lower

LIFETIME POWER CONSUMPTION

If we assume the effective operating lifetime of a modern projector to be 20,000 hours, then the lifetime power consumption is:

- Panasonic RZ670 9,621kW
- Conventional projectors 12,135kW

By this measure the Panasonic RZ670 uses only 79% of the power consumed by a conventional projector of equivalent brightness, whilst producing 26% greater Cumulated Light Output across its lifetime.

LIFETIME COST OF OWNERSHIP

Taking into account all costs associated with the purchase and effective operation of a projector for these sectors we see again a clear advantage for the Panasonic RZ670 compared with a range of most-purchased lamp-lit projectors:

- Panasonic RZ670 €13,551
- Conventional projectors €15,259

Although the initial purchase price may be higher, lifetime freedom from maintenance and lamp changes gives the Panasonic RZ670 a Lifetime Cost of Ownership 11% lower than a range of conventional projectors of equivalent brightness.

LIFETIME CARBON EMISSIONS

The lifetime comparison between the two projectors types shows:

- Panasonic RZ670 2.18 tonnes
- Conventional projectors 3.78 tonnes

Across its lifetime the Panasonic RZ670 produces only 74% of the carbon emissions of a lamp-lit projector of equivalent brightness.

RENTAL & STAGING

Changing to ultra reliable projectors like the Panasonic RZ670 has the ability to transform the performance of hire companies serving the Rental & Staging sector:

- Point to Point hiring – increase hire events per projector per year by 33%
- Replace 'hot back-up' with 'at location cover' – halving requirement and costs of back-up
- Minimise accelerated bulb change – saving more than €6,000 across lifetime, with consequent reductions in environmental damage
- Early re-sell fleet management model – re-sale after four years with 15,000 maintenance-free hours remaining

10. EVALUATION OF LIFETIME COST OF OWNERSHIP AND ENVIRONMENTAL IMPACT

APPROACH TO THE PROJECT

ROI TEAM'S BRIEF:

Benchmark the performance/consumption of the Panasonic RZ670 series of projectors against a range of historic lamp-lit projectors against the following fields:

- Lifetime Cost of Ownership – Financial Cost
- Lifetime Carbon Consumption – Environmental Impact

MARKET SECTORS:

- Higher Education organisations:
Universities, colleges, training schools etc.
- Museums and public access galleries
- Rental & Staging: performance and live events

Models for comparison: Solid Shine model: Panasonic RZ670 – 6,500lm ANSI versus a range of models identified by resellers and dealers across Europe as projectors in class 6,000 to 7,000 lm most purchased by the above three verticals.

PROJECTOR LIFETIME:

Assumed to be 20,000 hours (equivalent to advertised maintenance-free lifetime of the Panasonic RZ670).

For Rental & Staging sector lifetime assumed to be 5,472 hours across approximately four years.

USAGE PATTERN:

Higher Education organisations:

10 hours/day x 6 days/week x 45 weeks/year = 2,700 hours per year

Museums & Galleries:

58 hours/week x 52 weeks = 3,016 hours per year

Rental & Staging:

57 hire events per year x 24 hours operational = 1,368 hours per year

SOURCES OF PERFORMANCE METRICS:

- Resellers/dealers independent of Panasonic, and actively selling into the Higher Education and/or Museums & Galleries sectors. ROI team survey made initial contact with 90 from 7 different territories. Information received from these sources was averaged.
- Manufacturers' published product data sheets.
- Aggregated Cost Calculator built for this project by Project Subject Expert, Dr. Joyce Tsoi with assistance from Ruby Sehmbi of ROI team.

Research Approach Work undertaken by project team from ROI team, London, UK (www.roiteam.co.uk), Project Director, Andrew McCall, with expert input from Subject Expert Dr. Joyce Tsoi.

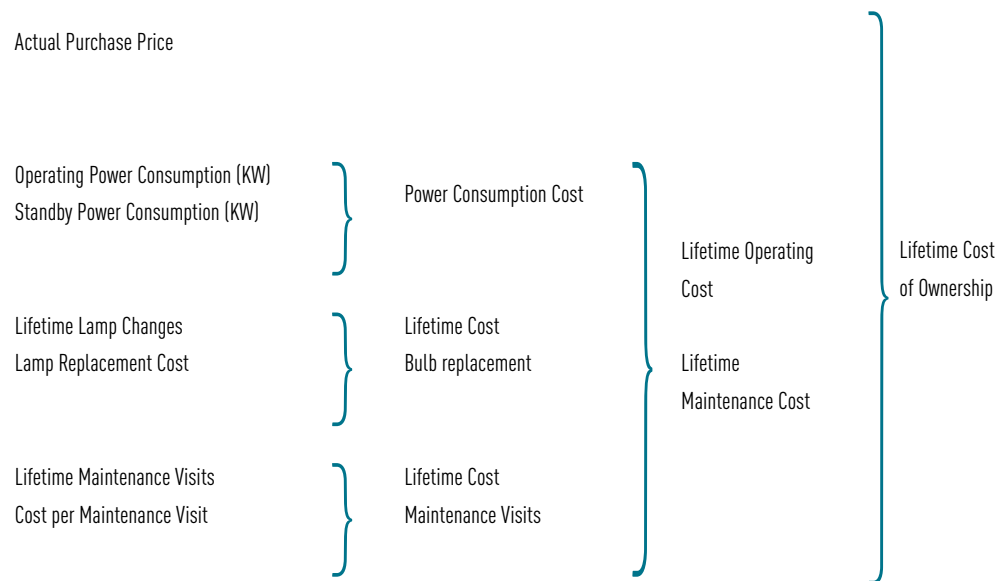
Research approach and method adopted was scrutinised and endorsed in 2012 by UL (www.ul.com).



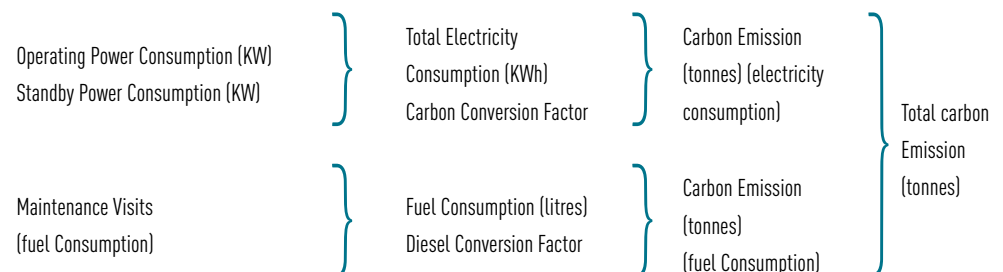
11. APPENDICES

ANATOMY OF CALCULATORS

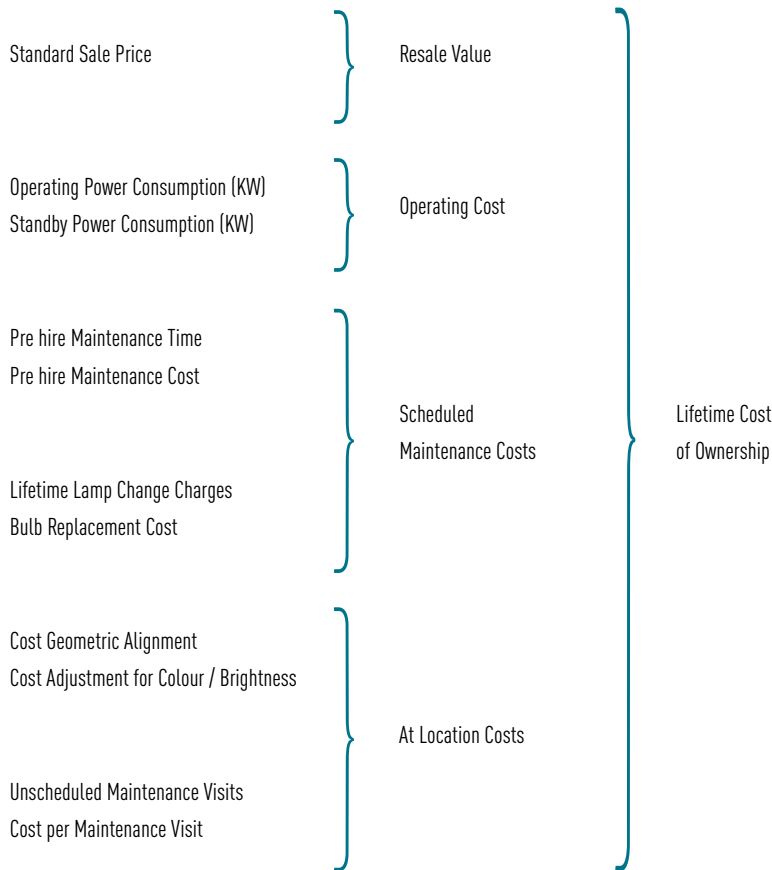
SECTORS: MUSEUMS & GALLERIES AND HIGHER EDUCATION – LIFETIME COST OF OWNERSHIP CALCULATOR



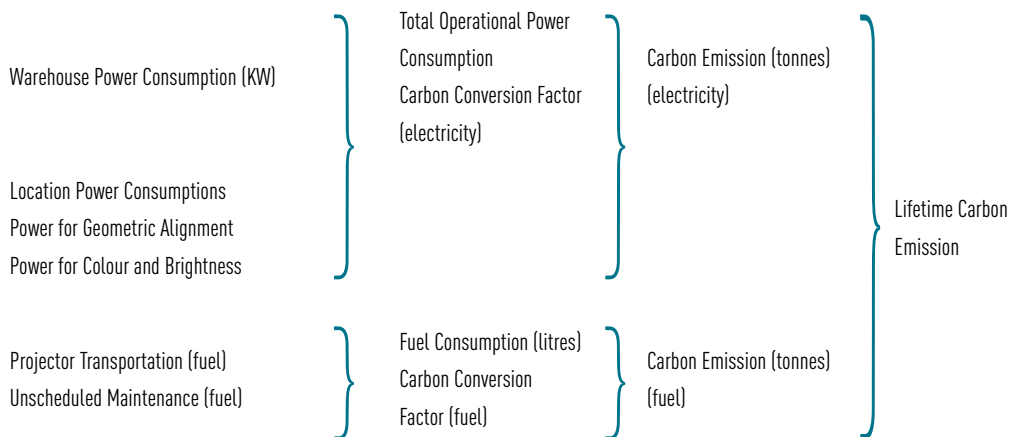
CARBON EMISSION CALCULATOR



SECTOR: RENTAL & STAGING – LIFETIME COST OF OWNERSHIP CALCULATOR



CARBON EMISSION CALCULATOR



PROFILE OF ROI TEAM

ROI team is a research consultancy that works to understand clients objectives, strategies, and challenges, devising and managing programmes of research to provide the hard evidence to enable well informed strategies and commercial decisions.

Clients include retailers such as Harrods, Flying Brands, and Best Direct; owners of retail property like Capital & Regional plc, Cadogan Estates, and Orion Land; the NHS and Department of Health and various regional health boards; and media companies such as Thomson Reuters, community TV operator The Life Channel, and publisher JLD Media.

Directors of ROI team have also led projects to benchmark performance of key products for leading companies such as 3M, JCDecaux, and Media Zest plc as well as Panasonic PSCEU.

In 2013 ROI team, in conjunction with counting company PFM Intelligence, launched the UK Markets Index, the first performance index for the UK retail markets sector. ROI team is currently developing its second index, the Retailers' Revival Index for launch in 2015.

ROI team is wholly owned by its founding directors and does not have any financial arrangements or obligations within its fields of operation. Our aim is to provide sound information, impartially interpreted, to provide a basis for informed business decisions.

ROI team (www.roiteam.co.uk) was founded in 2006 by Jo Johnson and Andrew McCall, who continues as Managing Director of the firm.

Dr. Joyce Tsoi is the Subject Expert for this project. Joyce has over 10 years of international experience in leading and managing sustainability projects in more than 15 countries, exploring strategic and pragmatic lines of progress in the areas of supply chain sustainability on behalf of leading international companies and governments. Her work has ranged from analysis of product and organizational life cycle, energy and climate change, sustainable water management, to reporting on sustainability and communication issues. Throughout her career, Joyce has conducted extensive research on Corporate Social Responsibility and sustainable supply chain management topics, and is a contributor to Journal of Business Ethics; Journal of Cleaner Production; and contributed a chapter to the book Corporate Social Responsibility.



Andrew McCall



Dr. Joyce Tsoi



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