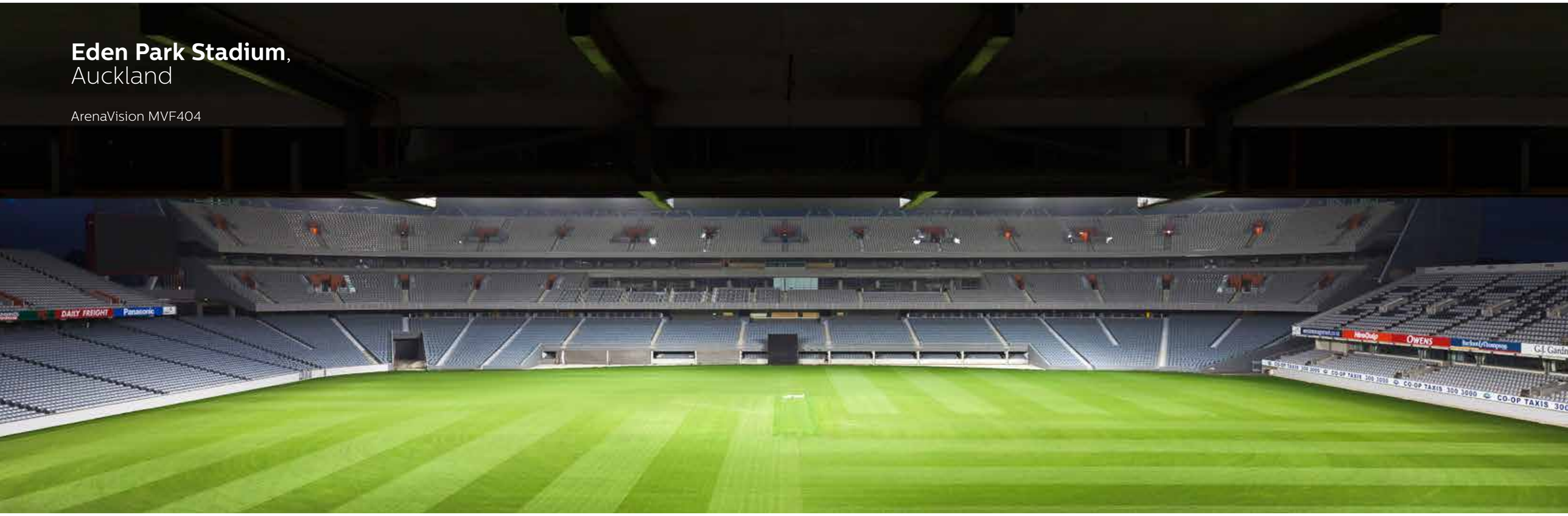
PHILIPS

Professional lighting

Sports application guide

Lighting to **play by**

Sports lighting that creates the perfect atmosphere for players and supporters.



Eden Park Stadium,
Auckland

ArenaVision MVF404

Sports **Lighting**

Why is good lighting necessary for sport?

All sporting events require good light to enable the sport to be played properly, the best results to be achieved and to provide enjoyment for participants and spectators, whether they are present in the venue or watching at home on television.

To maximise the use of limited space and expensive facilities, venues are increasingly being used for a range of different sports and even for other events as well, such as concerts, theatre performances and exhibitions. This needs to be taken into account in any lighting design.

Media coverage, and television coverage in particular, is playing an ever-increasing part in sporting events and this means there is a demand for lighting that will enable excellent image quality whilst also limiting the glare and distraction for players, spectators and referees.

The quality of the lighting installation can be one of the main factors that determine the quality of a venue.

The reality

Sometimes the lighting is not given proper consideration and an inadequate lighting system is installed.This almost always proves to be a false economy and at some stage the participants, spectators and television companies demand an upgrade – at considerable extra cost.The end result is that the work is effectively carried out twice.When venues are developed and refurbished it is important to incorporate energy-efficient installations so that wastage can be reduced to a minimum. How can all these factors be taken into account to achieve a good lighting scheme? The objective of this guide is to give sports venue owners/managers, architects, engineers and site technicians an overview to enable them to proceed with a lighting project for a new or existing indoor or outdoor sports venue.

Key terms in **sports lighting**

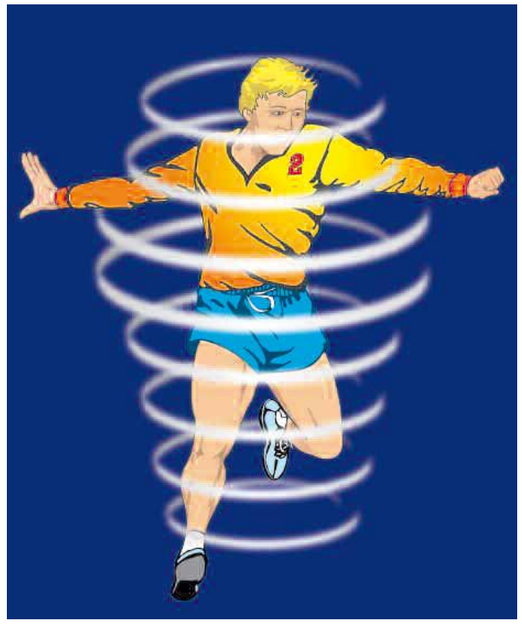
Good sports lighting design aims to achieve three things. Firstly, to ensure optimum visibility for participants and spectators (including television spectators); secondly, to create a visually satisfying and interesting scene; and, thirdly, to ensure that the lighting system integrates well with the surrounding architecture. What factors need to be taken into account to achieve this?

Quantity of light required (illuminance)

This is the amount of light (measured in lux) that is required for the sport to be played.The faster the sport and the smaller the playing object, the higher the lighting level required. Normally several different settings or 'switching modes' are recommended so that the lighting system can be used efficiently at all levels, from 'training mode' (non-televised) right through to 'international TV' mode (televised).

Average maintained horizontal illuminance (Eh)

This is the average quantity of lux to be achieved over the agreed maintenance cycle period for an installation. Maintenance includes replacement of lamps and cleaning of luminaires. Where there is television coverage, it is becoming increasingly common for minimum lighting levels to be specified in the industry.This is also true for the vertical illuminance described on the next page.



Average maintained vertical illuminance (Ev)

Vertical illuminance: This is the quantity of light on a vertical plane and should be calculated for unrestricted camera positions.

Camera illuminance: This is the quantity of light that shines in the direction of a fixed camera position. Calculations should be carried out using the actual angles perpendicular to the camera positions. The side of a player forms the reference for a television camera.

The camera illuminance should ideally also be considered for the ball in flight, as this reading will differ from the camera illuminance at ground level. For diving, the camera illuminance should be considered from the diving point to the surface of the water.

It may be important to provide TV shots of the spectators. The contrast ratio between the participants and the spectators should therefore be considered (as a rule of thumb, 15% of the average camera illuminance level can be assumed). The point of reference is generally defined as being 1.5m from the ground, except for some sports such as swimming and diving.

Illuminance uniformity

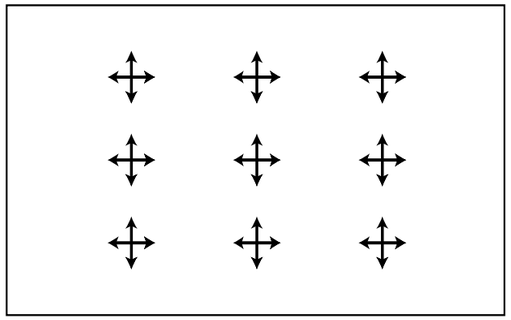
There are two measurements that are normally taken:

Minimum/Average: This is the ratio of the lowest to the average level of illuminance.

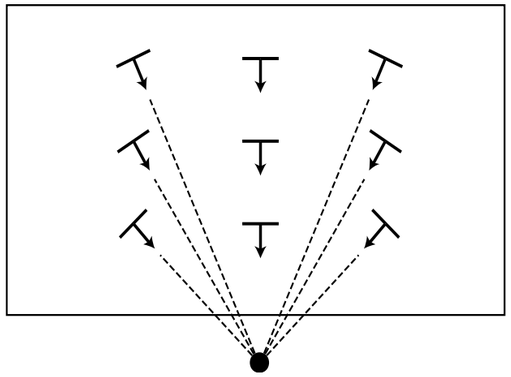
Minimum/Maximum: This is the ratio of the minimum to the maximum level of illuminance.

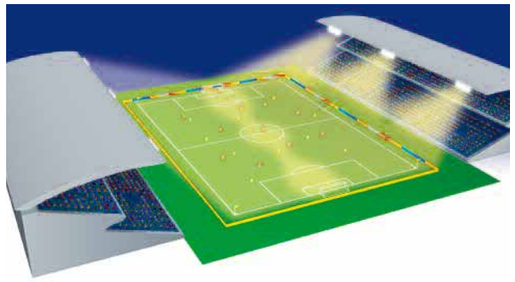
An adequate level of uniformity is required to create balanced lighting conditions so that people's eyes and the television cameras do not continually have to adapt to a different light level.

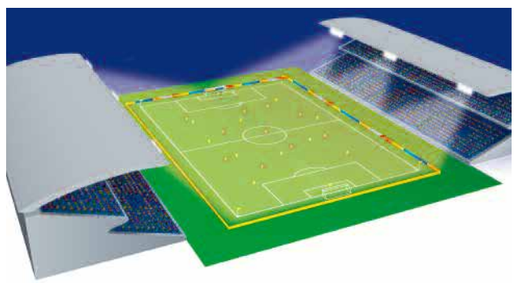
VERTICAL ILLUMINANCE



CAMERA ILLUMINANCE

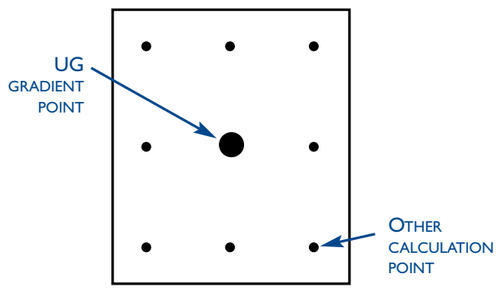






Uniformity gradient

As a television camera pans over a match or tournament, the differences in illuminance levels will affect the image quality. It is therefore not only the uniformity that needs to be considered, but also the gradient of change between the calculation points.The UG is expressed as a ratio of the illuminance at a single point to the 8 adjacent grid points, as shown in the diagram on the right.



Colour rendering

Colour rendering is the ability of a light source to reproduce surface colours accurately. A colour rendering index (Ra) is used to describe the performance of the light source.

Definition	Colour Rendering Index
Colour matching (advertising)	Ra 91-100
Good colour rendering	Ra 81-90
Moderate colour rendering	Ra 51-80
Poor colour rendering	Ra 21-50

NATURAL COLOUR (DAYLIGHT)

POOR COLOUR RENDERING UNDER ARTIFICIAL LIGHTING

GOOD COLOUR RENDERING UNDER ARTIFICIAL LIGHTING

Modelling and shadows

Modelling defines the ability of the lighting to reveal form and texture.This can affect how attractive a scene looks. Shadows can cause serious problems on a field of play.

A classic example is ice hockey, where the side barriers around the perimeter of the playing area can create a harsh shadow at the edges of the ice pitch if the luminaires are not positioned correctly. To reduce harsh shadows a ratio of 60/40 should be used as a rule of thumb to determine the maximum number of luminaires on one side of a sports arena in relation to the number of luminaires on the other side.

Colour temperature (colour appearance)

This is the apparent colour of the light source and is often described as ‘warm’, ‘white’ or ‘cool’. The colour temperature is defined in degrees Kelvin (K).The lower the value, the warmer the colour appearance. For example, 2700 K has a warmer colour appearance than 4000 K.

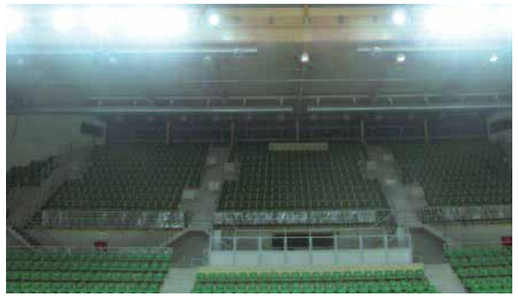
The colour temperature is used to help create the ambiance in a space and should not be confused with the colour rendering. If there is to be television coverage, it is not recommended to mix colour temperatures.

BOREAL SKY NORTHERN LIGHTS

SUN AT THE ZENITH DAYLIGHT

IN THE AFTERNOON SUNLIGHT

SUN ON THE HORIZON LIGHT AT DUSK



Glare caused by poor luminaire light control

No glare thanks to good luminaire light control

Glare

‘Glare’ is a controversial issue. There are mathematical formulae for calculating glare, but whether or not people will experience glare in a sporting situation is something that is very subjective. Obviously, if someone looks straight at a 2 kW luminaire at close range they will experience ‘glare’, but in the majority of other situations it is less clear whether an individual will experience glare from the lighting.

Specific recommendations are given in the sections on indoor sports, outdoor areas and outdoor stadiums. It is strongly recommended that a sports lighting specialist is consulted to ensure glare is reduced to a minimum.

Factors which influence glare:

- Viewing angles. It is essential to consider which sports are going to be played and to anticipate what the key viewing angles will be. Luminaires should be arranged in such a way as to take account of these viewing angles.

- Luminaire light control. If the luminaire has the facility to control the light produced by the lamp this can play a significant part in determining the amount of glare. This is one of the reasons why it can be a false economy simply to opt for the cheapest lighting solution.

- Maximum tilt angle of luminaire.The aiming angle of a luminaire must be limited to control glare.

- The intensity of the source in relation to the installation height.This should be adapted to suit the relevant situation.

Emergency escape lighting

This is also required to ensure orientation and a safe escape for spectators and players in an emergency.

Switching mode

Lighting should be designed to include different levels of light that are appropriate for the relevant level of play. This is also relevant from the point of view of energy consumption.
The following levels or ‘switching modes’ are commonly used:

- Training
- Competition
- Emergency TV
- International TV

Emergency (continuity) television lighting and hot restrike

A sports arena should ideally have a backup power source in case the principal power supply fails. If high-intensity discharge lamps are to be used, the lighting installation should incorporate an ‘emergency TV’ switching mode with ‘hot restrike’ luminaires. A hot restrike system enables a high-intensity discharge lamp to be re-lit straight away in the event of a temporary power failure, instead of having to wait for up to 15 minutes before the lamp can restart. This is not only essential for television coverage, because the loss of images for up to 15 minutes is unacceptable, but also for the participants and spectators because the lack of lighting will totally disrupt play.

Obtrusive Light

Obtrusive light is uncontrolled light that is directed up in to the sky or beyond the boundary of a sports facility. Reference should be made to local regulations.

Mark Taylor Oval,
Sydney

Optivision MVP507

Total cost of **ownership**

There is a wide variety of lighting systems available on the market and there can be a temptation to choose the cheapest solution. In most cases you get what you pay for and the cheapest luminaires may have reduced photometric efficiency, be made from low-quality materials or the manufacturer may have little expertise and provide poor levels of support.

A cost-of-ownership study should be carried out, taking into account the following factors:

Quantifiable aspects:

- Initial cost of luminaires and lamps
- Number of luminaires needed to achieve the required result
- Ease of installation
- Ease of maintenance
- Quality of luminaire materials/likely lifetime of product
- Power consumption
- Competent support from the manufacturer – is this available? If not, what will a consultant cost?
- Cost of gear replacement
- Efficiency of the gear system, taking into account any ballast losses.

Less quantifiable aspects:

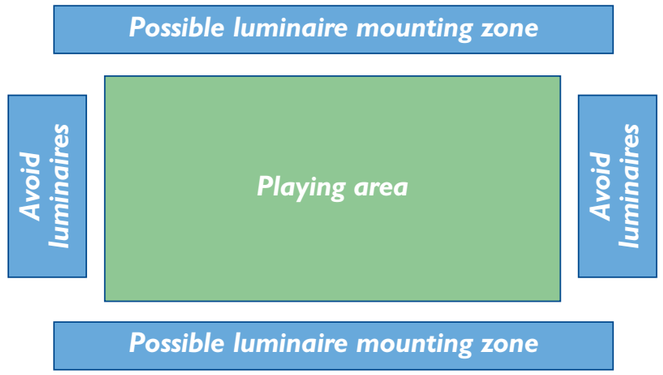
Even in non-televised events, the competitors, judges and spectators attach great importance to their sport and expect the lighting to work effectively. In the case of televised events, the sponsorship for the event and the status of the venue depend very much on the performance of the lighting. A good quality lighting system is a simple way to ensure optimum conditions for an event to take place and the right ambiance to ensure the event is enjoyed by the participants and the spectators, both in the arena and at home.

Avantidrome cycling velodrome,
Cambridge

ArenaVision MVF403

Sports lighting applications

Indoor sports halls



Most indoor sports halls are suitable for a wide variety of sports and events.These may be staged at anything from local club level to international competition level.

For this reason,
the requirements to be fulfilled by the hall need to be defined at the outset. Additional adjustments can then be made for specific sports.
A key consideration when positioning the luminaires is glare prevention.

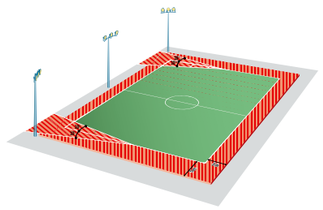
It is always important to carry out a lighting study for each specific project: If there is a polished / varnished floor surface thought should be given to the reflections caused by the luminaires and the viewing positions (camera / spectators).

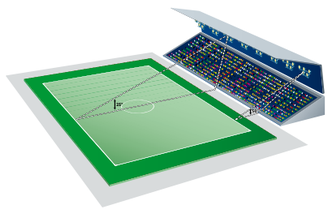
Luminaires should be positioned at a minimum height of 9.144 metres above the court surface at the net and at a minimum height of 6.096 metres at the base lines. Luminaires should not be mounted in the players' line of vision.

Trafalgar Park Stadium,
Nelson

ArenaVision MFV 404

Sports grounds and **stadiums**





Lighting configurations

There are many possible different lighting configurations for sports grounds, but broadly speaking they fall into three categories:

- Lighting from columns or masts
- Lighting from the spectator stand
- A combination of the above.

Sports lighting is increasingly being positioned within the stand, if there is an appropriate mounting height, it reduces the amount of obtrusive light (also called light pollution) and improves architectural integration.

Sports grounds with no spectator stand

If there is no spectator stand or the spectator stand is not high enough (a lighting study will show this), then columns or masts are required. The diagram above shows some of the possible configurations and the zones where it is permitted for masts to be positioned for general sports fields.

Sports grounds with a spectator stand

Ideally, lighting should be designed to be an integral part of the spectator stand because it is one of the factors that determine the optimum height of the structure. A lighting study should be carried out to determine if the stand is high enough and whether the distance from the pitch is appropriate for the required horizontal and vertical illuminance levels and uniformity. If the structure is too low, there will be an increased risk of glare. A sports lighting specialist will be able to advise on this. The diagram above is generic; a lighting study should always be carried out because each stadium has a different layout.

Other **applications**

Swimming

A key factor to be considered for all types of swimming pools is how to position the luminaires in relation to the spectators and the television cameras without creating glare or unwanted reflections for the participants. It is not always easy to get this balance right. Water acts as a reflective surface and, furthermore, this surface moves (+/-20˚), thus increasing the reflective area. Lighting levels for TV coverage should be calculated at water level as this is the point of reference.

Diving

The factors that affect the positioning of luminaires for swimming also apply to diving. The vertical illuminance from the diving position to the water surface should also be calculated.

Downhill Skiing

For all sports, lighting makes it possible to continue play after dark. As the days are shorter in the winter, this is especially applicable for snow sports. As the skiers travel downhill, they pass level with each luminaire on the slope. It is therefore important that the lighting is positioned so that it cannot be seen by the skier. Usually the lighting is aimed across and down the slope. However, this can mean that there is not sufficient vertical illuminance for the cameras that are facing up-hill, so it is necessary to aim some luminaires up hill

Theatrical effects and dynamic lighting

Theatrical effects are increasingly being included in sports arenas where it is appropriate to add drama to the sporting action. For example, for fencing and boxing the ring is lit as the focal point, with little or no light on the spectators.

In addition to this, dynamic coloured LED lighting which is adjustable through lighting controls, can be added to complete the theatrical experience.

Area **lighting**

For safety and efficiency

The 24-hour economy has led to a significant increase in human activity around the clock. Whether it's a production centre, airport, container terminal or industrial site, the activity is non-stop as people carry out tasks throughout the night.

Lighting can increase the efficiency of these 24/7 locations. It also makes them safer and more secure for those working on site. When selecting area lighting the efficiency of the system in terms of long burning hours will be a key consideration. But limiting light spill will also be important, especially when the surrounding environment is residential.

At Philips, our aim is to optimise area floodlighting by adapting it to specific customer needs. We can define the right level of lighting, uniformity, comfort and colour quality for each situation. And by optimising the cost of ownership, end users and society in general can benefit from the resulting energy savings. What's more, our innovative optical systems reduce light pollution thanks to sharp cut-off beam characteristics, features that are integrated in an impressive range of floodlights.

Philips **floodlighting range**

	Product Families		Conventional vs LED	
Applications	**High Intensity Discharge**	**LED**	**High Intesity Discharge (typical wattages excluding ballast losses)**	**LED (typical system wattages)**
Area Lighting	Contempo 	Tango G2 	70w Metal Halide 150w Metal Halide 250w Metal Halide 400w Metal Halide 600w Sodium	40w-55w 80w-105w 120w-175w 200w-280w 315w-335w
	Tango 			
	Optivision 	Clearflood LED 	1000w Metal Halide	560w
Sports Lighting	Optivision 	Clearflood LED 	1000w HPI-T Metal Halide	560w
		Optivision LED 	up to 1500w Metal Halide	375w-1375w
	ArenaVision 	ArenaVision LED 	up to 1000w LA Metal Halide	500w-1400w
Swimming Pools (Indoor)		Gentlespace G2 LED 	250w Metal Halide 400w Metal Halide	158w 234w
		Clearflood LED 	1000W HPI-T Metal Halide	560w
		Optivision LED 	up to 1500w Metal Halide	375w-900w

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