P.L. LIGHT SYSTEMS

Return on Investment

LED vs. HPS

DETERMINING ROI LED VS HPS

When it comes to building an ROI comparing LED versus HPS be careful with results that are supplied by manufacturers of only one type of lighting (HID / LED). Below is an outline of things to look out for when receiving an ROI comparing lighting technologies.

Efficiencies

Photosynthetic efficiency is best measured in µmol/J ("micromoles per joule" with joule being a measurement of watts).
We will use P.L. Light System's ParFX Ultra (UW) (R80:W5:B7:FR8) as an example:

A 750W luminaire with PPF of 2849 µmol is 3.8 µmol/J (2849 / 744 = 3.8), where the 1000W DE HPS has an output of 2100 µmol is 2 µmol/J (2100 / 1045 = 2). Many LED manufacturers will show how quickly they can hit a good ROI with LEDs and use 1.85 µmol/J as their HPS comparison. However, most comparisons of new LED technology are made to older magnetic ballast HPS luminaires. These lamps have an output of 1850 µmols at 1000W. Some manufacturers use as low as 1.7 µmol/J for an HPS comparison, which would be the equivalent to the end of life of the old HPS technology. Therefore, when comparing efficiency in terms of µmol/J it is important to look at the most current technology and make calculations that way.

Light Planning

When comparing both technologies, always compare light levels of the entire growing area and not just luminaire to luminaire. Today, many modern LED luminaires are purpose-engineered to operate at the same mounting height, power supply, and spacing requirements as 600W and 1000W HPS systems, making one-for-one or near-equivalent replacements achievable in many applications when the correct luminaire and layout are selected.

While first-generation LEDs often produced high peak intensities directly beneath the fixture with rapid light falloff, today's LEDs use wide-beam optics, multi-angle photon delivery, and advanced optical design to distribute light evenly across the growing area. As a result, canopy-level PPFD uniformity comparable to — and in some cases exceeding — HPS systems is achievable.

LEDs remain a directional light source at the emitter level, but modern luminaire optics and lighting design mitigate this through system-level distribution. Uniform light delivery across the canopy remains essential to avoid uneven water use, nutrient uptake, and crop development. For accurate comparisons between HPS and LED systems, lighting plans should be evaluated based on target PPFD (µmol/m^2/s), average and minimum uniformity, and total system efficacy, rather than point measurements directly beneath individual luminaires.

Heating and Cooling

Another area you should always do your own math on, is the BTU calculation for your grow room. Your AC load is based on the number of BTUs produced from your luminaires, as 1 watt equals 3.412 BTUs. No matter which 1000W luminaire you use, the BTUs from that luminaire will be 3412 BTUs.

P.L. Light Systems' ParFX Ultra is a 750W LED luminaire, which equates to approximately 2,559 BTU/hour. While this represents a reduction in heat load compared to a 1000W HPS fixture, modern high-efficacy LED luminaires can achieve comparable or higher usable light levels with an equal or fewer number of luminaires.

Unlike HPS, LEDs emit significantly less radiant (infrared) heat toward the crop, meaning less direct canopy warming and a greater reliance on the facility's heating system to maintain optimal plant temperatures. This shift often results in improved environmental control, but it should be factored into overall heating and energy planning when evaluating LED ROI. There is a correlation between temperature and crop production—plants will grow slower, producing less yield the colder they are. In northern climates, many growers rely on the heat from HPS luminaires to warm their crops.

Canopy Penetration

LEDs now use advanced optics, higher photon flux, and adaptive light distribution to deliver consistent illumination through dense crop canopies. ROI models should consider not just fixture cost and efficiency, but also light uniformity and plant performance throughout the canopy.

A common misconception is that mounting LEDs closer to the canopy always improves yield. However, the real improvement comes from optimized fixture spacing, wider beam angles (100–150°), and spectral tuning, ensuring light overlap and even penetration without excessive density.

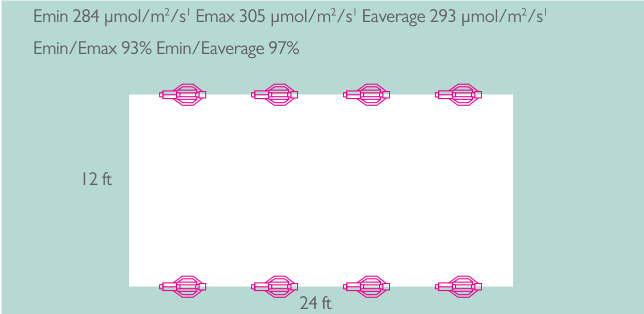
Some modern horticultural LEDs can also integrate with smart control systems that adjust intensity and spectrum in real time, enhancing growth at different crop stages. With proper design, today's LED systems can equal or outperform HID in canopy penetration—while delivering superior energy efficiency, spectrum precision, and long-term ROI.

RETURN ON INVESTMENT

Comparative light plan examples based on all HPS vs. all LED for the same application.
These calculations are based on a hypothetical greenhouse with three bays. Each bay is 24' x 84'.

1 1000W Electronic NXT2 HPS Beta Luminaires

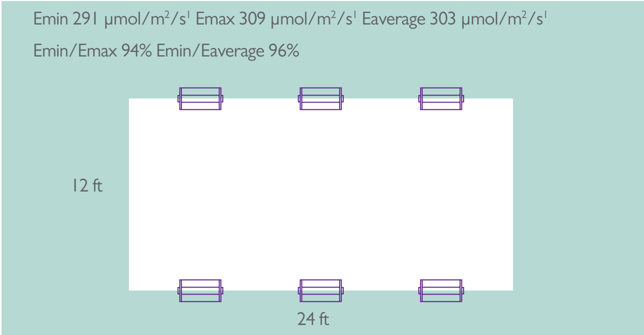
Luminaire Output:	1978 µmol
Luminaires/Section:	8
Crop to Light	10ft 2in
Row Spacing:	12ft x 6ft
Ave. Light Level:	293 µmol
Ave. Uniformity:	97%



Calculation plane for HPS luminaires

2 750W ParFX Ultra (UW) (R80:W5:B7:FR8) LED Luminaires

Luminaire Output:	2849 µmol
Luminaires/Section:	6
Crop to Light	10ft 10in
Row Spacing:	12ft x 8ft
Ave. Light Level:	303 µmol
Ave. Uniformity:	96%



Calculation plane for LED luminaires

LED fixtures now match—or surpass—HPS performance in both total photon flux and distribution efficiency, even within the same truss spacing. This improvement comes from advances in diode efficacy (up to 4.2 µmol/J), modular light engines, and optimized optical designs that allow broader, more uniform light spread without adding extra tracks or dense fixture layouts.

HPS luminaires rely on large reflectors to scatter light across the canopy, but much of that reflected energy is lost as heat or directed inefficiently. By contrast, modern LEDs use engineered optics and multi-bar or matrix configurations to direct photons precisely where plants need them—reducing wasted light and improving penetration at lower power draw. With tunable spectra and adaptive controls, today's LED systems can maintain even distribution across wide canopies while consuming 30–40% less energy than comparable HPS installations.

While HPS lamps emit a broad, unoptimized spectrum, LEDs deliver targeted PAR and beyond-PAR wavelengths (including far-red) that align with plant photobiology. As a result, despite slightly lower raw photon counts in some setups, LED-lit crops often achieve equal or higher biomass and quality because the photons are spectrally efficient and biologically relevant. Today, performance comparisons must consider usable photon efficiency (YPF) and spectral efficacy, not just total µmol output.

The way you can calculate the payback period for LED luminaires, is by weighing the initial incremental capex costs versus the resulting energy savings.

Capex Cost Differential:

72 HPS Luminaires @ $240 ea. = $17,280

54 LED Luminaires @ $895 ea. = $48,330

Capex cost of LED luminaires is two times more for same light level. The calculations you see here show that the capex cost of the LED luminaires is an investment of two times that of HPS.

Energy Consumption Differential:

72 HPS Luminaires @ 1045W ea. = 75,240W

54 LED Luminaires @ 744W ea. = 40,176W

Electrical energy consumption of LED luminaires is 46% less than HPS.

Annual Energy Cost Savings:

HPS 75 kW * 2500 h/year * $0.15 kWh = $28,125/year

LED 40 kW * 2500 h/year * $0.15 kWh = $15,000/year

Electrical energy cost saving of $13,125/year. The LEDs offer a savings of 47% in electrical costs.

ROI Calculation:

Incremental capex cost* / electrical savings = payback period

$31,050 / $13,125 = 2.4 years

*Excludes additional infrastructure costs

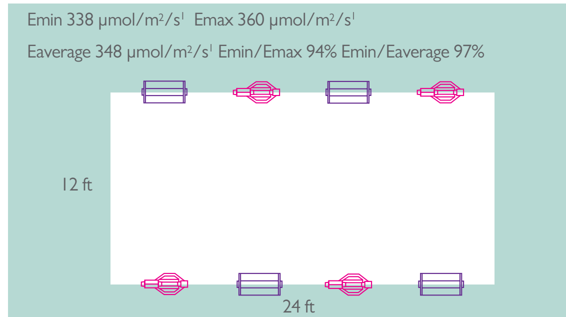
Remember that in addition to the capex investment, you also need to consider additional infrastructure costs (like wiring and extra track), along with the relevant labour cost if you're transitioning from HID to LED. You need to consider all the factors to determine if the ROI will actually make sense.

HYBRID ROI

Let’s look at how a hybrid LED and HPS lighting system might differ from an all LED or all HPS system. In this plan, we replaced every other HPS luminaire with two LED luminaires. The spacing of the luminaires also means that they can still be mounted on the 10ft truss, rather than having to install additional track.

Hybrid: 1000W HPS + 750W LED

Luminaire Output:	1978 μmol / 2849μmol
Luminaires/Section:	3 HPS + 3 LED
Crop to Light:	10ft 2in & 10ft 10in
Row Spacing:	12ft x 6ft
Ave. Light Level:	348 μmol
Ave. Uniformity:	97%



Capex Cost Differential:

HPS ONLY: 72 HPS Luminaires @ $240 ea. = $17,280

LED ONLY: 54 LED Luminaires @ $895 ea. = $48,330

HYBRID: 36 HPS Luminaires @ $8,640 + 36 LED Luminaires @ $32,220 = $40,860

Capex cost for hybrid solution is only $23,580 more than HPS solution.

Energy Consumption Differential:

72 HPS Luminaires @ 1045W ea. = 75,240W

54 LED Luminaires @ 744W ea. = 40,176W

36 HPS + 36 LED Luminaires = 26,784W + 37,620W = 64,404W = 64.4 kW

Hybrid solution delivers 14.4% energy savings vs. HPS

Annual Energy Cost Savings:

HPS 75 kW * 2500 h/year * $0.15 kWh = $28,125/year

LED 40 kW * 2500 h/year * $0.15 kWh = $15,000/year

Hybrid 64.40 kW * 2500 h/year * $0.15 kWh = $24,150/year

Electrical energy cost saving of $3,975/year

ROI Calculation:

Incremental capex cost / electrical savings = payback period

$23,580 / $3,975 = 5.9 years

You can see that the hybrid solution is only an incremental capex cost of $23,580 over the HPS installation but offers an energy savings of 14%.

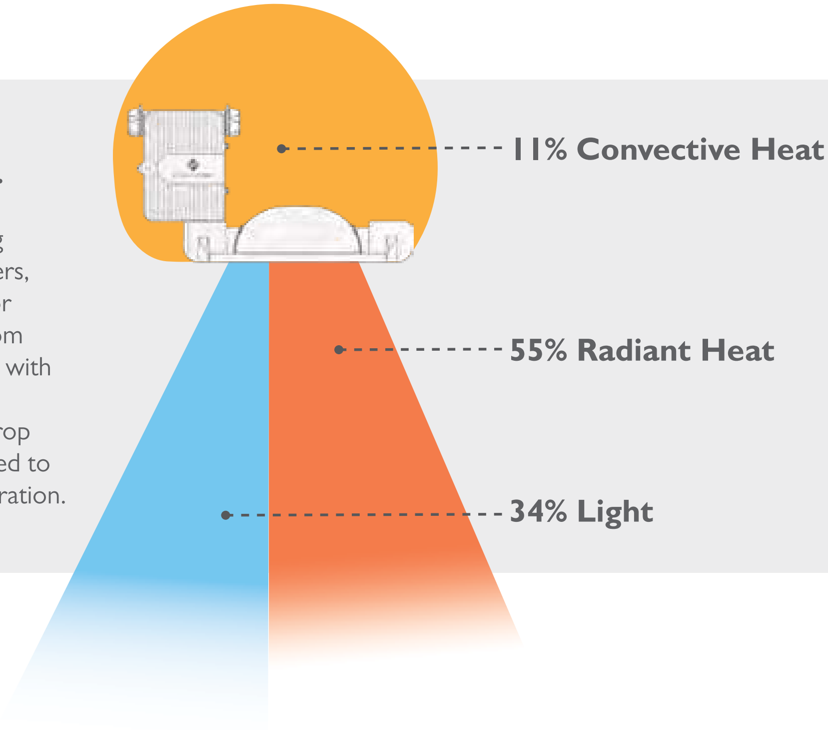
Remember - that we are looking at the lighting costs alone in these calculations. To really figure out what solution works best for a particular project, we need to also factor in the relevant infrastructure and heating or cooling costs to determine which setup will truly offer the best ROI for your application.

COMPARING HOW LUMINAIRES EMIT ENERGY

HPS LUMINAIRES

HPS lamps emit a significant amount of radiant heat in the plane of illumination.

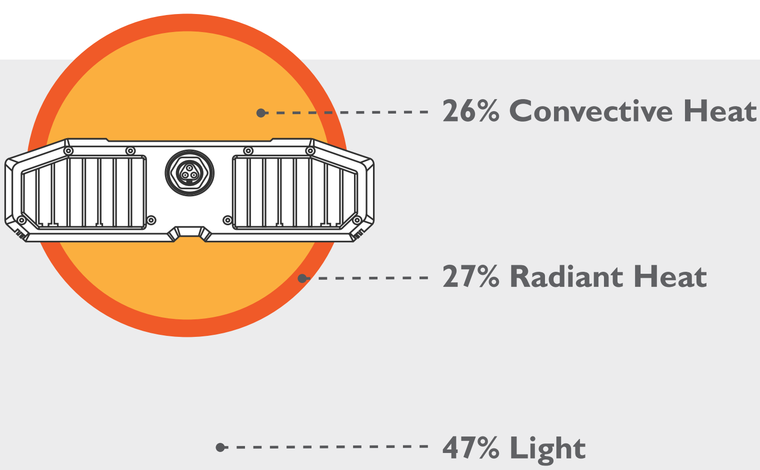
This radiant heat is very effective in transferring heat to high wire crops like tomatoes, cucumbers, and cannabis, that require high temperatures for growth and development. The heat emitted from the lamps can help to offset the cost of heating with natural gas or electricity. HPS lamps need to be placed further away from the crop to reduce crop burn and watering schedules need to be adjusted to account for the higher amount of evapotranspiration.



LED LUMINAIRES

LEDs dissipate heat away from the illumination field in the form of convective heat.

This is contrary to HPS lamps which emit radiant heat in the direction of illumination. Since heat is directed away from the crop, lights can be placed very close to the crop canopy without any burning. Because of the lack of heat, this also means in cooler months of the year, heating costs will be higher—especially in northern climates. On the other hand, low heat from LEDs can be of benefit to growers in the south who would otherwise need to spend money on cooling their operation.



Energy Savings During Winter: HPS and LED Technology

HPS and LED technologies, both emit heat in very different ways. This can have profound effects on your greenhouse environment and plant growth, as many growers have come to depend on the radiant heat from HPS luminaires to heat their crops during cold months of the year. The way LEDs dissipate heat makes them more efficient at regulating indoor temperatures, however, this does often require greenhouses at high latitudes to compensate for the lack of heat during winter months.

In a recent study by Wageningen University, entitled *Energy savings in greenhouses by transition from high-pressure sodium to LED lighting* (2020), they assessed the actual energy savings of LED vs. HPS technology, reviewing both energy and heating costs of greenhouses at high latitudes, and discovered that actual energy savings is only around 15% when factoring in heating.

Their results demonstrate that in most climates with traditional HID technology, about half of the energy consumption from the luminaires goes into heating. So, while LEDs can reduce energy consumption by up to 40%, it will increase heating costs by around 25%, making energy savings only around 15%. These metrics should be taken into account when calculating your ROI, as it can help show the actual costs and savings of HID versus LED technology. Again, your needs and goals will largely depend on your geography, building, and crop type.

CONTACT US

Our **sales team** is dedicated to supporting our customers throughout the project and beyond. Contact your regional sales manager to find out how P.L. Light Systems can help you grow.

Our friendly, North American based **customer service team** are available Monday – Friday between 8:00am and 4:30pm (EST) to assist with product-specific inquiries and general technical guidance to ensure an experience that is as seamless as possible for all our customers.

Our **website** is also a hub of product information that can be accessed 24/7.

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