The advantages and shortcomings of by-product heat in your greenhouse

Meta Description: *HPS lighting systems are commonly used, but are they effective? Learn more about by-product heat, energy waste and which lighting systems offer the greatest advantage.*

Photosynthetically active radiation (PAR) is naturally the only figure represented in a PAR chart when comparing HPS and LED spectra. However, the additional radiation that lies just outside of PAR—ultraviolet (UV) and infrared (IR) wavelengths—can pose significant implications for plant growth and, just as importantly, heat in a controlled environment.

The HPS spectrum contains a massive amount of IR, which of course is not documented in PAR charts. Only a representative radiation chart will display the true HPS spectrum. Why is this so important? Understanding both PAR and other wavelengths plays a crucial role in the by-product heat fixtures produce.

LED systems create convective heat that warms the air above the fixture rather than radiating it downward to plant surfaces like HPS, which in turn warms crops relative to the ambient temperature.

The key to decreasing overall energy use is to switch to LED systems or implement a hybrid LED/HPS lighting plan, which will trigger the need for an increase in the ambient air temperature. This will cause a rise in heating costs, but it will also enable production gains and lower overall energy use. This is a crucial transition for growers, as an LED retrofit finally puts the responsibility of heat management on the HVACD system itself, which offers more precise control of an environment than HPS lamps.

How should growers calculate the expense of thermal waste?

All of the electricity consumed within a greenhouse is heat, with the exception of the light that escapes the covering.

Some electricity becomes convective heat within the ballasts, drivers, lamps and circuit boards; some becomes IR (in the case of HPS systems); and the remainder of the electricity becomes light. Ultimately, all light converts to heat as it is absorbed by surfaces, and only a small amount escapes the building envelope.

Calculating the electrical input of greenhouse lighting in BTUs will allow growers to quantify the by-product heat for a direct comparison to space heating energy loads. Then, they can make cost comparisons using a conversion factor of kWh to BTUs.

Use this equation to calculate the expense of thermal waste:

(kWh of lighting demand/month) (price/BTU) (3,412 BTU/1 kWh) = Price of by-product electrical heat/month

Electricity prices will vary depending on your own greenhouse products, but reducing by-product heat typically yields significant savings. But what does this mean when you're choosing between HPS and LED systems (or a hybrid of the two)?

"Regardless of your lighting technology, all of the electricity you bring into your greenhouse becomes heat. The advantage of LEDs is they create more PAR per BTU than HPS."

— Michael Hannan, Fluence commercial agriculture sales manager

Put simply, LEDs convert electricity into photosynthetically active radiation (PAR) more efficiently than HPS lamps.

Commercial LEDs achieve 2.7 to 3.8 micromoles (µmol) per joule (J), while HPS fixtures seldom exceed 1.8 µmol/J. This results in increased efficiency that helps growers reduce overall energy use, even though the amount they pay for lighting seems higher.

Some cultivators may be resistant to LED lighting because the high IR output from HPS lighting allows them to generate more heat; however, it's important to remember that heat is far more expensive to generate through electrical lighting than it is when paying for a heating system and switching to an LED system instead of relying solely on HPS.

Ultimately, switching to LEDs will result in a trickle-down effect that creates savings and results in better environmental control.

What an LED retrofit means for energy reduction

A landmark study at Wageningen University & Research (WUR) in the Netherlands recently analyzed how transitioning from HPS to LED lighting saves energy in a variety of climates.

WUR's research used sophisticated modeling and climate data to predict energy-usage changes in a hypothetical tomato greenhouse at 15 locations ranging from subtropical to arctic.

The study assessed energy vectors related to solar radiation, air temperature, relative humidity, horizontal radiation from the sky, insulation, ventilation, photosynthetic photon flux density (PPFD) and a variety of fixture efficiencies for both LEDs and HPS.

LEDs' reductions in lighting energy were offset by increases in heating energy, yet yielded a 10 to 25 percent reduction in overall energy usage across all locations.

Does this mean that the energy use reduction from LEDs is the same across the board? Not always. LED systems are particularly beneficial when the cost of electricity is higher—as is the

case in most countries and regions today—because LEDs shift the utility load away from electric heating to less expensive thermal energy sources.

Reduce by-product heat and energy waste with Fluence

Having a better understanding of the advantages and shortcomings of by-product heat in your greenhouse is crucial, but finding the right products can be the most difficult part of the process.

If you're searching for efficient LED lighting systems in your greenhouse, contact us to explore our products, conduct lighting design assessments and learn how we can help you tackle your unique cultivation goals and challenges.