**Maximizing Savings with Centralized Remote Drivers for Greenhouse Lighting**

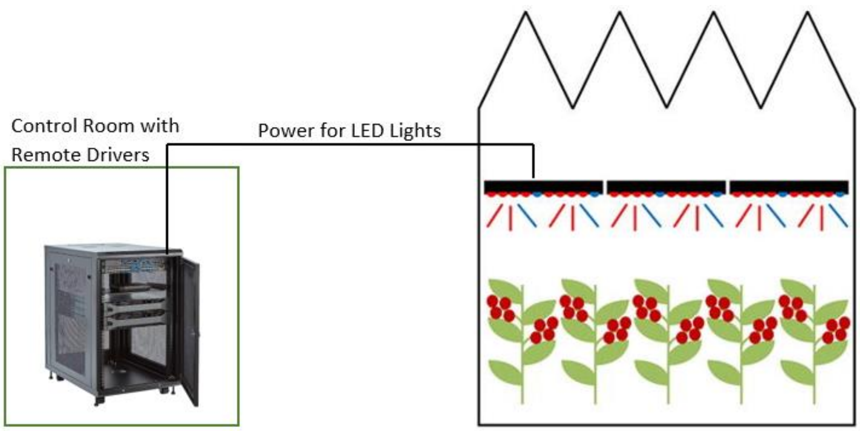
In the current economic landscape, especially as the Controlled Environment Agriculture (CEA) sector faces financial challenges, finding effective cost-saving measures is crucial. This article explores the significant economic advantages of using centralized remote drivers for supplemental greenhouse lighting, particularly with LED grow lights. By adopting this technology, the following benefits can be realized by greenhouse operators:

- *Extended Equipment Lifespan:* Centralized remote drivers can substantially extend the life of LED drivers, reducing frequent replacements.
- *Efficiency in Maintenance:* Centralizing drivers simplifies maintenance logistics, leading to tangible financial savings.
- *Energy and Material Cost Savings:* Harnessing the power of DC drivers and high voltage with low current configurations can lead to notable reductions in energy bills and material costs.
- *Simplified Installations:* Innovations like digital electricity offer cost-effective installation methods, further driving down expenses.

As we delve deeper, we'll explore how these benefits manifest in real-world applications and how companies, including Thrive Agritech, are pioneering solutions that not only save costs but also enhance the efficiency and sustainability of greenhouse operations.

Centralized remote drivers, boasting power capabilities beyond 10kW, have the potential to energize hundreds of grow lights. An optimal setup allows these potent drivers to be strategically positioned away from the plant canopy, and located within a distinct, climate-regulated control room, as depicted in the accompanying figure.

*Overview: Centralized Remote Driver Strategy*



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## Driver Reliability

A known vulnerability in LED grow lights is the driver. Historically, these drivers have a lifetime averaging between 30,000 to 50,000 hours, paralleling the longevity benchmarks set by traditional lighting technologies, such as High Pressure Sodium (HPS) and Ceramic Metal Halide (CMH)[1]. However, LED chips can achieve lifetimes far in excess of 50,000, which makes the driver the likely failure point in an LED lighting fixture[2].

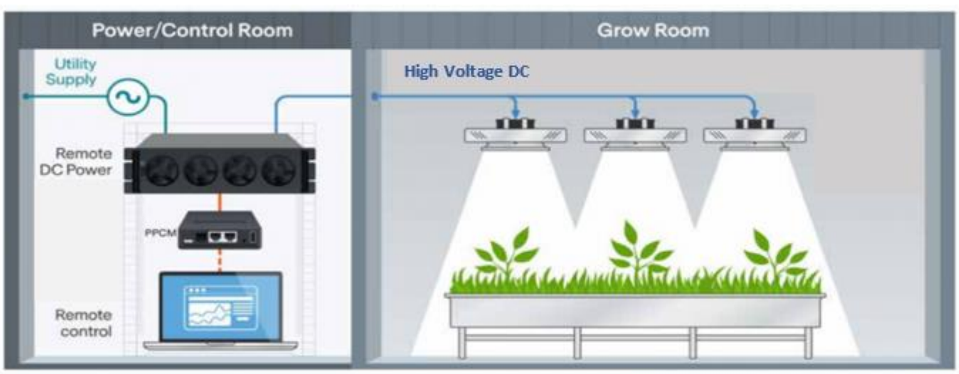
By separating the drivers from the LED light fixtures and relocating them to a climate-optimized control room, we can achieve multiple cost advantages. Implementing this strategy shields the drivers, especially their silicon components like capacitors and transformers, from the harsh environmental conditions found within greenhouses. Not only do we boost the lifetime of the drivers but also decouple the reliability of the LED units from the drivers' limited life cycle. Consequently, the LED fixture's reliability becomes primarily determined by the reliability profile of the LED chips. The consequence of this is the streamlining of maintenance cycles and curtailing of fixture replacements[3].

When we consider the typical height at which grow lights are suspended in greenhouses—about 6 to 10 feet from the ground—servicing a malfunctioning driver becomes a logistical challenge. Centrally housing the drivers mitigates this issue, ensuring technicians have straightforward access, fostering maintenance efficiency and leading to palpable financial savings.

## High Voltage DC Power

Two dominant implementations of centralized remote drivers are found in greenhouses. The first, utilizing high voltage DC power for LEDs, is depicted in the subsequent figure.

*High Voltage DC Power to the LED Lighting*




[1] *Comparative Study of Traditional Lighting Systems, Lee, S., 2019.*
[2] *Hongwei Liu, Dandan Yu, Pingjuan Niu, Zanyun Zhang, Kai Guo, Di Wang, Jianxin Zhang, Xin Ma, Chengkui Jia, Chaoyu Wu, Lifetime prediction of a multi-chip high-power LED light source based on artificial neural networks, Results in Physics, Volume 12, 2019, Pages 361-367, ISSN 2211-3797.*
[3] *Kliss, Zoltan, Endrich, "LEDdrivers–reliability,and performancefactors", http://www.electronics-articles.com/LED040/en-led-drivers-reliability-and-performance-factors.html#:~:text=According%20to%20failure%20analysis%20of,originate%20from%20LED%20driver%20failures.*



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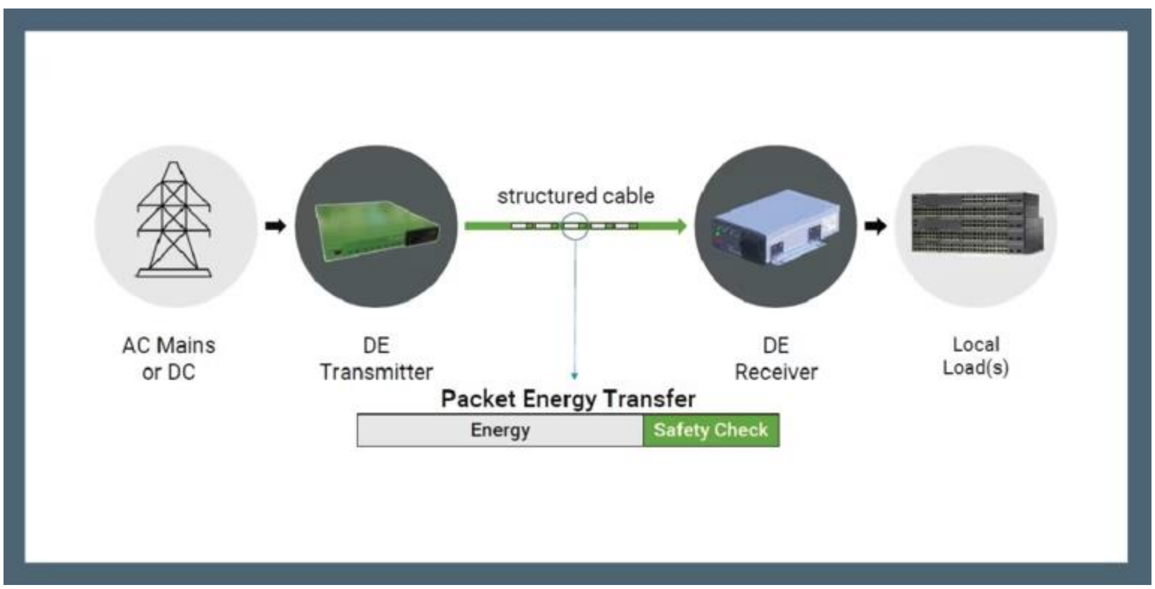
In this configuration, the lights are powered by high voltage DC – typically on the order of 100VDC to 300VDC. DC drivers for LED grow lights present several advantages over AC drivers, offering benefits such as increased efficiency, extended lifespan, flicker-free lighting, improved dimming capabilities, compact size, reduced electromagnetic interference, and enhanced safety[4]. The superior efficiency of DC drivers stems from the elimination of power losses during AC to DC conversion, resulting in energy savings and decreased utility bills. Using high voltage and low current allows for thinner wires, reducing material cost and weight. Additionally, lower currents minimize wiring losses.

The majority of LED grow lights are designed to operate with an AC power source, making it essential to confirm the compatibility of the light with the chosen driving strategy. Thrive Agritech offers versions of its Pinnacle high-power greenhouse light that are compatible with remote DC drivers. These tailored lighting solutions ensure seamless integration with advanced driver configurations, allowing growers to leverage the benefits of remote DC drivers.

**Digital Electricity**

Digital electricity represents the second commonly used implementation of centrally located remote drivers. Digital electricity systems offer the convenience and safety of low voltage, such as Power over Ethernet (PoE), with the power and distance capabilities of AC[5]. With digital electricity, specially designed drivers generate packets of energy, similar to data packets in computer networking. The energy packets are then transmitted over standard low-voltage wiring, such as 18AWG  to power the LED lights. The concept of digital electricity is shown in the figure below[6].

*Digital Electricity to Power the LEDs*




[4] *Bickford, R. (2019). LED Drivers: AC Versus DC Power. LEDs Magazine.*
[5] *Voltserver website: https://voltserver.com/digital-electricity/what-is-it/*
[6] *Ibid.*



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The National Electric Code recently introduced a specialized power classification known as "Class 4 Power," solely dedicated to leveraging the potential of digital electricity[7]. A compelling advantage of Class 4 Power is its unique safety profile that allows it to be installed using ethernet wiring methods even though it delivers power at high voltages. This makes Class 4 Power a safe and especially efficient option for powering LED lighting. The ability to transmit high voltage using ethernet wiring methods significantly reduces costs associated with installation including licensed labor, inspections and permits, specialized equipment like breakers, ground fault protection, and step-down transformers[8].

As in the case of high voltage DC power, it is critical to verify the LED lights are compatible with digital electricity. Thrive Agritech works closely with the key manufacturers of drivers that produce digital electricity, such as Voltserver, to ensure a flawless system-level LED lighting solution.

**Summary & Conclusions**

In an era where cost-efficiency is paramount for the controlled environment agriculture industry, especially given the economic challenges of 2023, leveraging technology effectively becomes essential. Implementation of centralized remote drivers for greenhouse supplemental LED lighting is a compelling solution in this respect. These systems not only tackle the inherent limitations of LED grow light drivers, but also ensure extended equipment lifespans and reduced maintenance complexities. Both high voltage DC configurations and the innovative approach of digital electricity provide substantial benefits – from energy savings to simplified installations. While it's vital for growers to ensure compatibility and adaptability of their lighting solutions, companies like Thrive Agritech are already paving the way with products tailored for these advanced configurations. As we move forward, the adoption of centralized remote drivers paired with strategic implementations like Class 4 Power will not only optimize greenhouse operations but also set new benchmarks for efficiency and sustainability in the horticulture industry.

The evolution of centralized remote drivers for greenhouse lighting beckons a fascinating phase of advanced research and innovation. As the technology gains traction, a vital area of exploration will center around the integration of smart IoT sensors and AI-driven algorithms, enabling real-time adjustments to light intensity and spectrum based on plant health and growth stage[9]. Furthermore, the development of energy storage systems, harmonized with centralized remote drivers, might offer consistent power even during grid instabilities.

[7] *Safer Buildings Coalition, March 2023: https://www.saferbuildings.us/blog/here-comes-class-4-power-differences-between-circuit-classes*

[8] *Voltserver website: https://voltserver.com/digital-electricity/what-is-it/*

[9] *Alahi, M.E.E.; Sukkuea, A.; Tina, F.W.; Nag, A.; Kurdthongmee, W.; Suwannarat, K.; Mukhopadhyay, S.C. Integration of IoT-Enabled Technologies and Artificial Intelligence (AI) for Smart City Scenario: Recent Advancements and Future Trends. Sensors 2023, 23, 5206. https://doi.org/10.3390/s23115206.*



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