

Tame costs with LED lighting

Nate Klieve and Melissa Stephany look at how light-emitting diode technology can reduce costs for mining operations, along with a host of other benefits

300W LED floodlights on a shovel at an iron ore mine in North America

“LED longevity translates to significant energy savings, greatly reduced maintenance and reduced cost of ownership”

To achieve sustainable operations as well as long-term viability and profitability, mining must do everything it can to conquer the myriad of variables affecting operating expenses. According to the Southwest Energy Efficiency Project in the US, energy represents more than 15% of total production costs in US mining.

With commodity prices surging to all-time highs, accelerated production has become the mantra of most mining companies. The result, however, is as onerous as it is predictable: operating costs are rising across the board.

One unpredictable expense is energy. Taking a holistic overview of energy use and building flexibility into the energy mix will enable mine operators to reduce both current expenses and the impact of future cost fluctuations.

Industry leaders are beginning to explore technologies that can help them better manage energy consumption, costs, supply and pressures from international and national regulations.

LED TECHNOLOGY

Light-emitting diodes (LEDs) have been around since the 1960s. They are small



semi-conductors that can produce millions of different colours and brightness levels of light, but they use significantly less energy than traditional lighting methods. A select number of manufacturers have created high-brightness LED fixtures for mining equipment that surpass incumbent technology for consistency and efficiency.

LEDs create light differently from

conventional forms. Other lighting technologies, such as halogen and incandescent sources, heat up a fragile filament until it radiates light, wasting large amounts of electrical energy through infrared radiation.

Conversely, LEDs convert an electrical current directly into light; as a result, less energy is wasted. LEDs do not burn out as a standard lamp does, so individual diodes do not need to be replaced. Instead, the diodes very gradually produce lower output levels. In fact, well-designed fixtures can last up to 50,000 hours. And if one LED fails, it does not necessarily result in a complete fixture outage.

Based on sample hours of daily illumination, consider the performance life of a 50,000 lifetime-hour-rated LED chip:

Hours of operation	Life
24 hours a day	5.7 years
18 hours a day	7.6 years
12 hours a day	11.4 years
8 hours a day	17.1 years

When compared with traditional light sources, LED longevity alone translates to significant energy savings, greatly reduced maintenance and reduced cost of ownership over the product's lifetime.

The vast majority of industrial-use light fixtures are not designed with mining applications in mind. Because of harsh site conditions, they require frequent unscheduled maintenance that demands considerable time and creates considerable aggravation for maintenance ▶

Modular design

Proper design of an LED system is critical in any industry, but design is especially important in mining, with its harsh environment of shock, vibration and extreme weather.

- **Heat reduction:** A properly engineered modular LED design can promote better thermal management because the individual components – the modules – are independent of one another. Space between components promotes airflow around each one, a measure that allows cooling and helps ensure the LED fixture's long life.
- **Tight seal:** Sealing the smaller surface areas of a module to protect against moisture and dust intrusion is far more effective than trying to seal the large surface area of a traditional fixture lens.
- **Light control and customisation:** Traditional light sources such as high-intensity discharge (HID) spread light over 360°, illumination that has to be captured and directed by a reflector, yielding significant light loss and inefficiencies. A smaller bank of LEDs allows for each diode to have its own optic for precise control, directing the light exactly where desired. A large percentage of HID lumens are not being delivered directly to the target, so an LED

fixture's lumen output should not be compared with a HID lamp's lumen output.

- **Light pattern:** An array of optic choices for LED modules allows for mixing and matching optics within a fixture to customise the overall light pattern for nearly any application. As a result, installers and maintenance crews may have to learn only one fixture. For example, the fixture on their shovel can be installed and maintained exactly as the fixture in their workshop, in the heavy-vehicle wash bay and on the train/truck/ship loader. They do not need to keep track of and master information from a stack of user manuals and guides.
- **Ease of maintenance:** Many of today's LED fixtures are factory-sealed, and opening them to perform maintenance actually voids the product warranty. However, a well-engineered modular design allows for repairs in the field, permitting mine personnel to inventory and plan for the unlikely need to replace LED modules and drivers in the same way they planned for traditional light bulbs and ballasts. With LEDs, fewer replacements are needed, so maintenance is much less frequent.



Left: the 300W floodlights make night work easy ▶ personnel – not to mention the effect on overall production of unscheduled maintenance interruptions.

Right: 150W Phoenix Products ModCom Lo floodlights illuminate the area behind the shovel

Solid-state LEDs have no moving parts, nor do they have fragile filaments or glass that is vulnerable to breaking. The risk of damage during transportation, installation and operation is eliminated, even in a harsh mining environment.

LEDs ensure instant full brightness, and there is no restrike time following a power interruption. Full illumination is

instantaneous, reducing expensive downtime for mine sites that have been accustomed to long wait times for warm-up and cool-down cycles.

The efficiency of LED technology addresses both cost and environmental concerns. Light that is dispersed at all angles creates light pollution; either as sky glow, which is light directed upward, or light trespass, which is light falling into unwanted spaces. The International Dark-Sky Association estimates that 30% of all outdoor lighting is directed skyward and

is wasting US\$1.5 billion per year in the US alone. Effective lighting design and engineering direct light only to where it is wanted and needed.

SCOPE OF FIXTURE PAYBACK

LED fixtures garner a higher upfront cost than their high-intensity discharge lamp predecessors, but a mine operator can realise significant energy savings, decreased maintenance costs and reduced revenue loss from equipment downtime. Savings can be so substantial that it's not unusual for LED fixtures to pay for themselves in 1–2 years or less. After that, all continued savings go straight to the mine's bottom line.

Ever-increasing environmental regulation, along with the need to reduce costs, increase productivity and reach sustainability goals, is putting tremendous pressure on mine operators. LED lighting can be a giant step toward creating solutions to the multifaceted challenges they face. New technologies, when combined with process improvements and operational changes, can significantly improve a mine's financial performance. ♥

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