

# UNLOCKING ENERGY EFFICIENCY AND LONGEVITY IN MINING



**Francesco Giuseppe Lanzillotta, Klüber Lubrication, Germany,**

explains how implementing energy-efficient lubricants in mining operations can enhance sustainability and deliver substantial savings.

**A**s the mining industry faces increasing pressure to reduce operational costs and minimise environmental impact, optimising energy efficiency has become a top priority. However, one often-overlooked contributor to energy loss is friction within essential mining equipment. High loads, harsh conditions, and intense operational demands can cause substantial wear on machinery, leading to higher energy consumption and more frequent maintenance cycles. This is where energy-efficient lubricants – specifically designed to meet the unique demands of mining environments – come into play.

The article explores how energy-efficient lubricants can deliver tangible savings and enhance equipment reliability in mining operations. By switching to these advanced solutions, the global mining industry could potentially save more than

€1 billion annually. From reducing energy consumption and CO<sub>2</sub> emissions to increasing output of mills and lowering total ownership costs, the switch to specialised lubrication solutions represents a smart investment for any mining operation aiming to boost productivity and sustainability.

With years of experience in the mining sector, Klüber Lubrication's expertise in energy-efficient lubrication brings practical solutions to the mining sector. This article will explain how a small change in lubrication can drive big productivity gains, with real-world case studies, potential savings estimates, and guidance on implementing these advanced lubricants in their own operations.

With substantial energy requirements, mining operations often bear the brunt of rising electricity and energy costs. For many mining sites, critical machinery such as crushers,

conveyors, and grinding mills account for a significant portion of operational electricity expenses. As environmental regulations tighten and the demand for sustainable practices grows, the industry is under pressure to adopt energy-efficient technologies that align with standards like ISO 50001 and other energy management certifications.

One often-overlooked area for improving energy efficiency lies in the selection of lubricants. By switching to energy-efficient specialty lubricants, mining operations can reduce electricity consumption, lower costs, and contribute to environmental targets – all while optimising machinery performance under demanding conditions.

## Optimising gearbox efficiency in mining operations

In the mining industry, energy efficiency in critical equipment, such as crushers and grinding mills, can yield significant savings. Gearboxes within this equipment represent a crucial starting point for reducing energy consumption. Large-scale mining mills, including ball mills and vertical mills, often rely on multiple gearboxes to maintain high-load operations. These gearboxes, when inefficiently lubricated, convert much of the input energy into unwanted heat, vibration, friction, and noise, rather than effective grinding.

Grinding remains one of the least efficient processes, with a considerable portion of energy lost to factors beyond actual material reduction. For example, a typical mining mill operating at 5500 kW and running at 90% load for approximately 6000 hr/yr can consume nearly 30 MW annually. At an electricity cost of 10 euro cents per kW/h, this amounts to approximately €3 million in energy expenses per mill each year. Given that mining operations often utilise multiple mills across expansive sites, the cumulative energy costs can be substantial.



Figure 1. Mining mills require significant power but lubricants offer huge potential for energy savings.

Energy saving	Power rating of gearbox (kW)			
	5,000	10,000	15,000	20,000
1%	30,000 €	60,000 €	90,000 €	120,000 €
2%	60,000 €	120,000 €	180,000 €	240,000 €
3%	90,000 €	180,000 €	270,000 €	360,000 €
4%	120,000 €	240,000 €	360,000 €	480,000 €
5%	150,000 €	300,000 €	450,000 €	600,000 €

Table 1. Energy savings – the most common scenarios.

## Practical gains in mining lubrication

In mining operations, a substantial number of facilities still rely on conventional mineral oils for lubricating critical equipment. By transitioning to energy-efficient lubricants, mining sites can achieve an estimated 3 – 4% reduction in energy consumption per gearbox.

Klüber Lubrication has successfully upgraded a range of gearboxes in diverse industries from conventional oils to specialised lubricants, such as the Klübersynth MEG 4, GEM 4N, and GH 6 series. Regardless of the gearbox type, these conversions consistently yielded measurable energy savings.

Typically, mining mills require significant power, with nominal capacities often between 4000 – 5000 kW and oil volumes ranging from 3000 – 5000 l. Klüber Lubrication's experience shows energy savings between 2 – 6.5%, with average results of 3 – 4%. Additionally, energy-efficient lubricants often extend oil replacement intervals by a factor of three to five, reducing the frequency of lubricant purchases and disposal costs, as well as lowering maintenance demands. This level of efficiency can lead to payback periods between three and 20 months, making it a viable investment for mining operators aiming to reduce operational costs and extend equipment life.

## Quantifying savings in mining operations

In a mining mill with a power rating of 10 000 kW and an annual operation time of around 6000 hr, a switch to energy-efficient lubricants can yield estimated savings of 3 – 4% in electricity costs. This translates to annual cost reductions between €180 000 – 240 000, based on an electricity rate of 10 euro cents per kW/h.

Across larger mining sites with multiple mills in operation, these savings can scale up considerably, with potential annual reductions starting from €2 million. Additionally, this can contribute to lowering CO<sub>2</sub> emissions by several thousand tonnes per year, aligning with sustainability targets in the mining sector. Typical payback periods for such efficiency upgrades range from one to two years, often less.

To illustrate these savings further, Table 1 provides examples of potential electricity cost reductions based on various gearbox power ratings and energy savings percentages.

To accurately assess the impact of energy-efficient lubricants, mining operations measure specific energy consumption both before and after the oil change, following standardised protocols such as IPMVP and ISO 50015. This approach ensures a reliable evaluation of the achieved savings and demonstrates the measurable impact of optimised lubrication on both costs and environmental performance.

## Overcoming adoption challenges for energy-efficient lubricants in mining

Despite the clear benefits, many mining operations have yet to adopt energy-efficient lubricants, missing out on substantial cost savings and efficiency gains. On a global scale, widespread adoption of these lubricants in mining could lead to significant financial and environmental savings across the industry.

## **Addressing awareness gaps**

One key reason for the slow adoption is a lack of awareness regarding the savings potential. To address this, it is essential to involve all relevant stakeholders, including maintenance teams, production staff who monitor energy KPIs, and environmental and energy managers. Educating these groups on the direct impact that energy-efficient lubricants can have on reducing energy costs and CO<sub>2</sub> emissions could drive more widespread acceptance.

## **Demonstrating ROI and long-term benefits**

Another factor is the unfamiliarity with the extent of potential savings. Beyond cutting energy costs, these lubricants also enhance wear protection, extending the lifespan of high-cost equipment and reducing total ownership costs over time. However, since these lubricants can be two to five times more expensive than standard options, initial cost concerns often deter decision-makers. Mining operations are encouraged to conduct a thorough return-on-investment analysis per piece of equipment to demonstrate long-term benefits.

## **Verifying savings with standards and protocols**

Additionally, there is sometimes skepticism about whether these savings will materialise in specific mining applications. Therefore, working with a lubricant provider capable of measuring and verifying energy savings is critical. Standards such as IPMVP and protocols like the Energy Performance Contracting (EPC) model can offer assurance, with performance guarantees that align with mining operational needs.

## **Ensuring compatibility with existing equipment**

Lastly, compatibility concerns with existing equipment, including seals and coatings, may create hesitation. To address these concerns, Klüber Lubrication collaborates closely with Freudenberg Sealing Materials through the 'Lube & Seal Partnership,' ensuring optimal compatibility between lubricants and seals. Using OEM-approved lubricants and working closely with providers to assess material compatibility can mitigate these concerns and help ensure seamless integration into existing systems.

## **Innovative payment models for mining efficiency**

The initial cost of energy-efficient specialty lubricants can sometimes be a barrier for mining operators, as these lubricants are often more expensive than conventional options. To address this, Klüber Lubrication has introduced a transparent payment model that shifts the financial risk to the lubrication experts. Through the Energy Performance Contracting (EPC) model, mining clients can pay based on measurable, verified energy savings. This approach allows operators to start with a basic price that may be significantly lower than standard market rates.

## **Starting with an initial assessment**

The process begins with an assessment of the specific equipment and systems where savings can be realised,

followed by an initial measurement of energy consumption and operating variables with the existing lubricant. Using this data, a savings target is set, and energy consumption is monitored at regular intervals, following standards like IPMVP and ISO 50015.

## **Flexible pricing based on verified savings**

Based on the verified savings, a pre-arranged variable price is applied, which remains lower than the market price throughout the contract term. If the savings exceed targets, the cost remains fixed; if no savings are achieved, only the basic price is paid. This model reduces the financial risk for mining companies and ensures they benefit from the efficiency improvements without upfront commitment.

## **A five-step guide to implementing energy-efficient lubricants in mining**

### **Step 1: Choose the right lubricant partner**

Selecting an experienced lubrication provider is essential. Evaluate the available lubricants, verify that they are OEM-approved, and assess the provider's capability for conducting detailed energy analyses specific to mining equipment.

### **Step 2: Identify site-specific savings potential**

Work with the lubrication partner to pinpoint target applications within a mining operation. Select the most suitable lubricant and perform a return-on-investment analysis to gauge potential savings.

### **Step 3: Plan the transition**

Organise the switch to energy-efficient lubricants by prioritising key applications. Select a pilot application, account for any planned equipment replacements or shutdowns, and establish a timeline. Typically, implementing the new lubricant requires only one to two days.

### **Step 4: Run a pilot study**

Conduct an energy efficiency study on the pilot application to demonstrate the savings potential. This internal proof of concept can be instrumental in gaining support for broader implementation.

### **Step 5: Scale the success**

Apply the successful results from the pilot to additional equipment, maximising CO<sub>2</sub> reductions and electricity cost savings across the operation.

## **Conclusion**

The use of energy-efficient lubricants can increase energy savings and enhance equipment reliability at the same time. For companies in the mining industry, a switch to advanced product solutions – such as Klüber Lubrication's – offers a great opportunity to reach new levels of energy efficiency and machinery longevity. On a global level, the mining industry could even save more than €1 billion annually, and also contribute immensely to sustainability targets. **GMR**