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Mozambique Domgas
Mining

Natural gas, when liquefied into LNG (Liquefied Natural Gas) or compressed into CNG (Compressed Natural Gas), can be used to replace diesel as fuel to power large mining equipment. By increasing the energy density of natural gas though conversion to LNG or CNG, it becomes ideally suited for this type machinery. Other applications, particularly for remote operations, include replacing diesel driven power generation with natural gas.

As discussed in our introductory piece to this series on applications of **introductory piece**, the LNG developments will have a significant impact on the potential for southern Africa as a whole. The possibility of reduced energy costs will open significant opportunities for many industries, and the first one that we will explore in further detail is Mining.

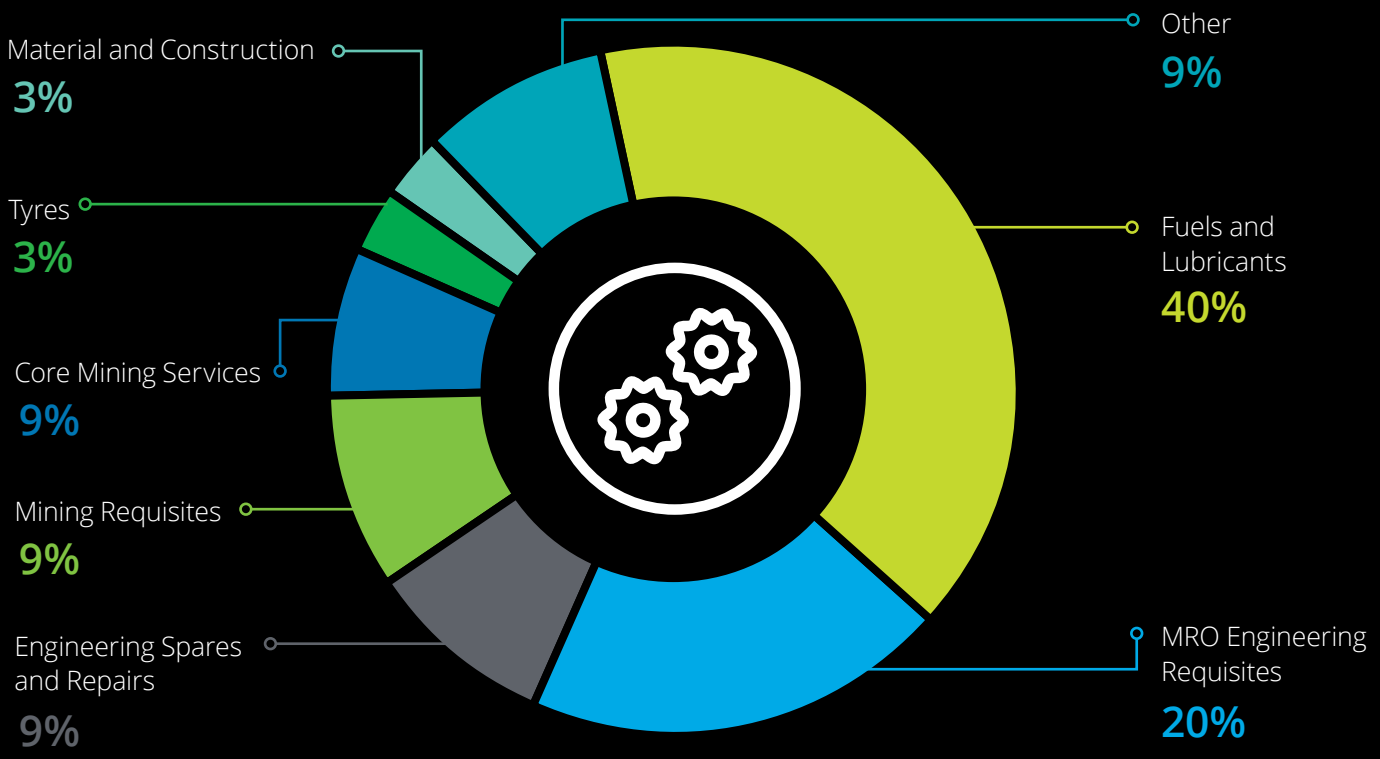
For the mining sector, the change in the southern African energy landscape caused by the Mozambican natural gas disruption will not initially seem to matter much; however, the expected future increases in the electricity consumer tariff across the region will have a significant impact on the sector. This will especially be the case for deeper operations (where energy is a significant component of the cost structure) and in the processing plants that convert raw materials into sellable products.

Currently, open cast mining is not a large consumer of electricity or of natural gas, but it does consume large amounts of diesel fuel. Open cast mining may be one of the biggest opportunities that the new natural gas and LNG landscape will open up.

Mining companies looking to reduce costs and greenhouse gas emissions have been left with a difficult challenge. Open cast mining equipment is difficult to electrify due to the mobile nature of the operation. Powering this equipment takes enormous amounts of energy. For decades, diesel has provided this energy because of its high energy density, perfect for mobile equipment. Until recently, few alternative options were available to provide this power. Switching from diesel to natural gas is beneficial both from a cost perspective and a greenhouse gas emissions perspective.

Diesel-powered equipment is used in open cast mining for drilling, loading and hauling material. The majority is used by haul trucks to move ore and mine waste. Mine pit depths vary from tens of metres to hundreds of metres with haul trucks loading hundreds of tonnes per round-trip. As a result, fuel and lubricants can account for about 40% of the operational spend for a typical mine.

Sample of the Operating Cost Breakdown for an open cost mine in southern Africa



So, how could LNG reduce this cost? Engines running on LNG have a 15% improved thermal efficiency compared to equivalent diesel engines[1]. In addition, when comparing cost of delivered fuel (delivered to the mine), LNG gains an even bigger advantage. Diesel costs around $11.62 to $14.11 per GJ while LNG costs between $1.90 - $2.84 per GJ in global spot markets. Our estimates indicate that future prices of LNG delivered to the end client could be between $5.80 and $8.74 per GJ[2]. Combining efficiency improvements (15% improvement), unit energy cost reductions (50% reduction) and the relative contribution of a mining operations overall spend (40% of total operating cost), this presents a significant opportunity.

From an emissions perspective, changing to 100% LNG (from diesel) represents a reduction in tailpipe GHG (Greenhouse Gases) emissions, 25% reduction in carbon dioxide (Co_2), 80% reduction is nitrogen oxide (NOx) and a 97% reduction in carbon monoxide (CO)[3].

So, what are the hurdles in converting a mining operation from diesel to LNG? While at a unit price, LNG is significantly cheaper than diesel, there are some challenges to overcome, namely supporting infrastructure and power unit conversion.

Source: [1]Iveco, [2]Deloitte Analysis

Converting mine haul trucks to run on natural gas can be done with available technologies. There are fully integrated, field-installed systems which include onboard LNG fuel storage and all required hardware, allowing for a combined LNG and diesel operation. In-field installation takes about 6-8 hours per truck. New engines that run only on LNG can also be procured. Diesel Displacement Rate (DDR) for converted engines will vary according to the specific haul profile and duty cycle of the vehicle with higher displacement rate at higher loads. Equipment converted to dual fuel (LNG + diesel) exhibit diesel-like performance in critical areas such as power, response and efficiency. In addition, the dual fuel vehicles allow mining operators to switch back to only diesel use if LNG supply is interrupted.

LNG requires specialised infrastructure to be able to store, handle and transport it. The major infrastructure hurdle required for southern Africa is the facility to move imported LNG from ship-based transport to land-based storage. This is one of the reasons for the delivered price being almost double the spot price, making the challenge to reduce delivery costs.

The unit cost to import and transport LNG lowers significantly as volumes increase and as the high costs of infrastructure required to offload LNG from ships is diluted. Various options are available that could address this cost; using small-scale LNG technologies, collaboration amongst potential consumers to share infrastructure or alternative transportation solutions (e.g. Cryogenic Tank Containers). Mining operations looking to switch fuels will need to consider these transport costs and the security of supply options in their respective business cases.

Existing mining equipment cannot be scrapped overnight. Over time, power units can be replaced with original equipment manufacturer (OEM) units designed to be fuelled with natural gas, while existing diesel-powered equipment can be converted using conversion kits. Many OEMs already supply conversion kits for existing equipment.

South African annual fuel consumption*

Diesel 12,783,148,691 litres

Petrol 10,894,888,211 litres

*Year to June 2019

As discussed, converting mining equipment to run on LNG has many benefits. The most significant of these are reduced operating cost and emissions. All technologies required to implement these changes have been tested and are at a sufficient maturity level to allow large-scale adoption now.

While natural gas vehicles have a higher initial cost, the fuel savings offered can mean payback periods of a few years. With incentives, this could even be reduced further. It is recommended that businesses do a baseline of their current energy consumption using traditional fuels and the tax costs associated with these legacy technologies (i.e. establish a cost base). Payback timing will depend on vehicle type, fuel consumption and annual mileage. Early movers could reap significant benefits.

Source: [3]Elengy

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