Unearthing the carbon footprint

While the emissions profile of detonating explosives contributes to less than 1% of mine-site greenhouse gas emissions, using advanced blasting technologies has the potential to reach emissions intensities targets. And it helps to significantly increase profitability. Orica Global Based Blast Services Manager Angelo Labriola writes.

With the upcoming introduction of the Australian Government's Carbon Pollution Reduction Scheme (CPRS) in 2010, there is now a greater urgency placed on identifying and delivering changes to reduce energy usage and Greenhouse Gas (GHG) emissions.

The mining industry has not been slow to respond to this, and many energy efficiency initiatives have already been undertaken.

Understandably, these have targeted the 'low-hanging fruit' first, including targeting unnecessary energy usage with items like motors and compressors.

GHG intensity

It is common amongst mining companies to track and report total energy usage, but most use GHG intensity as a key performance metric.

Several factors have combined to increase total energy use and emissions, including increased stripping ratios, greater mining depths (meaning longer hauls), lower ore grades and increased production.

A key measure, therefore, has been energy efficiency and targets have been set for the reduction of emissions per unit of metal/coal mined.

Unfortunately, in many cases these efficiencies and/or intensities have also increased, due to increased stripping ratios, lower grades, etc. and it will be a considerable challenge for mining companies to meet such targets.

Emissions of various GHGs are expressed in equivalent tonnes of carbon dioxide (CO_2-e).

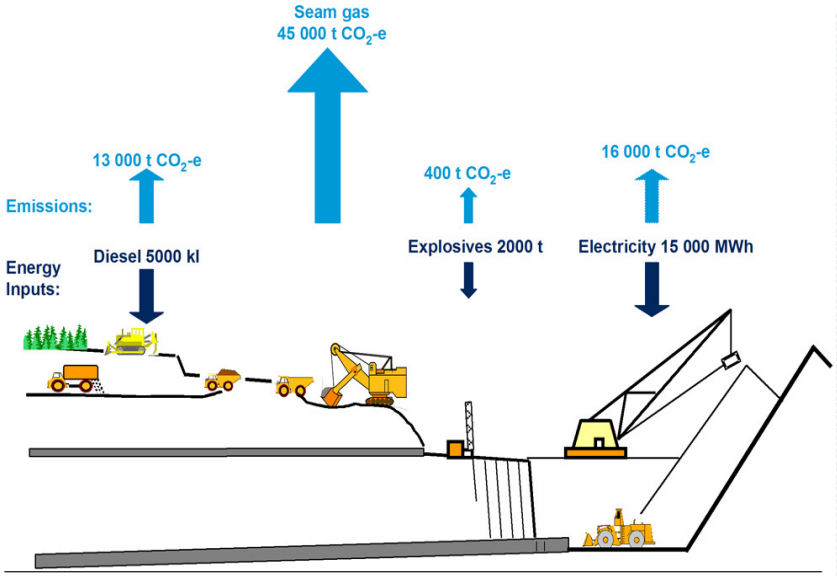

Figure 1: *Example coal mine energy and emissions per tonne of coal ex-pit for a 7:1 stripping ratio dragline operation.*

Explosives and blasting

Formulation and composition changes to commonly used modern bulk explosives result in very little variation of GHGs produced on detonation.

Major changes in GHG intensity can be realised in the ammonium nitrate manufacturing process, but this does not impact mine site blasting emissions.

To contextualise the impact of explosives GHGs relative to other mine emissions, let's examine example energy and emissions profiles from an open pit coal mine (Figure 1) and an open pit metal mine scenario.

Around one million tonnes of base metal ore mined produces about 200 tonnes of CO_2-e from explosives detonation versus 32,000 tonnes of CO_2-e from diesel and electricity usage.

Much worse is a coal mine (Figure 1), as methane seam emissions need to be reported as well, and this is source of the majority of CO_2-e emissions.

In this case, one million tonnes

of coal produce about 400 tonnes of CO_2-e from explosives detonation versus 74,000 tonnes from diesel, electricity and seam gas emissions. From the above figures it's clear that changes to the emissions profile of detonating explosives is impacting less than 1% of the problem.

Even if the GHG emissions from detonating bulk explosives could somehow be reduced by half, the impact on mine GHG intensity would be in the order of 0.5% or less. So far, there's not much to celebrate.

The up side, though, is that the rock breakage process is near the beginning of the mining cycle, therefore, the optimised usage of explosives products and their capabilities has the ability to significantly impact the downstream emissions profile. Most mining companies are setting aspirational targets of reducing GHG intensities in the order of 5% to 8%.

Open pit coal mining

In open pit coal mining, coal losses through the drill, blast and dig process results in losses from 5% to 25% of in-situ coal.

While maintaining control of the roof of coal when blasting is one of the main challenges, the most significant blast-related problem is coal edge losses.

Another challenge in open pit coal blasting when a dragline is involved is minimising the amount of material that the dragline needs to move to uncover coal. Often this is pursued by maximising cast to achieve the final spoil profile.

If less overburden material needs to be moved, then either less energy is used to uncover a given amount of coal, or conversely, a reduced energy (and therefore emissions intensity) profile can be achieved by uncovering more coal for the same energy and emissions profile.

Similar cases prevail for truck/shovel fleets, particularly when dozer assist is required.

Orica's Blast Based Services (BBS) are targeted at either exposing more coal for virtually the same amount of energy used, or conversely, maximising coal recovery for the same amount of energy consumption.

This can assist in reducing GHG intensity and improve the profitability of the mining operation.

Different impact scenarios are examined in Table 1.

In Table 1, mines that are unable to sell or move more than a fixed amount of coal per annum fit into the fixed coal production per annum category.

Site Condition	BBS Capability Examples	Reduction in GHG Intensity (%) per tonne of coal	Margin % Improvement	Margin Improvement per 1 M tonne of coal (@US$40/t)
Fixed coal production per annum	6% increased throw	0.6%	0.06%	A$37,500
	6% increased throw +10% improved recovery	10.6%	1.8%	A$1,125,000
Increased coal production	6% increased throw	5.7%	6.0%	A$3,750,000
	6% increased throw +10% improved recovery	14.8%	16.0%	A$10,000,000

Table 1: *Examples of the impact of Orica's BBS on GHG intensity reductions (excluding seam gas emissions) and corresponding estimated impact on margin per 1 million tonnes of coal mined. The analysis assumes a US$40/t margin.*

Open pit metal mines

The big driver of emissions generation in open pit metal mines is the comminution process. Often, this accounts for 60% of total mine energy usage.

BBS aim to contribute to the reduction or risk management of GHG intensity through blasts producing improved fragmentation for higher mill throughput, reduced ore dilution and minimising the blasting impact on pit walls, thereby reducing risk of changes to wall design impacting strip ratio.

While many energy saving initiatives undertaken by mines are delivering results, changes in blasting techniques using BBS can help provide GHG intensity reductions within or beyond the target range of many companies. This comes with the potential for significant profitability benefits. Orica's Blast Based Services provide a framework of customer engagement and analysis that maps the benefits possible through introducing tailored technological solutions.

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