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The Alchemist

Decarbonisation

The Mining and Metals Industry Reaction – Is It Smoke and Mirrors?

Introduction

Recent shifts in investor sentiment towards carbon intensive industries are leading to a significant re-allocation of capital, a trend which is being accelerated by climate activism. As an energy intensive industry, mining and metals companies are evaluating their portfolios and future strategy in light of a carbon constrained future. The primary actions to date involve stating ambitious emissions targets such as 'net zero by 2050' or '30% reduction by 2030'. Now that such ambitious goals have been set, how will mining companies achieve them?

Companies targeting such reductions have yet to set out a strategic and actionable roadmap for achieving these targets. This is understandable to an extent as technology advances (or regulatory changes) may change the optimal decarbonisation path. However, there appears to be a lack of disclosure around the current opportunities available and how they are assessed. Industry analysts generally expect a company to substantiate their strategy for increasing production, so why does the market appear to be satisfied with unsubstantiated emissions reduction targets?

This issue of *The Alchemist* will provide a critical analysis of the levers available to the mining and metals industry to reduce emissions and shed some light on the path which the industry has chosen thus far. A high-level overview of emissions, carbon pricing and assessing abatement opportunities is also provided.

Emissions Overview

Emissions are defined by their source, and are reported in three categories:

- Scope 1 – direct emissions from owned or controlled sources
- Scope 2 – indirect emissions from the purchase of electricity
- Scope 3 – all other indirect emissions that occur in the value chain of the company (but not under their control), including upstream and downstream emission

Approximately half of mining and metals industry emissions are Scope 1 with the other half being Scope 2. It is important to note that if a mine site produces its own electricity this falls under Scope 1 and if it purchases electricity this comes under Scope 2.

It is generally up to the company to outline the basis for the preparation of their emissions reporting, including the methodology used. These may be reported in accordance with a global standard or guideline, such as the World Resource Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol. Calculation methodologies are generally built up from first principles within a defined emissions boundary, which may be legislated depending on the jurisdiction (in Australia this is legislated under the National Greenhouse Energy Reporting Act 2007). Most sustainability reports are audited with an assurance statement, often from an accounting firm accompanied with a disclaimer of "Limited Assurance". Issues can arise with double counting of specific emissions reductions and/or carbon offsets (e.g. when reported both by the electrical utility and the electrical consumer) and this inconsistency remains a common criticism of emissions reporting.

It's important to distinguish between absolute emissions and emission intensity. For the purposes of comparing relative performance and tracking reductions, emissions intensity can be more useful as it indicates operational improvements reducing energy intensity and removes the impacts of changes in product volumes (say as a result from asset acquisitions or divestments).

Commodities have varying emissions intensity which is highly correlated to the power intensity required for processing. It's no surprise that aluminium and copper have the highest emissions intensities due to the high level of energy required for smelting (aluminium) and crushing/grinding (copper). Other energy intensive commodities include nickel processing (in particular nickel laterites) as well as refractory gold ores. Most bulk commodities have low emissions intensity, mostly from diesel use, except in the case of coal where fugitive methane emissions can be significant.

The wide range of emissions intensity within each commodity is linked to operational drivers such as deposit grade (lower grade requires additional processing for the same unit of output), mining method (selective vs. bulk methods) and ore body mineralogy (determines grind size and required energy input). Furthermore, differences in the local grid emission intensity will be a major driver for most operations. For example, sites located near ample hydroelectricity sources will have lower Scope 2 emissions when compared to sites connected to a grid dominated by coal-fired generation.

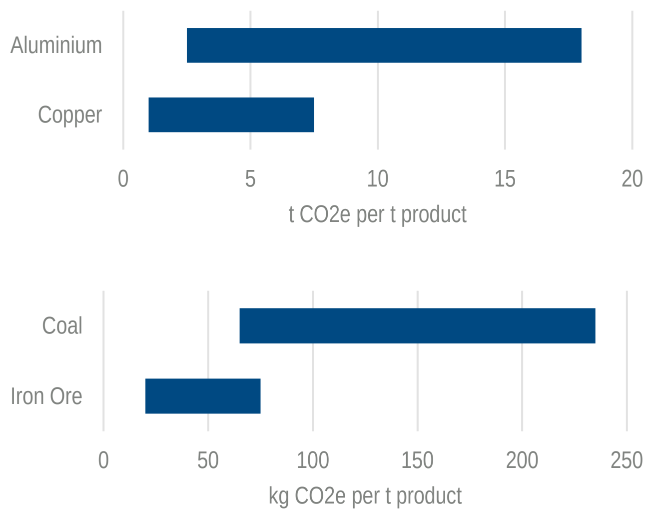


Figure 1. GHG emissions intensity by commodity. Source: ICMM, 2013

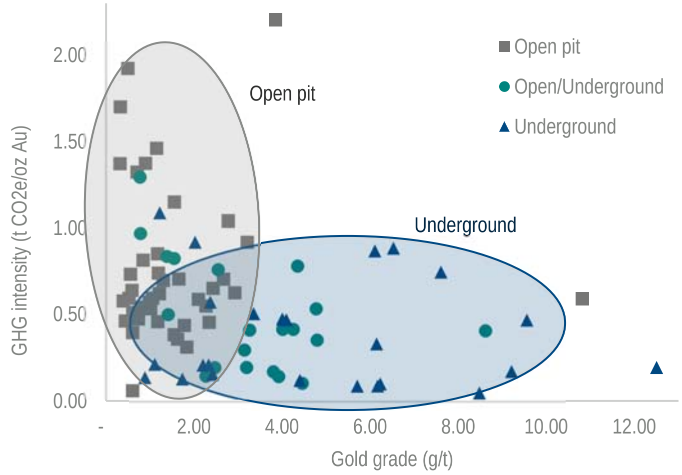


Figure 2. Gold mine GHG emissions intensity vs. grade and mining method. Source: SNL

Carbon Pricing Background

A carbon price is any cost applied to GHG emissions and can be present in many forms as shown in the table below. Carbon pricing policies are usually price based (taxes) or quantity based (emissions trading); hybrid versions of each method exist. Each mechanism comes with certain advantages and disadvantages with varying levels of government oversight and administration required.

Table 1. Overview of carbon pricing mechanisms

Mechanism	Description
Carbon Tax	• Price based policy where the regulator sets the price of carbon emissions directly ($/t CO_2e) • Can be taxed at the source of emissions, or upstream of the source
Cap and trade systems or Emission Trading Scheme ("ETS")	• An emissions cap is set and a number of permits corresponding to that cap is provided to industry • The permits can be either auctioned off (generates revenue) or administratively distributed (given away for free) • Emitters must surrender permits to cover their emissions or face a penalty • Permits are permitted to trade freely and can be banked • In some jurisdictions, permits can be created (and sold) if a technology has negative or zero GHG emissions • Hybrid designs exists with ceiling and floor carbon prices
Baseline and credit approach	• Baseline emissions are determined for each sector, usually on an intensity basis • Participants earn credits for exceeding the baseline and surrender credits if they fall short • Credits are permitted to trade similar to an ETS
Offset or project-based mechanisms	• Similar to the baseline approach, but applied at the project level – e.g. comparing a wind power project to a coal fired power plant • Credits are permitted to trade similar to an ETS

The purpose of any carbon pricing mechanism is to reduce GHG emissions, a negative externality which is not priced into the market. A good carbon pricing mechanism should drive implementation of the lowest cost GHG abatement technologies from left to right across the carbon marginal abatement curve up to a theoretical expected carbon price. Subsidies for both GHG emission reduction technologies and fossil fuels distort the mechanism. A good pricing mechanism should remain technology and sector agnostic.

Carbon abatement curves can be constructed at any level - national, industry or company-wide. In theory, each company has their own carbon abatement curve, reflecting the emissions reduction available to them at a specified cost.

Setting a shadow or explicit carbon price will provide a corresponding volume of GHG abatement. Alternatively, if an absolute volume of emissions is targeted then the corresponding cost to achieve the desired abatement volume is known.

61 carbon pricing initiatives currently exist worldwide as of 2020, covering 12 Gt CO_2e or around 22% of global GHG emissions – a significant increase from approximately 5% in 2010. Despite increased adoption, 50% of emissions covered are priced below US$10/t CO_2e. Price comparisons are not necessarily meaningful, differences exist due to sectoral coverage, allocation methodology and exemptions.

A common international carbon price has been in existence since the 1997 Kyoto Protocol was introduced, which only applied to signatory countries. Various mechanisms exist to aid in the creation of cross-border carbon markets, the most successful was the Clean Development Mechanism ("CDM") which supported US$90bn in GHG emissions reduction projects in developing countries through 2014. Unfortunately, the CDM has since suffered from an oversupply of credits and a trend toward agreement of international carbon pricing has since ground to a halt. Article 6 of the Paris Agreement was proposed to set out the framework under which cooperation would be achieved between nations, however, agreement cannot be reached on key issues including double counting of emissions, treatment of surplus credits from the CDM, and other legacy Kyoto Protocol mechanisms.

Differences between carbon prices and sectoral coverage can lead to material variations in the relative competitiveness of mining and mineral assets, particularly for emissions intensive commodities such as aluminum, copper and nickel. Whilst downstream processing can be relocated, the orebody will always be constrained by its jurisdiction and, without additional capital, the prevailing local energy generation mix.

Another related concept is internal carbon pricing or shadow carbon pricing; whereby a company sets an internal price for GHG emissions when considering future projects. Several mining companies have adopted this approach to date.

Table 2. Examples of shadow carbon pricing in mining and metals industry. Source: Company reports

Company	Carbon price (US$/t CO_2e)
BHP	$24/t, up to $80/t by 2030
Newcrest	$25 - 50/t
Newmont	$50/t
South32	$25/t from 2025
Vale	$50/t

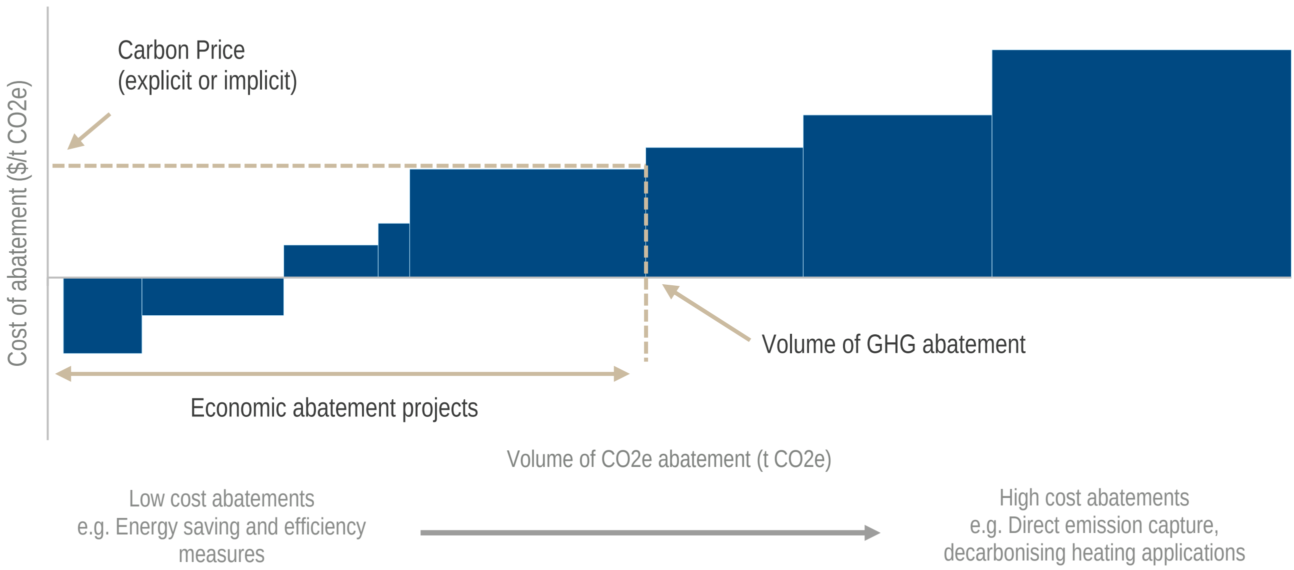


Figure 3. Theoretical carbon marginal abatement cost curve - carbon prices and abatement mechanisms

ISSUE
38
September 2020

The Alchemist

How are Mining companies reducing reportable emissions?

There are several approaches the Mining and Metals industry can take to reduce reportable emissions (Scope 1 and 2), an overview is shown in Table 3. Fundamentally, the measures all relate to energy – elimination, reduction, substitution, offset or capture.

Abatement opportunities available to an individual company will vary widely and depend on multiple factors, such as operational characteristics and local electricity generation. There is also a degree of interplay between various abatement options making it difficult to accurately determine where a specific abatement project sits within a company's or industry's marginal abatement curve.

However, we can make high level comparisons of the relative difficulty of implementing competing abatement projects, abatement potential or size, and associated costs. Further, we can assess whether an abatement project requires fundamental changes at the operational level (addressing operational and reportable emissions), or whether the measure comprises a corporate transaction or contractual arrangement with no operational impact (addressing reportable emissions only). This dynamic largely drives how difficult a given project is to implement.

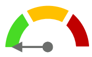
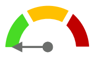
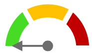
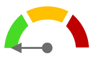
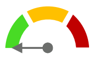
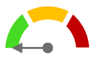
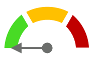
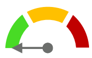
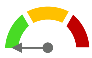
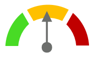
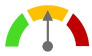
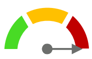
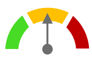
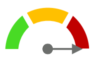
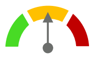
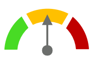
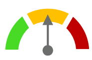
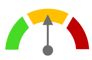
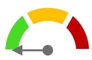
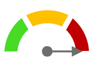
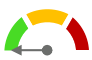
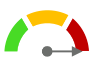
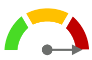
Divest high emission assets

Readers will no doubt be aware of the popular move to divest thermal coal assets and other GHG intensive assets in recent years. The trend has been driven by the rise of ESG activism encouraging the divestment of fossil fuel assets from mining company portfolios. This is a relatively easy abatement measure which can be completed without disruption to core operations. Divestments also have the added benefit of freeing up capital, making them relatively attractive. We do expect that any divested assets will continue to operate, however, simply transferring the emissions "ownership".

Table 4. Recent GHG intensive asset divestments. Source: SNL, RFC Ambrian analysis

Seller	Announced/Completed	Proposed
Anglo American	Drayton, Dartbrook, Callide, Eskom-tied coal operations, New Largo	South Africa thermal coal
BHP	South32	Mt Arthur, Cerrejon, BMC
Rio Tinto	Coal & Allied, Hail Creek & Valeria, Kestrel, Bengalla	-
South32	South Africa Energy coal	-

Table 3. Typical abatement opportunities for mining and metals companies

Abatement	Driver / Source	Implementation difficulty	Abatement size/potential	Cost - capex	Cost - opex	Comments
Divest Assets	Corporate					Capital returns, low cost
Procure renewable energy	Contractual					Abatement potential and operating costs depend on local grid
Procure carbon offset credits	Contractual					Operating costs depend on credit cost
Self-generate renewable energy	Operational					Depends on amount displaced and power source access
Fuel switching & electrification	Operational					Depends on scale/type and generation source
Efficiency and process changes	Operational					Depends on scale/type and generation source
Emissions capture	Operational					Depends on scale/type

Renewable energy procurement

Mining companies have been rushing to execute renewable Power Purchase Agreements ("PPAs") with utilities to supply up to '100%' of their power needs. Generally, these involve a utility providing 'accredited' renewable power to a mine site over a long term (10+ years). As the renewable power is accredited (sometimes by a third party), the mining company can claim a significant reduction in reportable Scope 2 emissions. The decision to enter into a PPA can be made by corporate and senior site personnel and does not require any capital commitment or operational changes.

The ability to enter a renewable PPA is reliant on sufficient renewable generation within the local grid. Mining companies can sign PPAs directly with a single renewable power project or more commonly with a utility who owns a portfolio of renewable and other generation assets. These PPAs are almost always 'virtual', 'synthetic' or 'financial', in the sense that the energy produced by the renewable project is not directly consumed and sold to the buyer. Under a virtual PPA, the source of the electricity consumed remains the same (i.e. the mix from the local grid) but is synthetically accredited as renewable from sources elsewhere in the grid. The renewable power project will sell the generated energy into the market and a separate agreement, usually a contract-for-difference is agreed where the buyer will pay a fixed price to the renewable power project. This differs to a physical PPA which requires a dedicated connection to the renewable project. Consequently, the buyer does not have the benefit of supply security from the grid as a whole and is instead directly exposed to variability of the load profile and inherent intermittency of most renewable sources.

The PPA market is increasing in complexity, key items including the allocation of risk and benefits associated with the project in addition to the load profile and any residual load requirements. Renewable PPAs can help underwrite the financing and construction of a renewable project and thus support an increase in renewable generation.

The practice of signing renewable PPAs has been particularly prevalent in Chile since 2019 when the northern Chilean grid (dominated by coal and gas fired generation) was connected to the southern grid (significant hydroelectric generation). The connection of the two grids enabled some of the largest copper mines in Northern Chile (Atacama, Antofagasta and Tarapacá regions) to sign virtual PPAs with utilities to cover up to 100% of their power needs from renewable sources. The sources of renewable power for these PPAs are rarely mentioned, largely because the mine site continues to consume electricity from the local grid which is generated with fossil fuels – with the utility assigning renewable generation from elsewhere in their portfolio. Asterisked sites in Table 4 disclosed the source of power and contributed to underwriting a specific renewable project.

Table 5. Chilean mines - announced renewable PPAs. Source: Company announcements, RFC Ambrian analysis

Site / contract	Supplier	Size	% of power	PPA length	Start year
Escondida/ Spence 1	Enel	3 TWh	Not disclosed	15	2021
Escondida/ Spence 2	Colbun	3 TWh	Not disclosed	10	2022
Collahuasi 1	Enel	1 TWh	100%	10	2020
Collahuasi 2*	Sonnedix	150 GWh	12%	Not disclosed	Not disclosed
Anglo American (multiple sites)	Enel	3 TWh	100%	10	2021
Centinela	Engie	Not disclosed	100%	11	2022
Quebrada Blanca	AES Gener	118 MW	50%	20	2022
Candelaria	AES Gener	1.1 TWh	Not disclosed	18	2023
Zaldivar	Colbun	550 GWh	100%	10	2020
Minera Antucoya	Engie	300 GWh	100%	11	2022
Los Pelambres*	Pattern Energy Group	104 MW	Not disclosed	22	2014
Los Pelambres*	Javiera	70 MW	Not disclosed	20	Est. 2015

*Indicates PPA contributed to underwriting a specific renewable project

Given the limited supply of renewable generation in a given electrical grid, the system rewards those who are first to sign renewable PPAs, particularly hydroelectric. Whilst this can create a market signal to construct new renewable projects and lead to change in the long run it has several issues in the short-to-medium term:

- Addresses only reportable emissions, not operational emissions of the power the mine is consuming – synthetically allocating renewable and non-renewable generation across the grid (notable exception: where fossil fuel fired generation is directly decommissioned)
- Can lead to double counting in emission reductions if the utility and the mine site both claim the reduction
- Ignores the fact that the mine site continues to enjoy positive externalities afforded by coal and gas-fired generation within the grid – dispatchable, reliable power

Arguably it is the job the network regulator, government, and utilities to concern themselves with the mechanism above. The practice of signing renewable PPAs clearly enables miners to report outsized reductions in emissions and achieve their reduction targets with relative ease. This diminishes the need to critically analyse the drivers of operational emissions at the site level and reduces the priority of searching for and implementing new technologies to fundamentally reduce GHG emissions at an operational level.

Carbon Offset credit procurement

Carbon offsets are a useful market mechanism, generally reflecting the lowest marginal cost abatement option available in the broader market. Carbon credits are generally created from carbon abatement projects, examples include capture of fugitive methane emissions, reforestation, savanna fire management or general emission reduction projects. Australia's voluntary Emissions Reduction Fund is an example of a carbon offset scheme – an Australian Carbon Credit Unit ("ACCU") is created for each tonne of CO_2e stored or avoided by a project. These ACCU's can then be sold to the Australian government or to the secondary market.

Procuring carbon offsets has a similar impact to renewable energy procurement but may enable the miner to offset Scope 1 emissions as well. The important distinction is that carbon offset procurement generally incurs a greater cost than renewable energy procurement and hence its use by mining companies has thus far been limited.

If the cost of abatement exceeds the cost of carbon offsets, purchasing offsets is a prudent economic decision. For example, certain industrial processes do not have access to sufficiently mature technologies which can replace fossil fuels - steel production is an excellent example requiring coking coal. If a mining company chooses to procure carbon offsets, we believe it is important they focus on direct involvement with abatement projects relevant to their industry or within their supply chain to stimulate innovation within the sector. In turn this will assist in reducing the cost of abatement for difficult processes, such as steel production in the medium-long term. If selecting lowest cost abatements outside of the mining industry (such as savanna fire management) carbon offsets offer a convenient mechanism for companies to avoid studying their own carbon abatement opportunities while reducing reportable emissions.

Process improvements

The mining industry has a reputation for slow technology adoption (average is roughly 10-15 years), thus it is no shock that innovative process improvements to reduce operational emissions have not featured prominently to date. Process and efficiency improvements by their nature result in operational changes and are generally accompanied by some upfront capital and initial loss in efficiency during implementation, providing multiple reasons to overlook such initiatives. This is despite recent technology advances which facilitate positive flow-on effects which further enhance economics and sustainability benefits. For example, bulk ore sorting and coarse particle recovery can also reduce water use and increase production rates at operations with fixed plant capacity. Specific innovations are multiple in number - we have previously covered various process improving technologies in our New Technology & Innovation report series https://www.rfcambrian.com/index.php/category/new-technology-innovation-series/

Fuel switching

Fuel switching may include converting a diesel mining fleet to LNG, biofuels, synfuels, hydrogen or battery powered vehicles. Fuel switching is at varying stages of technology readiness and generally involves large capital outlay and may require an increase in operating costs. LNG and dual fuel haul truck conversions have existed for around 10 years (trolley-assist – see below - having been around considerably longer). Declines in the oil price since 2015 have dampened the operating costs savings and thus the economic case for these conversions, resulting in slow uptake by industry with few operating examples. EV take-up in underground mining operations has emerged following improvements in battery technology. Electric shuttle vehicles were first utilised by the underground coal industry for the purpose of reducing particulate emissions, thus easing ventilation requirements. Hardrock underground mines can now decarbonise via electric loaders, jumbos and haul trucks offerings from Caterpillar, Sandvik and Epiroc.

Fuel switching for mining fleets requires new infrastructure, is likely to be more expensive than diesel, and may disrupt operations. The application of EV's in mining to date is largely concentrated in newer underground mines, including Resolute's Syama and Newmont's Borden Lake. The reduced ventilation requirements for EV's can materially improve economics, particularly for deeper operations which can be constrained by ventilation.

Hydrogen, biofuels and synfuels are still very early in their commercialisation, although we note pilot programs are beginning to emerge and offer a potential pathway to completely decarbonise material transport emissions.

Electrification

Electrification of operations is also starting to gain momentum - for example, the implementation of trolley haulage systems for haul trucks, particularly on uphill hauls such as that used in First Quantum's Kansanshi operations. If the operation has already procured all their power from renewable energy this may lead to an easy and significant reduction of Scope 1 emissions by converting them to Scope 2. The focus should remain on the efficiency of the conversion to ensure energy intensity is not increasing and being shifted to elsewhere in the economy.

Figure 4. First Quantum's Kansanshi open pit haul truck. Source: Hitachi

Heating applications are significantly more difficult to electrify, especially the production of steam for use in high pressure or high heat processes like those used in alumina processing. Steam for these processes is generally produced using HFO, coal or gas fired turbines. Abatements for heating are difficult, generally involving low volume efficiency improvements, converting to natural gas or upgrading existing plant and equipment to capture additional waste heat for cogeneration. High volume abatement options to produce heat are currently limited, with concentrated solar/ thermal solar forming the main viable low-emission alternative, albeit coming at a significantly higher cost.

Self-generation

Self-generation of power using lower emission sources is becoming more prevalent and there are multiple operational examples which are beginning to increase in scale. It is generally applicable to remote operations which are not connected to the local grid (and thus cannot simply procure renewable energy via a virtual PPA) and have a long mine life.

Renewable self-generation usually involves a hybrid installation using a solar PV system or wind turbines with a diesel/gas fired generator and sometimes battery storage capacity. Miners can expect in the order of a 20-50% reduction in power generation emissions depending on the size of the installation and quality of the renewable resource. Whilst less impressive than claiming "100% renewable" via renewable PPA's, these operations are arguably making a greater relative impact by immediately displacing emissions rather than shifting them elsewhere. Notable examples include: FMG's hybrid 150MW Solar PV, 150MW gas fired generation and battery at their Pilbara operations (in construction) as well as Sandfire's 10.6MW solar PV installation,18MW gas fired generation and battery at DeGrussa.

Switching to self-generation from coal or diesel fired to natural gas (potentially via LNG trucking) is another viable option available to remote sites, particularly where renewable generation is not feasible and access to the fuel source is viable.

Emissions capture

Fugitive methane emissions form most emissions from coal mines, in particular those operating within gassy seams. Coal seams with high methane content pose a safety risk; the practice of degasification prior to mining is well established. Using Waste Coal Seam Gas ("WCSG") for gas fired power generation has become an established practice in Australian coal fields with sufficiently gassy seams. Such projects usually have good economics, as the mine can utilise the WCSG to generate power. Future implementation is focused on further reducing fugitive WCSG, including utilising or flaring methane which occurs in lower concentration WCSG processes, such as ventilation exhaust or in goaf gas drainage. Due to the low concertation of methane in these WCSG processes, the ability to generate power to offset costs requires additional processing and compression – adding both capital and operating costs.

Carbon, Capture and Storage ("CCS") has been proposed as a solution to fossil fuel emissions for decades. The technology is proven and operating but due to large capital requirements, there are few working examples to date. In areas where a market exists for CO_2 (for example enhanced oil recovery or carbonated beverages), associated transport infrastructure is already well established. A global carbon price (with a stable political outlook) will likely improve the economics of such projects in the future and enable mining companies to directly decrease emissions within their supply chains.

The Challenge

It is logical for mining companies to chase the easy abatements, or lowest hanging fruits when it comes to emissions reduction. However, at some point, mining companies will move up the abatement curve and future emissions reduction targets will become more difficult to achieve without a step change in technology.

Abatements projects to date have occurred predominately at a corporate level and involve the divestment of assets or a reduction in Scope 2 emissions. The greater challenge now lies in driving change at an operational level and broadly driving down Scope 1 emissions.

Declining ore grades worldwide will increase power and water intensity per a tonne of final product produced using current technology. This potentially also squeezes margins further deterring abatements projects that come with additional upfront cost or (real or perceived) implementation risk. Setting aside mine sites fortunate enough to switch to renewables at a low cost, industry will need to implement a series of technology advancements to overcome declining ore grades just to maintain current emission intensity levels, before attempting the more ambitious goal of reducing emissions intensity.

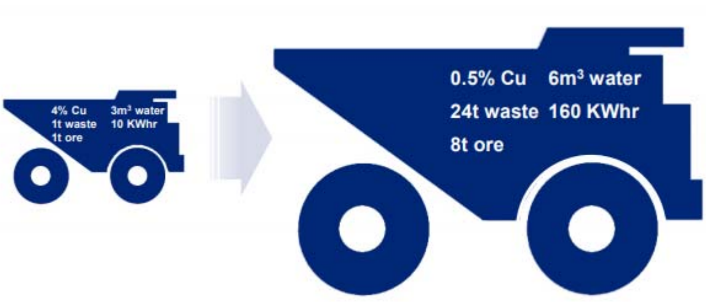


Figure 5. Impact of decreasing grades on resource intensity, 1900 vs. today. Source: Anglo American

As the easy abatements dry up, we expect a move to electrification by major mining companies in order to leverage off virtual renewable PPAs (where applicable). We hope these electrification initiatives do not take the focus away from process improvements nor result in increased energy intensity all in the pursuit of meeting reportable emission reduction targets.

The opportunities for miners are immense – access to green bonds and loans can decrease borrowing costs and therefore a miners' cost of capital. Whilst still in their infancy, green commodities might enable miners to differentiate their products and receive a premium price.

Conclusions

The industry needs to take responsibility and look inward to reduce operational emissions via reductions in energy (and water) intensity within their supply chain. Signing renewable PPA's to achieve reductions in Scope 2 emissions and divesting high emission assets simply shift these emissions to other external parties, or more broadly to society at large in the short-medium term. This is not to say existing market mechanisms are useless, they are excellent for the broader economy to stimulate low cost abatement technologies. Instead, we would challenge miners to consider how they look at their own emissions and supply chain. The existing framework of managing reportable emissions instead of operational emissions is a case of 'what gets reported gets managed'.

Without this change in mindset, the industry will remain complacent, targeting easy abatement wins and "shifting" the burden instead of tackling real abatement challenges.

We are starting to see green shoots of mining companies attempting to drive changes at the operational level, adopt new technologies, and display a greater willingness to collaborate with industry. Several mining companies have stated publicly that new technology would be required to achieve their emissions reduction goals, and we believe technology will be the most impactful factor in whether the goals are ultimately achieved. Unfortunately, operational and technology adoption remains slow despite the material economic impacts these changes can achieve. Modifying existing processes is challenging, thus we would encourage miners (and their investors) to more seriously consider new incentives to encourage technologies at a logical operating stage such as a mine extension, rather than be encumbered by the fear or potential cost of failure. The process can be greatly assisted through corporate leadership and we thus challenge mining executives and shareholders alike to develop a corporate and commercial culture with the real desire to reduce operational emissions, with an eye toward supporting good science and technology as being fundamental to this goal.

RFC Ambrian has partnered with the CSIRO and the US Department of Energy's National Renewable Energy Laboratory (NREL) to form a Basic Industries Science Incubator and Venture Fund to incubate and commercialise basic industry technologies directed to lower humankind's environmental footprint. We have engaged with several mining companies to become Innovation Partners, Australian Universities to become Science Partners, and large funds to finance the venture. We are committed to making a difference.

The Alchemist

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