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INQUIRY INTO 2024 ANNUAL REPORT OF THE NET ZERO COMMISSION

Organisation: Peak Carbon

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About Peak Carbon

Peak Carbon Capital is a project developer specialising in environmental commodity engineering projects especially in the fields of coal mine methane mitigation and biomass pyrolysis for biochar. We identify, design, finance, own and/or operate projects that reduce greenhouse gas emissions and take immediate, meaningful steps towards a de-carbonised world.

Neil Butler - Chartered Mining Engineer, Fellow of the Institute of Mining Metallurgy and Minerals (IOM3), Member of the Australasian Institute of Mining, with >35 years of experience specializing in safe technology design and development for mining and for energy transformation/generation and pollution control processes, >20 years at Director level. Member of United Nations ECE Group of Experts in Coal Mine Methane, Expert competence in Coal Mine Methane and Ventilation Air Methane. Experienced in procurement and technology development of methane abatement technology and R&D in thermal processing with multiple patents across pyrolysis, mine methane flaring and in VAM abatement.

Executive Summary

Coal mining currently represents one of the biggest sectoral greenhouse gas emissions sources in NSW, and the NSW Net Zero Commission has warned that additional emissions from the sector represents a material risk to achieving legislated emissions reduction targets. The report additionally notes that additional emissions from the coal mining sector "may require other sectors to make greater emissions reductions".

Within coal mining, ventilation air methane (VAM) represents the biggest source of greenhouse emissions, and is largely made up of methane gas which has a far greater short term warming impact than carbon dioxide. In line with the EPA's expectation that "proponents of coal mining and gas extraction proposals [should now] set ambitious emissions reduction goals", this document aims to outline the key concepts of and opportunities of achieving significant emissions reductions from VAM emissions sources, and is based on more than 20 years of commercial application.

Based on this industry experience, it is our opinion that an expanded roll-out of VAM mitigation across NSW could materially reduce the biggest known source of greenhouse emissions from underground coal mines. There are a number of currently high emitting facilities where we believe a VAM abatement system could be installed within a short time period (18 months) and achieve material abatement well ahead of 2030. This could be of significant value in supporting the achievement of both short term and long term emissions mitigation goals.

Background

The document linked below has been written for policy makers, mine owners, NGOs and other interested parties to outline the capabilities of technologies used for abating Ventilation Air Methane (VAM) at underground coal mines.

A comprehensive analysis of VAM abatement is available in the Best Practice Guide for VAM - United Nations ECE, Group of Experts in Coal Mine Methane

Waste Coal Mine Gas (WCMG) is a form of natural gas primarily composed of methane. This WCMG is stored within coal, and is released during mining production, and thereafter vented as a fugitive emission using various pathways. The primary pathway to the atmosphere for most of this fugitive emission is via release of Ventilation Air from the mine for safety in underground coal mines.

Typical US Mine Ventilation Fan

Internationally the proportion of fugitive emissions of methane released within ventilation air systems is typically 70% of mining's total release, though this proportion is generally lower in Australia because Australian coal is considered to have high gas permeability which allows gas to be pre-drained more readily than in most other mining coal basins. This methane extracted from the mine within the Ventilation Air, is described as Ventilation Air Methane (VAM).

This ventilation is performed using air fans that draws huge quantities of fresh air through the mine, to collect and remove the VAM. Safety requires that we keep the concentration of methane in the mine very low (typically regulated to below 1.25% methane in air) which means that while the volume of air and methane emitted from a mine are huge, the concentration of the methane within that air is tiny, in Australia usually between 0.1% and 0.3% methane.

Coal mines must remove WCMG to ensure that there is no dangerous build up of flammable gas within the underground mine. If the flammable gas reaches concentrations in air of between 4.3% and 15% methane in air within the mine and this mixture ignites, its enclosed combustion within the mine causes an explosion, which can cause fatalities.

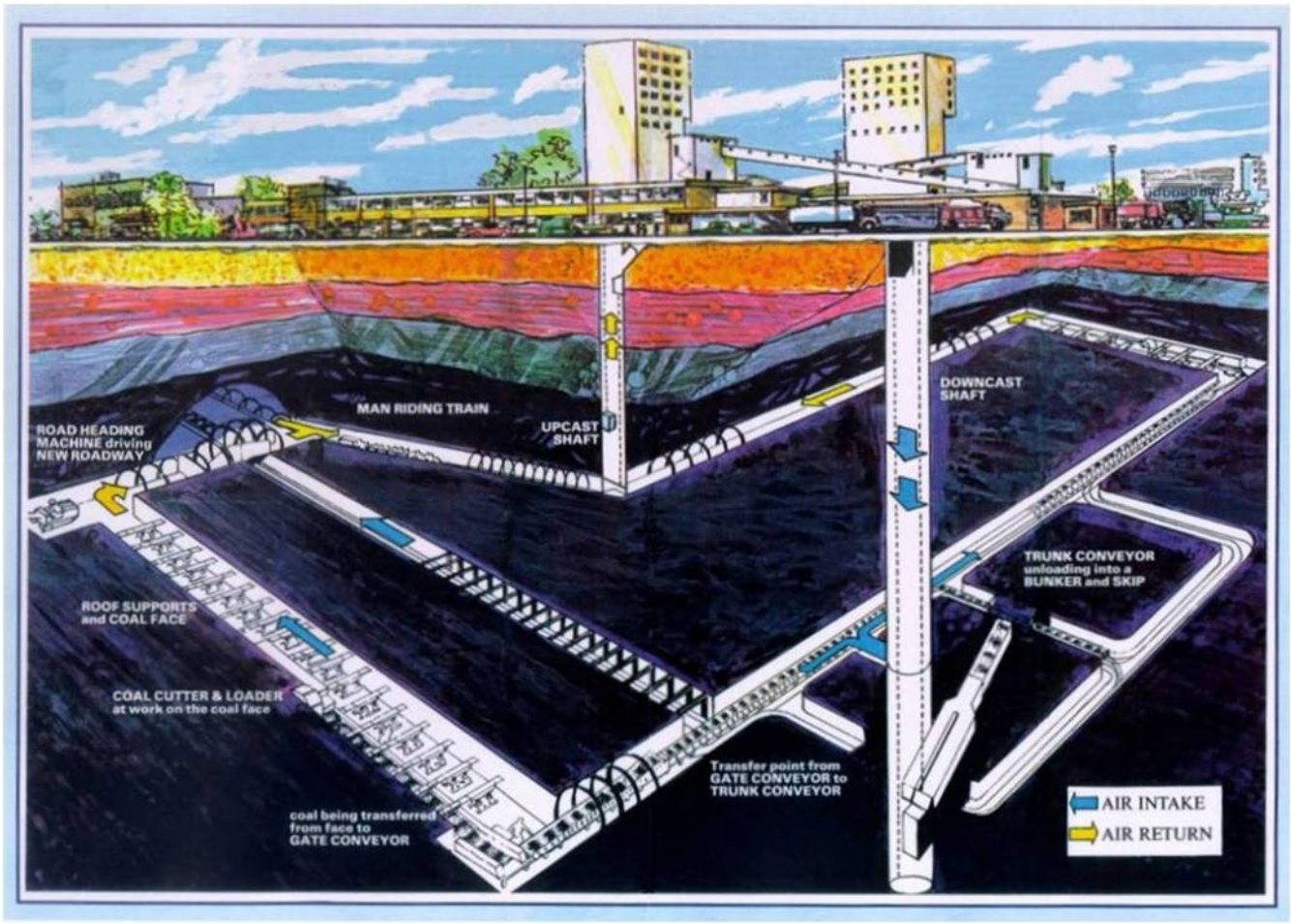

Illustration indicating flow path of fresh air being drawn through the mine (blue arrows), collecting methane, and venting the mixture of air and dilute methane to atmosphere (yellow arrows).

Methane explosions are feared in coal mining, but the advancement of ventilation and gas drainage techniques in Germany and the UK in the 1950s, which have been improved upon in Australia together with careful engineering and management controls mean that explosions in NSW are now very rare, but the threat of an underground methane release is the most significant risk to any coal miner, and drives how and under what conditions production is carried out.

Australian coal mining is amongst the very safest in the world, with regulatory practices in QLD and NSW originally derived from EU and UK risk analysis-based safety management processes, and then improved.

In addition to being a safety hazard, methane has been proven to be a Short Term Climate Forcer causing a rapid effect upon Climate Change, which Australia has assessed to be equivalent to 28 times that of carbon dioxide over a 100 year timeline [GWP100] (reference Clean Energy Regulator.)

or expressed in a more useful manner 85 times that of carbon dioxide over a 20 year timeline [GWP20].

Fugitive emissions of Ventilation Air Methane are generally considered internationally to represent the next target phase of low hanging fruit in terms of climate change driven emissions mitigation, as enormous quantities of these emissions can be mitigated rapidly. Further much of that mitigation can be done at a cost (in CO2e) that is well within the current Safeguard Mechanism Credit pricing and therefore highly cost effective for most underground coal mines in Australia.

Technology Options

There are multiple technology options which can be considered for mitigation of VAM. Regenerative Thermal Oxidiser (RTO) technology has been very widely used for pollution control in industry since 1971, and at coal mines for VAM since 1994. RTO technology is proven in VAM mitigation in around 20 projects worldwide, mainly in the USA and China.

The technology has been applied twice in New South Wales, once at Appin Mine as a demonstration operating in a stable manner down to 0.19% CH4 concentration, and once at Westcliff mine as a full-scale commercial project with nearly 10 years operation.

There at least 40 manufacturers of this type of technology internationally, with at least 6 of these having experience of VAM on coal mines.

Although there are plenty of RTO VAM demonstration and commercial projects worldwide, the uptake of the technology has not been widespread, because prior to the Safeguard Mechanism reforms in 2022 in Australia, and the recent EU Methane regulation, there have been no regulatory drivers to either incentivise or force mitigation of methane at mines. In the US projects are driven by commercial reasons associated with voluntary carbon credits. Mines will not mitigate their methane emissions without either regulatory or commercial incentives?

RTO technology for VAM applications is mature and will operate at most coal mines in Australia. There is a technical limitation in that the equipment can only operate without external energy down to a minimum methane concentration of 0.2% CH4. This limitation excludes a proportion of Australian mines from this abatement option, we would estimate that up to a quarter of coal mines have methane emissions that have concentrations that are too low for the RTO technology to be successful.

Regenerative Catalytic Oxidisers (RCO) are a possible future option for mitigation. They are very similar to RTOs but use catalysts to lower the oxidation temperature of methane. This technology R&D should eventually manifest itself in reduction of the CAPEX and OPEX costs, and in the ability to operate at concentrations below 0.2% CH4, which opens up a proportion of the mines currently untreatable using RTO technology. We are excited about the developments of CSIRO and Mining3 and hope to develop projects with them in scale in the near future. There are currently R&D projects operating on mines using RCO technology.

We would estimate that commercial scale deployment of these technologies to be available in 3 to 5 years.

Safety

The primary consideration of these VAM projects is the safety of the coal miners working underground.

Generally most VAM projects have taken place in the USA and China, where their regulatory policies are prescriptive. For this reason, the projects which have been recently undertaken in these geographies have not had risk science based methodical analysis of their designs, that is required within an Australian regulatory environment. Simply put, most international VAM RTO projects would not meet Australian standards of process safety in design.

While NSW has had at least two VAM projects installed on coal mines (one of which for nearly a decade), these projects were developed, installed and operated nearly 20 years ago, and the current sophisticated quantitative and qualitative risk analysis methods which are now in place, were not practiced at that time. We cannot point to those projects and say – it was safe then, why is it not safe now? Although the projects were indeed safe, if they were to be installed now, the designed risk control measures would be very different today.

The main risk to consider is where the mine has a large emission of methane underground, and this reaches the surface, where it could be ignited by the abatement equipment.
There are currently several organisations including ours, working on risk analysis projects to deliver RTO designs which will be safe for use at coal mines in Australia.

Our analysis so far shows that where the risk of the mine emitting methane in the flammable range at the mine surface is low, then a suitable safety system can be designed and operated to ensure that risks are reduced to As Low As Reasonably Practicable (ALARP) from a risk analysis perspective. It is fair to say that it is likely that this technology cannot be installed at all coal mines in Australia, simply because some mines will have a different risk profile than others. From our work over the last two years, we would expect that three quarters of underground coal mines could meet the likely risk analysis criteria for installation of RTO projects.

We have been working with several mines in Australia and have completed process safety management and control designs for RTO projects, which have been peer reviewed by four organisations to interrogate the conclusions that an RTO project would reduce risks ALARP. We consider our approach of mine assessment, then systematic risk analysis HAZID>Design>IRPA>LOPA>SIL>HAZOP>Bowtie to represent Best Practice.
We would welcome the opportunity to engage with the NSW Government further.