1 INTRODUCTION

I have been asked to summarise key features of the metallurgical coal and steel markets, and provide my expert opinion on future trends in these markets. This includes giving my opinion on the likely effect that extracting metallurgical coal in the UK at the proposed new mine at Whitehaven Coillery would have on these markets.

2 STATEMENT

This expert statement comprises my professional views. It is prepared on the basis that I have a duty of impartiality regardless of the interests of my clients and a wider duty to the planning authority and the public at large to provide independent expert evidence within my area of competence and expertise.

3 AUTHOR: QUALIFICATIONS AND EXPERIENCE

My name is Dr Neil Bristow and for the last 30 years I have developed expertise in the steel, iron ore, coal (metallurgical and thermal), coke, and ferro-alloy markets and business research and analysis, strategy development, and competitor analysis.
I hold the following Memberships and Committee positions:

- Member of American Iron and Steel Association; (AISI serves as the voice for the USA steel industry);
- Associate Fellow of Australian Institute of Management;
- Member, Advisory Committee of Met Coke International Coke Conference, USA; (International Coke Conference provides senior decision makers from the USA and global coke, coal and steel markets to hear the latest market trends, as well as technical and operational developments within the industry);
- Member, Advisory Committee of Euro Coke International Coal Conference, Europe; (The Eurocoke Summit provides senior decision makers from the global coke, coal and steel markets to hear the latest market trends, as well as technical and operational developments within the industry); and,
- Member, Steering Committee of International Coal, Coke and Carbon Forum (the most influential annual forum for the steel commodities market comprising a unique group of senior leaders in both the steel and coal industry).

I have developed a particular specialism in forecasting accuracy, market analysis, strategy development, innovation and insightful scenario thinking, technical trends and raw materials technology development. This specialism has been widely acknowledged "Dr Bristow is an internationally recognized industry expert[1] in areas of steel and steelmaking raw materials, long term trends and scenarios"[2].

I have led numerous major research studies and have chaired and presented at a wide range of international meetings and conferences, across iron ore, coking and thermal coal, and coke. I have authored numerous market and technical papers.

4 METALLURGICAL COAL

Metallurgical Coal: Uses and Availability

Over several centuries, coal has been mined and used for a variety of purposes, ranging from a simple source of heat and power generation ("thermal" coal), which exploits the calorific value of coal, to more specialist applications. It is found that coal exists in a range of forms, differentiated by its physical and chemical properties. These different forms, or grades, of coal, mean that coal can be mined, processed and put to a range of different end uses that are appropriate for its grade.

One of these grades of coal is metallurgical coal. Metallurgical coal is a grade of coal that, due to its physical and chemical properties, can be used in the production of good quality coke. Coke is one of a number of ingredients used to make liquid iron, which is the primary constituent of steel. A good quality coke will help to make a good quality steel. By contrast, the lower grade thermal coal does not produce coke when it is heated.

Metallurgical coal is relatively rare compared to thermal coal, and is therefore classed as a Critical Resource by the European Union,[3] because the largest known reserves of it are in the USA, China and Australia. The European Union is a significant producer of steel, and it recognises that this relative scarcity of metallurgical coal within its borders gives rise to potential risks in the supply, supply security, and geopolitical factors relating to obtaining sufficient metallurgical coal to keep its steel industry functioning. Metallurgical coal like other minerals can only be worked where it is found. A number of reasonably obvious consequences arise for example in terms of implications for the location of mining facilities and transportation.

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[1] Exclusive Interview: Dr. Neil Bristow Explains That Yes, There Is Life Left In Coke!
[2] https://www.metcokemarkets.com/eurocoke-summit/advisory-board
[3] https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en.

Metallurgical Coal: Production

Metallurgical coal is also mined in response to demand for the coal by the steel making industry. Coal mining is highly capital intensive, and it therefore requires relatively fast returns on the investment made in the cost of the mining and processing operations.

Well established market evidence demonstrates that if there is no market for metallurgical coal it is not mined, because mining companies will not incur the expense of mining a product if they cannot achieve the required rate of return upon the sale of the product. The return required will not be achieved if the product is not sold. Therefore, it simply is not viable to mine metallurgical coal in order to then place it in a stockpile with uncertainty around a future buyer.

To mine a product without a buyer and place it in a stockpile whilst it awaits the possibility of buyer interest incurs a great loss through product degradation. The longer the metallurgical coal product is exposed to air and weather, the more it degrades. Stockpiling would therefore cause it to degrade to such an extent that the properties which make it desirable for the steel making market will have deteriorated so that it can only be classed as a much lower grade with a considerably reduced value. Consequently, it is simply not a viable industry practice or viable business model.

Metallurgical coal is mined on demand. If better or equivalent grade coal can be mined from a closer location at a similar price, that coal will replace the coal that is currently being exported from further afield. In the present case, the WCM coal will substitute the equivalent volume of USA coal that is currently being exported to UK and Europe by being shipped across the Atlantic.

In my judgement, the USA would not continue to mine the same grade of coal for sale to other countries because there is no proven market for them to do that, and also because shipping to alternative major steelmaking countries in Asia and India involves such high transport costs that it is less economically viable. Instead, the most likely outcome is that there would be a corresponding reduction in the extraction of this coal in the USA.

Indeed, the closure or scaling back of mines in the USA as a result of reduced demand from Europe was recently highlighted in the Argus blog[4]. Additionally, the Chief Executive of Glencore stated in February 2020 that: "We don't want to dig the material out of the ground if it's not required in the market".[5] This related specifically to demand for thermal coal, however the same argument holds true for metallurgical coal - if the demand is not there, the material will not be mined. In the mining industry, when the market is not there, mining rates are adjusted accordingly.

It is reported in market research that "the revival of the metallurgical coal industry was driven by an increase in world steel demand.",[6] meaning that metallurgical coal mining is dependent upon demand from the steel industry.

Further market insight reports that, "Met (metallurgical coal) pricing is usually tied to global economic growth because an expanding economy means more construction which means more steel which in turn means more met coal demand", according to Jude Clemente, a widely published expert in natural resources markets.[7]

Mining is an operation which involves considerable cost and capital outlay. Accordingly, the maintenance of a sufficient cashflow is an essential part of securing the economic viability of mining operations. If faced with a market downturn, mining companies stop production to avoid incurring the costs of mining in the absence of achieving a return on those costs. Therefore, stockpiling mined coal to await an upturn in business is not financially viable and hence is not common industry practice.

The economic profitability of a mine is linked to its production costs, known as FOB costs. These are the costs associated with the mining, processing, transport, port charges and royalties of the coal. Mines that sell coal above their FOB costs produce a profit; those that sell below their FOB costs produce a negative return. My expertise in this industry enables comment to be made on the likely profitability of the WCM mine, comparing it with mines producing similar grades of coal across the world.

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[4] Argus is an independent media organisation with offices in the world's principal commodity trading and production centres and produces price assessments and analysis of international energy and other commodity markets https://www.argusmedia.com/en/news/2080089-several-us-coking-coal-mines-cut-output-in-4q.

[5] https://uk.advfn.com/stock-market/london/glencore-GLEN/share-news/Glencore-Swings-to-Loss-Amid-Lower-Commodity-Price/81786915.[3] https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en.

[6] Metal Bulletin Research, 2010, "Coking Coal: A Strategic Market Outlook to 2020".

[7] https://www.forbes.com/sites/judeclemente/2018/08/12/the-one-market-thats-sure-to-help-coal/#57dec2696f6e

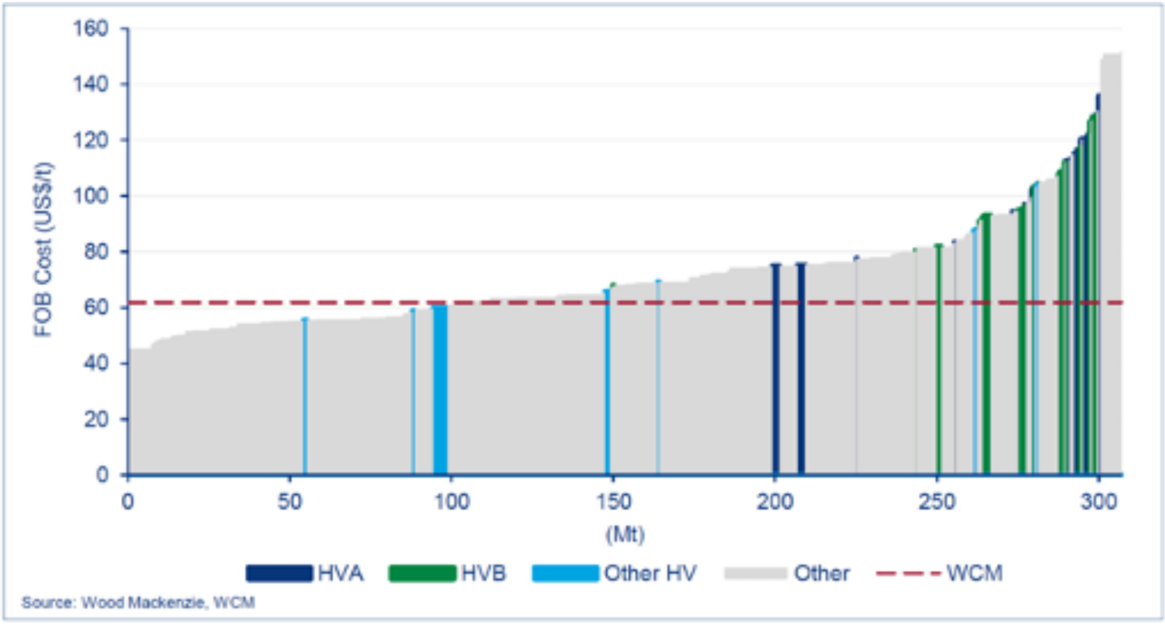
This is explained below.

The projected FOB cost bases of the WCM mine to other mines producing metallurgical coal in the rest of the world have been compared. It was found that the FOB cost bases of the WCM mine are advantageous compared to other world mines producing a similar grade of coal for several reasons. First, the UK operates one of the most attractive royalty regimes when compared with the rest of the world. Secondly, salaries for miners are lower than for other countries

WCM's predicted operating costs in steady state production are lower than around 75% of other world hard coking coal mines, due to lower cost bases and significantly lower transportation costs.

Independent market analysis proves this point. Figure 1 below shows the FOB costs for world exports of metallurgical coal in the year 2016, and compares these with the projected FOB costs for the WCM mine. Figure 1 shows that the projected FOB costs of the WCM mine are lower than around three quarters of other world metallurgical coal producers.

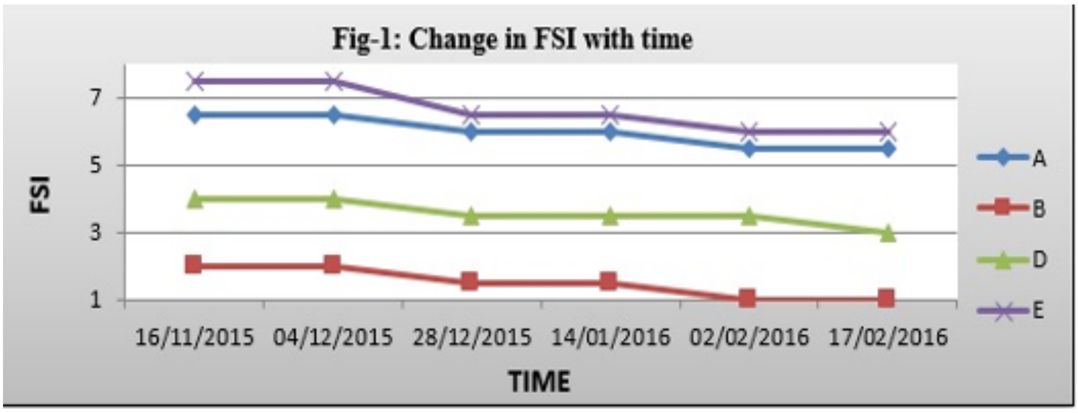
Figure 1. Export Metallurgical Coal Cost Curve (FOB) where the x-axis is the total annual quantity of export metallurgical coal globally, and the y-axis is the range of FOB cost of the various producers going from lowest (left) to highest cost producers (right).



Metallurgical coal is a premium product attracting a high price due to its specific properties. Weathering of metallurgical coal starts as soon as the coal is mined, and it will continue until it is charged in the coke oven to produce coke. In mines, coal exists in a water-saturated, oxygen-free environment. Any disturbance of this environment such as a change in the temperature, moisture content or oxygen partial pressure, results in changes of chemical properties and physical stability. This dynamic behaviour of coal is termed 'weathering' and includes the aerial oxidation of the organic and mineral matter (chemical weathering), the microbial oxidation of pyrite (biological weathering) and changes in the moisture content that result in particle size degradation (physical weathering). During transportation and stockpiling, coal is in contact with air for periods of time that may exceed 6 months. During this time, reaction with oxygen in the presence of water, sunlight and possibly elevated temperatures may take place. Different coals follow different trends during weathering. The weathered coal affects its beneficiation process as, due to oxidation, the coal's surface property gets changed and the coal surface becomes more hydrophilic. Therefore, the sooner the mined coal reaches its intended destination for use in steel making, the better the retained quality of this coal - meaning that less time spent in transit is advantageous for steel makers.

For example, one of the key differentiators in terms of the price for metallurgical coal is its Free Swelling Index (FSI). FSI is a measure of a coal's swelling properties when heated under prescribed conditions without physical restrictions. As FSI reduces purchasers will apply a 'penalty' to the selling price. Figure 2 below shows test results which evidence the fact that the FSI is significantly reduced over time.

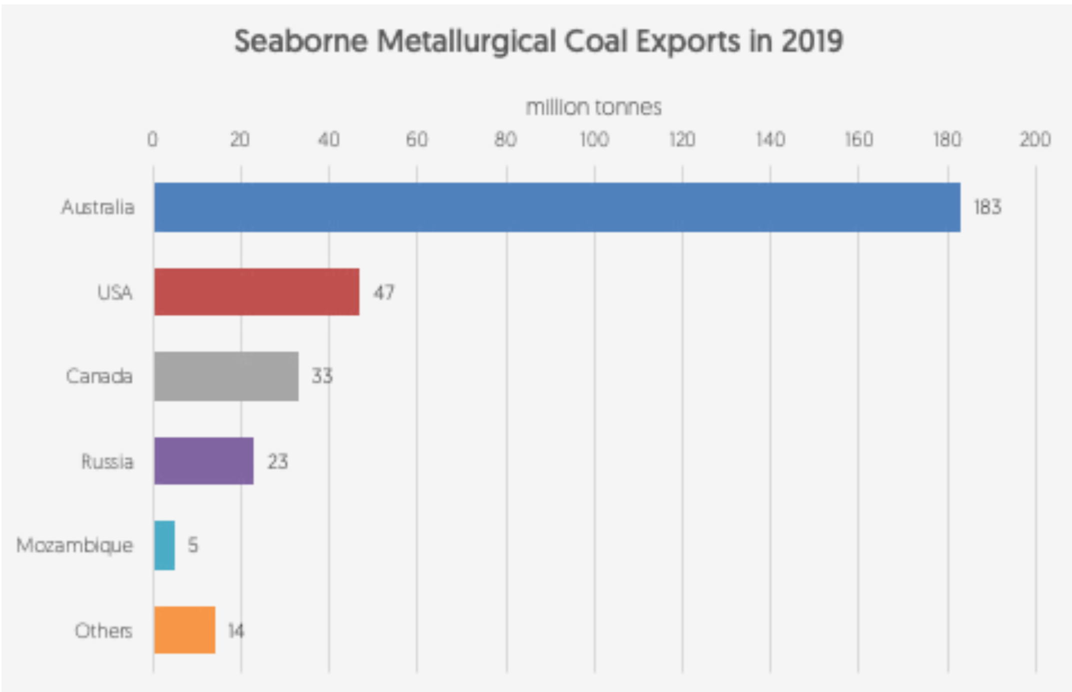
Figure 2. The deterioration of FSI in coal over time.



The cumulative effect over time is such that the value of the coal is significantly reduced as its suitability for steel making is eroded.

WCM coal will be classed as a 'High Volatile A' coal, due to its specific characteristics. This is a high-quality hard coking coal (HCC) used for steel making. The USA is currently the major source of a similar grade of coal for the European steel making market and exported 47million tonnes of metallurgical coal in 2019, with around 60% of this being High Volatile A, as per Figure 3 below.

Figure 3. The total seaborne exports in 2019



The primary reason that production from Cumbria will very likely result in an equivalent decrease in production in the USA is economic - Cumbrian coal will be significantly more cost competitive than the USA coal due to lower operational coal production and transportation costs. Many USA mines are now mining thinner seams which are more difficult and as a result expensive to operate and mine efficiently.

The operating costs of the Cumbrian mine will be much lower than the majority of other mines producing HCC coal and this cost advantage is of significant interest to steel makers. I consider that the WCM mine will be more cost-competitive than over 75% of USA mines producing a similar grade of coal, as shown in Figure 3 and explanatory text above.

This cost advantage is coupled with another significant advantage that Cumbrian coal has over the USA HCC producers; significantly less transport costs. USA HCC mines are several hundreds of miles distant from shipping ports, involving lengthy rail journeys to take the product to the ports. The east coast of the USA is several thousands of miles distant from Europe, therefore transport costs of HCC coal from the USA mines to Europe are significantly higher than the transport costs of Cumbrian HCC coal to Europe.

At least 50% of the USA coal mines are described as "marginal producers", which means that they operate with high levels of production costs (due to various factors including the distances and costs involved in transportation) and are only able to make profits when the coal selling price is high (typically above US$140/t). Indeed, recent evidence shows that high cost coal mines in the USA are closing down due to falling coal prices.[8]

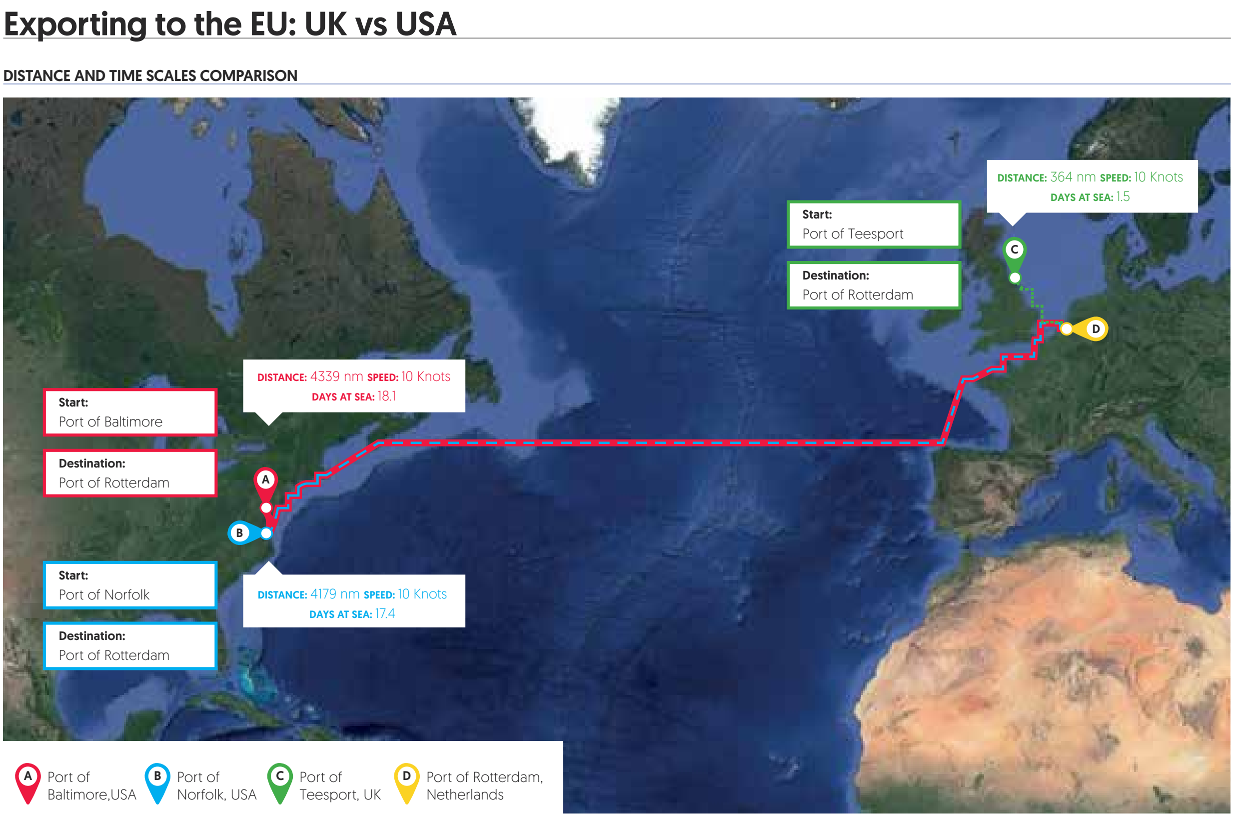
If USA mines were to try to compete on cost against WCM, they would simply become uneconomic - these established mines have fixed operating costs, which would make it very difficult for them to compete. Indeed, to undertake such measures to compete for such a small fraction of the market that WCM will hold is highly likely to be unattractive to those operators, whose most economic route would simply be to scale back production or close the mine.

Target customers in the UK and Europe all source the majority of their High Vol A metallurgical coal from the east coast of the USA, as there are presently no other more cost-effective sources. Reliance on one geographical source presents risks arising from transport delays, geo-political or tariff changes, and supply security. As a result, these customers are continuously seeking to diversify their supply sources to de-risk the supply of the raw materials required particularly for scarce High Vol A premium coking coals.

Cumbrian produced coal will be available to the UK and European market in a matter of hours, rather than weeks, and this has significant advantages for steel producers, including significantly reduced shipping costs, significantly shorter lead-in times from order to delivery, and the ability therefore to be much more responsive to last-minute demand, with better coal quality due to less degradation caused by coal being transported in a ships' hold for long periods as it crosses the Atlantic.

The largest producing area of metallurgical coal that would compete with coal produced by WCM in the USA is central Appalachia, which is rail linked over distances of, on average, 600km, to ports at Norfolk, Virginia and Baltimore, Maryland. Coal is shipped primarily to Rotterdam from these locations, over distances of 7,738 km (4179 nautical miles) from Norfolk, and 8,035 km (4339 nautical miles) from Baltimore. Comparing the travel distances for coal from West Cumbria Mining operations to Rotterdam, the rail route from Pow Beck valley to Redcar is 215 km and the shipping distance from Redcar (Port of Teeside) to Rotterdam is 674 km (364 nautical miles). This is demonstrated by Figure 4 below.

Figure 4: Shipping distances from WCM as compared to coal imported from USA



[8] https://www.argusmedia.com/en/news/2080089-several-us-coking-coal-mines-cut-output-in-4q

In my judgement based upon my experience of the market it is unrealistic to conceive that UK and European steel makers would continue to buy USA High Vol coal over and above Cumbrian High Vol coal when the Cumbrian coal is significantly cheaper, much more readily available, has better retained quality due to shorter shipping distances, and has fewer upstream carbon emissions arising from transport of the product due to far shorter travelling distances. This is further supported by information that I understand has been obtained by WCM from the UK and EU steelmakers, including two separate letters of support from British Steel and Tata Steel UK, signalling strong interest in a UK produced coal for sustainability reasons.

Steel makers will not simply buy more High Vol A metallurgical coal than they need once Woodhouse Colliery comes on stream, because High Vol A metallurgical coal is only one of several ingredients required in steel making.

Cumbrian High Vol A metallurgical coal is therefore most likely also be preferred by UK and European steel makers because of its significantly reduced travel distances, and consequent reductions in transport related environmental emissions. This has been most recently confirmed in discussion between WCM and one of Europe's largest steel producers, Tata Steel, and it is these factors that are the fundamental aspects of WCM's business case for investors in developing the mine.

WCM has undertaken market research over the last 5 years to demonstrate these principles, using industry experts and trade bodies. From this, it is clear that there is a very high level of interest from UK and European steel makers, who are interested because of the proximity of this resource so close to their plants.

Metallurgical Coal: Market

There is currently no viable and scaleable alternative to metallurgical coal in the steel making process. This factor differentiates metallurgical coal from thermal coal, the latter being much more readily available, and which is gradually being replaced by proven and scaleable alternative technologies for power generation, such as wind, solar and hydroelectric power.

Due to this, it is forecast that there will be strong demand for metallurgical coal until at least the end of this century. This demand will be driven partly by increased demands for steel as the less developed nations of the world accelerate their journeys into the provision of improved infrastructure, and improved lifestyles which demand more steel in domestic goods and transport.

The predicted continued demand for steel is also partly driven by a need for the world to reduce its emissions under the requirements of the United Nations Framework Convention on Climate Change Paris Agreement on climate change (which is signed by almost 200 countries). Emissions reductions will result in a significantly increased demand for alternative energy technologies including wind, solar, and hydroelectric. Decarbonisation of the transport system will require more trains, and electric cars will replace fossil fuelled cars. All of these applications are dependent upon steel - for example, a wind turbine is made predominantly of steel. It is fair to say that without steel there would be no green infrastructure, because there are no equivalent alternative materials to steel.

WCM's place in the global metallurgical coal market will be small. It is proposed that, at maximum output, WCM will mine 2.78 million tonnes per annum of HVA HCC metallurgical coal for a period of 45 years. The target markets for this coal are steel makers in the UK (primarily Tata at Port Talbot, and British Steel at Scunthorpe, now owned by the Jingye Group), and the European steel making industry. These steel makers currently import an equivalent grade of coal from the east coast of the USA, and would continue to do this if the WCM mine did not open. There are currently around 300 million tonnes of metallurgical coal exports around the world per annum, of which WCM's coal would comprise around 0.26%.

Since it represents such a tiny proportion of global production, the output from WCM's mine will have no measurable bearing on the price of coal in the remaining 99.74% of the world's metallurgical coal producers and markets. Since output from the WCM mine will be almost identical in grade to the current imports to the UK and Europe of this material from the east coast of the USA, it is reasonable for WCM to assume that its output will substitute for an equivalent tonnage of an equivalent grade of coal from the USA, and this is fundamental to WCM's business case, developed by market-leading experts.

WCM's coal will be significantly more cost-competitive to the equivalent grade of coal from the east coast of the USA, or anywhere else in the world, primarily due to significantly reduced shipping costs. Since coal is just one of a number of ingredients in steel making, this will not make the overall price of steel cheaper. As is set out above, the shipping distances alone from the USA to Europe are around 11 to 13 times greater than the UK to Europe. When UK and European steelmakers select British-produced premium metallurgical coal, they will not only be buying a cost-competitive product, but also one which reduces emissions from shipping transport by a factor of up to 13 when compared with an equivalent product from the east coast of the USA.

The production of coal in Cumbria will not cause a dip in global metallurgical coal prices, because its contribution to the market place would be so small as to be unnoticeable. In any event, as a start-up mine that requires full investment to build, it would be counter-productive of WCM to seek to disrupt world metallurgical coal pricing - even if it could, this would not be favourable to WCM's business case for investors. WCM, in common with any other business, is seeking to maximise returns via a high coal selling price, rather than minimise returns via disrupting the metallurgical coal market and reducing selling prices.

The competitive pricing of Cumbrian coal compared to its USA equivalent will have no impact on the price of steel, because metallurgical coal is just one of a number of ingredients in the steel making process, as described below.

5 STEEL MAKING

Steel Making: Methods, Uses and Future Outlook

Methods

Over 75% of steel is made using a sequence of three processes involving a wide range of raw materials including limestone, iron ore, coal and other minerals. These processes are coke making, iron making and, finally, steel making. The raw materials have to be mined and transported, often over large distances to the steel making plants. Therefore, minimising transport distances of raw materials minimises the GHG emissions generated from this transport.

Each step in these steel making processes is described in more detail below.

<u>Coke making</u>

Coking (metallurgical) coal is converted to coke by heating the coal in a coke oven. This drives off volatile materials to leave almost pure carbon. The physical properties of coking coal cause the coal to soften, liquefy and then re-solidify into hard but porous lumps when heated in the absence of air.

This process takes between 12 to 36 hours. Once removed from the oven, the hot coke is then quenched with either water or air to cool it before storage or is transferred directly to the blast furnace for use in iron making.

The coke making process releases gases which contain a high degree of energy. These gases are captured and then recycled in other parts of the steel making operations as a fuel. This reduces the amount of energy required from the grid in steel production, which in turn lowers total greenhouse gas emissions arising from this process.

<u>Iron making</u>

A blast furnace is fed with iron ore, coke and small quantities of fluxes (minerals such as limestone, which are used to react with impurities in the iron ore and coke). Air which is heated to about 1,200°C is blown into the furnace through nozzles in the lower section. The air causes the coke to burn, producing carbon monoxide at around 2,100°C, which reacts with the iron ore, as well as heat to melt the iron. Finally, the tap hole at the bottom of the furnace is opened and molten iron and slag (impurities) are drained off.

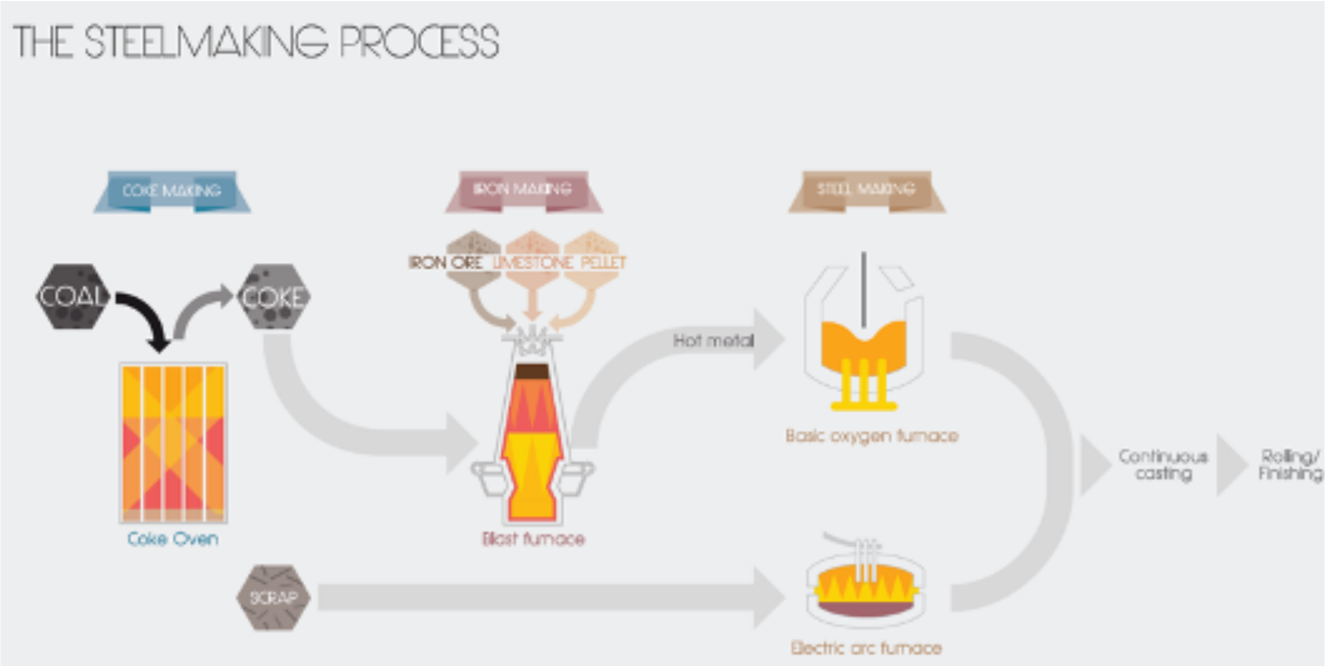
<u>Steel making</u>

Steel is most commonly made in a basic oxygen furnace. In the basic oxygen furnace, iron is combined with varying amounts of steel scrap (less than 30%) and small amounts of flux. A lance is introduced into the vessel and blows 99% pure oxygen causing a temperature rise to 1,700°C. The scrap melts, impurities are oxidised, and the carbon content is reduced by 90%, resulting in liquid steel.

Other processes can follow, called secondary steelmaking processes, where the properties of steel are determined by the addition of other elements, such as boron, chromium, manganese and molybdenum, amongst others. These secondary processes create the required grade and quality of steel.

Optimal operation of the blast furnace demands the highest quality of raw materials; the carbon content of coke therefore plays a crucial role in terms of its effect in the furnace and on the hot metal quality. A blast furnace fed with high quality coke requires less coke input, results in higher quality hot metal and better productivity, together with a lower blast furnace fuel rate, i.e. lower carbon emissions.

Figure 5: Below shows the steel making process in graphic form



It takes up to 770 kg of coal to produce 1 tonne of steel through this production route.

The remaining 15% of steel making is using scrap steel as a primary ingredient in an electric arc furnace. Scrap steel is usually only able to produce relatively low grade long steel products, for example construction products such as reinforcement bar or steel mesh. This is because recycled steel contains impurities such as copper and tin, which are difficult to fully remove in the recycling process, and make the resulting steel unsuitable for high grade applications. High grade steel, for aviation, domestic and medical applications, for example, requires a much lower, or zero, presence of such impurities, and therefore it can only be produced at scale using the blast oxygen furnace route.

Around 85% of scrap steel in Europe is already recycled. The ability to recycle scrap steel depends upon the quality of the scrap steel and its intended use following recycling. Prior to use, the scrap steel needs to be cleaned of the contamination caused by its previous use before being heated at a high temperature in order to reduce it to a molten state and drive off remaining contaminants. The processing and cleaning of scrap is itself energy intensive, resulting in GHG and other emissions.

The market for recycled steel products is heavily constrained by the availability of scrap steel to feed into the recycling process. Around 51% of all steel made is 'locked in' within infrastructure, for example bridges, tunnels and buildings, which typically has a long lifetime before it will be decommissioned and demolished. Other medium to long term uses of steel include rail lines, engines, aerospace uses etc. Steel only becomes scrap once it, or the structures it supports, have reached the end of its useful life. Arcelor Mittal, one of the world's largest steel producers, published a report in 2019.[9] Arcelor Mittal provide commentary on the availability and use of scrap steel. Arcelor Mittal's Report [page 2] states that there is, "not enough scrap

[9] Arcelor Mittal (2019) Climate Action Report

available in the world to make all steel through the electric arc furnace"; and at page 10 that, "the strong demand for steel in the developing world means that end-of-life scrap is only sufficient for a modest share (approximately 22%) of metallic input for global steel production.", and that, "the availability of end-of-life scrap lags demand for steel by several decades, typically 10-50 years or more after production depending upon application. This means the world will still be reliant on primary steel making from iron ore until nearer the end of this century." At page 12, the Arcelor Mittal Report states, "As living standards improve and infrastructure across the globe matures, demand for steel will eventually plateau. After that, enough end-of-life scrap will be available to meet the bulk of steel demand, leading to a fully circular steel value chain. Since this transition is unlikely to become reality much before the end of the century, iron and steelmaking from iron ore will continue to play an important role in meeting global steel demand well beyond 2050."

Uses of Steel

Steel is used in a very wide variety of applications - from domestic (cookers, fridges, kettles, saucepans), to aerospace, defence, medical, construction, industrial, shipping, automotive, power generation and transmission, medical and infrastructure provision. Steel is a vital material in green infrastructure - it is the primary material used for wind turbines, rail lines, bicycles, and is used in solar power equipment. Therefore, not only is steel recyclable, and therefore highly sustainable, it forms a significant part of green infrastructure for which there is no alternative material.

Future Outlook for Steel Use

In February 2020 the British Government launched its hugely ambitious plans for the 'COP 26' UN climate conference which it will host in 2021 (delayed after the Covid-19 outbreak). This will be a major event and could lead to a new global agreement to speed up carbon emission reductions. The path to significantly reducing global emissions can only be achieved if new low carbon technologies are built and deployed around the world. This will require the mass manufacture and construction & installation of renewable technologies as well as other low carbon power generation on a scale never before witnessed.

On 2 March 2020 the Prime Minister, Mr Boris Johnson, announced a change in UK energy generation policy, reversing what was effectively a moratorium on onshore wind turbines announced by a previous Conservative administration. This will generate an increased demand for wind turbines and the associated infrastructure required to install and operate them. With the takeover of British Steel in Scunthorpe completed on 9 March 2020, the future for the British steel making industry looks positive.

To achieve the green infrastructure, low emissions vision, the world will require high grade steel which cannot currently be produced from recycled steel, due to the issues raised by the presence of impurities in scrap steel, as discussed earlier. Manufacturing of one wind turbine of 1MW capacity requires around 200 tonnes of coking coal.

Additionally, global demand for steel will increase as less developed countries, for example India, improve their infrastructure and standard of living, requiring steel containing products from railways to bicycles and construction and domestic appliances.

Drivers for Steel Making

Demand for steel is driven by a country's economic outlook and Gross Domestic Product (GDP) growth. Stronger economies with GDP growth generate infrastructure spending and improved quality of life, which in turn increases steel demand. This requires an increase in iron production, which requires coking coal.

Steel makers make steel to order. The process of making steel is expensive and energy intensive, so for manufacturers to make it without a market for it would result in the need for steel to be stockpiled. Stockpiled steel degrades over time by processes including age hardening and rusting, which results in a devalued product, or, in the worst case, a product which may need reprocessing before it can be sold. The money invested by the manufacturers in making it is then lost.

The Future of Coal in Steel Making and Recycled Steel

A combination of market knowledge, industry forecasts, and the requirements for a move to green infrastructure, lead to the conclusion that steel is a critical material in the future. Not only will it allow less developed countries to 'catch up' with the infrastructure and goods enjoyed by developed countries, it will also allow the roll-out of green infrastructure, including power generation.

These conclusions are supported by environmental scientists, whose research shows that in order to move away from using oil and gas for electricity consumption (the most significant source of global GHG emissions), that 1,500 wind turbines would need to be built every day for the next 30 years just to keep the lights on as gas and coal power stations are closed. This is not accounting for the proportion of the world's population that does not yet have good or reliable access to power, so it is reasonable to assume that power demand will increase beyond this. Further, the significant amount of wind and solar renewable energy needs a source of significant concentration of energy, for example coking coal, to produce steel required for wind and solar power infrastructure.

One of the primary authors of the 3rd Assessment of the Intergovernmental Panel on Climate Change (IPCC) recently stated in an interview recently that fossil fuels are a necessary part of the future, in conjunction with carbon capture and emissions reductions in order to achieve a 'net zero' balance of GHG emissions.[10]

The European steel making industry has made significant advances in emissions reductions. Emissions reductions will continue in the future. Such an approach will almost certainly require forms of technology which are being tested by steel makers, including carbon capture and storage, as well as carbon offsetting. Research is also being conducted by steel makers into methods of steel making which do not use coal, or which use less coal - such as the Electric Arc Furnace method, or Direct Reduced Iron. However, these processes are still energy intensive and use other fossil fuels.

It must be remembered that the recycling of steel using the electric arc furnace demands very significant quantities of electricity and cannot produce high grades of steel which are required for specific purposes and uses. This is due to the relatively low quality of the steel which is recycled in this method (it contains copper and tin), and the resulting steel is of similarly low quality, and is therefore only capable of being used for general construction purposes (for example, reinforcement bar in concrete buildings and structures). High grade steel is produced from raw materials, rather than recycled scrap. Thus, even if scrap steel availability were to increase dramatically, it would still not be able to meet the considerable demand for new higher-grade steel.

The Direct Reduced Iron (DRI) method relies on natural gas or coal, and is typically used in countries with large domestic reserves of steam coal or natural gas. Therefore there are still GHG emissions from this technology.[11] Over the coming decades, as steel making methods are refined to use less metallurgical coal, there will be a per tonne reduction in the amount of metallurgical coal required for steel making. However, the current alternative methods are not yet commercially tested or viable, and are certainly several decades away from being a meaningful competitor to the blast furnace method. 20% of the current ~100Mtpa production of DRI uses coal as the reductant, mostly in India. Most other production is centred on countries where gas is very low cost, i.e. Iran and Russia.[12]

It is my clear opinion that metallurgical coal will continue to play an important role in the steel industry for a considerable period of time. During this period, the availability of WCM coal will have no material impact on steel industry or other research initiatives to become more efficient, nor will it have any materially adverse effect on incentives to de-carbonise the steel industry.

6 SUMMARY AND CONCLUSION

For the reasons that I have set out above, from my experience in the metallurgical coal and steel-making industry I would draw the following conclusions on likely future market trends, having regard to any possible effects caused by the availability of WCM coal as summarised below:

i. The European Union is a significant producer of steel, and European (including UK) steel makers currently import 40-44 million tonnes of metallurgical coal, principally from the USA. This trade route has been established for decades, and if the WCM mine does not go ahead, European (including UK) steel makers will continue to source their metallurgical coal requirements from the USA.

ii. Metallurgical coal is mined on demand. If better or equivalent grade coal can be mined from a closer location at a similar price, that coal will replace the coal that is currently being exported from further afield. In the present case, WCM coal will effectively substitute the equivalent volume of USA coal that is currently being exported to Europe by being shipped across the Atlantic. This is further evidenced by expressions of interest for WCM coal received from UK steel makers.

[10] Professor Myles Allen, a physicist who has spent 30 years studying global climate change, and is a former lead author of the 3rd Assessment of the Intergovernmental Panel on Climate Change in 2001, stated in interview that fossil fuels are a necessary part of the future, albeit that carbon capture and/or emissions reductions are essential https://www.bbc.co.uk/sounds/play/m000fgcn

[11] World Coal Institute (2009) Coal and Steel

[12] https://www.midrex.com/wp-content/uploads/Midrex_STATSbookprint_2018Final-1.pdf

iii. Metallurgical coal degrades once it has been mined and exposed to the air and weather. Stockpiling this coal would cause it to degrade to such an extent that the properties which make it desirable for the steel making market will have deteriorated so that it can only be classed as a much lower grade with a considerably reduced value. For this reason, stockpiling of metallurgical coal is not common practice in the industry For this reason, stockpiling of metallurgical coal is not common practice in the industry or generally regarded as a sensible business model.

iv. The USA would not continue to mine the same grade of coal for sale to other countries because there is no proven market for them to do that, and also because shipping to alternative major steelmaking countries in Asia and India involves such transport costs that its economical viability would be questionable. The most likely outcome of product substitution is therefore that there would be a corresponding reduction in the extraction of coal in the USA, which is currently mined for importation into Europe.

v. WCM coal would be competitive on cost, which would encourage its substitution for imported coal. However, its production will not affect global metallurgical coal prices. Furthermore, any cost savings that do arise in relation to WCM coal would be unlikely to affect the cost of steel production, or the demand for steel. This is because there are many variable components in steel production, and because steel consumption is driven by demand for it from the market (rather than its availability or price).

vi. Despite increases in the use of electric arc furnaces to recycle steel from scrap steel, there will still be continued demand for primary steel making using metallurgical coal until nearer the end of this century. This is because of limited availability of scrap steel, and the continued need for high grade steel for some industries, which cannot usually be made from recycled steel.

vii. Other alternative mechanisms of steel production, such as Direct Reduced Iron (DRI), are unlikely to be commercially viable for large-scale steel production for several decades. Furthermore, there is also very significant incentives for the steel industry to work towards de-carbonisation, and the availability of WCM coal will not have any material effect on this process.

viii. There is likely to continue to be a demand for metallurgical coal for steel-making in Europe throughout the life-span of the Proposed Development.

Signed N. Bristow .... Dr Neil J Bristow

Dated ....5/5/2020........