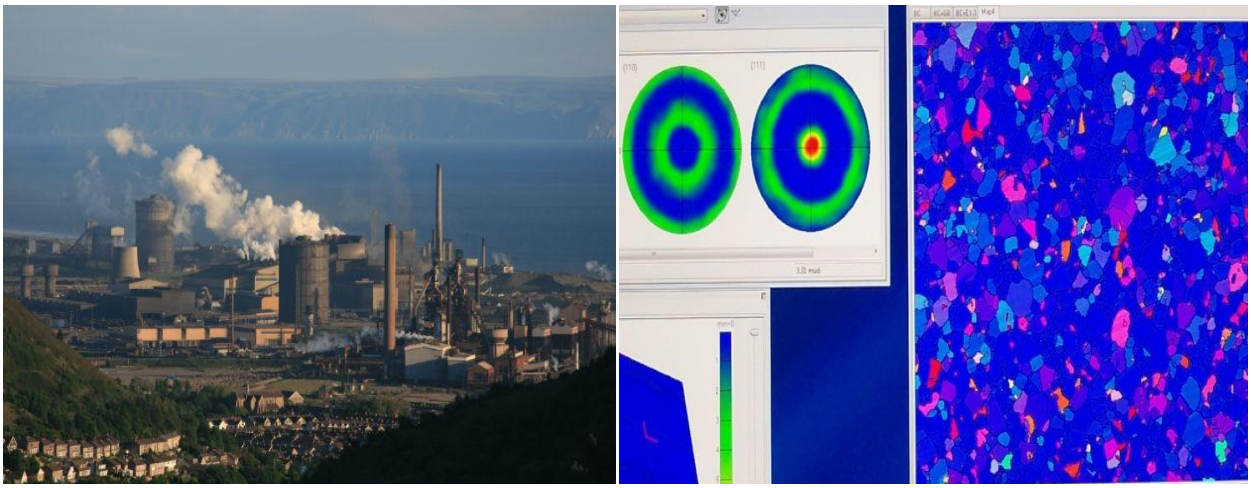
The sun has risen over steel town

Developing a sustainable steel industry in the UK



Pictures: Port Talbot steelworks; new steel materials being examined under powerful microscopes at Swansea University

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Introduction

With Port Talbot's future still in question despite having returned to profit, is the Government support pledged for the steel industry likely to achieve a sustainable steel industry in Europe rather than the UK?

The Tata steel strip business at Port Talbot is today making profit and is in a much healthier position, performing above the ambitious levels targeted in the local transformation plan, which had been previously rejected as unviable by the Tata Board in Mumbai. Little has been reported of this turnaround, and the industry today faces ongoing and increasing uncertainty whilst Tata is now in talks about a potential merger of its European strip steel businesses with those of the German producer, Thyssen Krupp Steel (TKS).

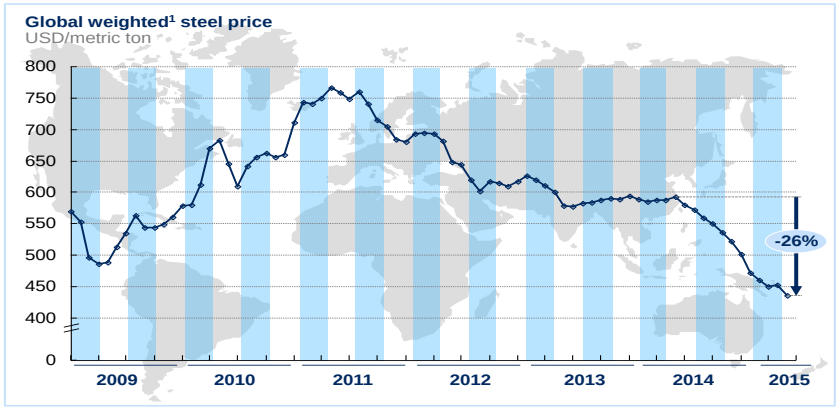
TKS believe that capacity reduction is necessary in Europe, and Port Talbot could become a convenient sacrifice for them. Tata themselves have previously expressed the view that there remain serious question marks over the long-term viability of the UK strip steel businesses, with pension and energy costs along with business rates being cited as areas where the UK businesses were disadvantaged compared with their European counterparts. Whilst Tata have called into question the viability of the very assets they were attempting to sell, there is now internal recognition that the UK strip steel businesses have turned the corner back to profitability.

The UK steel industry could evolve into a leading-edge zero-carbon steelmaker with carbon-positive products utilising locally-generated by-products as a chemical and raw materials feedstock; this is a model that could be exported to all developed economies ensuring a vibrant, innovative and profitable steel sector with regional and national product specialisms. The Port Talbot plant does have a viable future once in the hands of an owner with a longer-term vision, who will commit to - and invest in - transformational change.

This article lays out the case for a viable future for Port Talbot in the context of the important key global drivers for the steel industry and the recent history of the plant.

The Bottom Line

The profitability of an integrated steel plant is dependent less on marginal improvements in productivity than upon the fluctuations in raw material prices and market conditions (the sale price) - what the industry refers to as "the spread". Added to this is the degree of infrastructural favorability in the geographical location, a point we will return to later in this section. In the year 2014-2015 the global weighted steel price fell by 26% (although at the time of writing there has been some recovery in sales price). The sharp dip in this long-term price reduction has been driven by the well-documented global overcapacity of steel and the market disruption caused mainly by dumped steel from China and elsewhere.



1 Weighted average by region and by product

Global weighted steel price (Source data: MEPS International Ltd).

However, this only tells half the story. Considering raw material prices over the same period, iron ore prices have dropped 60%, ensuring improved margins for the primary steel producers. In Port Talbot, where the annual spend on raw materials is in excess of $1.0 billion per year, this has a big impact on financial performance. Considered over a longer timeframe, ore prices show significantly more volatility than sale prices.

Building resilience into fluctuations in this fundamental margin for the business is key to delivering a sustainable steel industry in the UK. It would seem logical to pursue a strategy when conditions are favourable (like now) to make the industry resilient towards these fluctuations through technological innovations.

Average iron ore price (Source data: Bloomberg)

Maintaining the status quo, and awaiting the next dip in the market and/or increase in raw material prices, is the last thing to do. Given that UK Steel have estimated that Port Talbot is already hamstrung by a £6-7MWh wholesale price differential between the UK and German energy costs [(1)], its recent profitability suggests it is a prime candidate for this type of investment.

Likewise, any suggestion that the Port Talbot site could have a sustainable business model with a single blast furnace operation (currently two) is highly flawed because this would reduce the volume of fuel gases arising from coke ovens, blast furnace iron making and steel making. These gases are used as the fuel source for the plant's own power generation system. Cutting coke and iron production to 50% of maximum capacity would result in a huge increase in the need to import natural gas to provide the electrical power required for the rolling operations and for gas heating of furnaces. Indeed the requirement for both increased electricity and natural gas would overwhelm the capability of the local energy network. Moreover, whilst employment costs and other

operational costs would be reduced, this would be more than negated by higher energy costs, squeezing margins further and setting the business on a path of spiraling decline.

The road to resilience can be achieved through innovation supported by targeted capital investment in the development and introduction of transformative changes at the front and back ends of the process. At the front, where the reduction of iron ore into metallic iron is by far the most intensive – in energy, raw material and CO_2 - of all steps, *flexibility* is crucial. Ideally, this would mean flexibility with both the iron source and reduction agent. At the back end, the ability to increase flexibility would be ideal – imagine if steel grades, coating type and gauge could be decided per demand, like ordering a sandwich? The latter may be too far-fetched at this point, for an industry where profits are still tied to volume, based on the very limited and remote technology support available today.

This should also be supported by adding value to the products through innovative measures that create differentiated products for unique applications where competition is low and the UK customer supply chain is strong. A value-added steel-based product that uniquely enables something, such as light weighting for a car, electric machines or protective armour, is more viable in a modern economy than volumes of steel produced with no specific application. History has shown that primary-only production is not sustainable, an example being the recent failure of the SSI venture on Teesside that produced only steel slab. This business model was doomed to fail, as the role of the Teesside plant was merely to bridge a gap in SSI's own capacity development; once the problem was solved then Teesside was sacrificed, with drastic effects on the local community.

Why bother making steel in the UK?

This is a tricky question because it is not one that is founded on whether or not the Government considers the industry of national importance. In a country where there is no abundant energy availability, or a clear strategy towards national energy resilience, and no obvious sources for raw material, the question arises – "do we need to make steel in the UK?"

While it is a valid question, it is one that is applicable to most manufacturing sectors, and not limited to the UK but to the rest of Europe and the industrialised countries in Asia as well. One could argue that countries such as Japan, Korea and Austria have a modern steel industry that is perceived as viable, but only because POSCO, JFE, NSC and Voest Alpine are considered national assets. A climate is created in these nations where infrastructure is developed to support these producers: preference for nationally-produced steel for national infrastructure projects, along with support for research and innovation centres at universities and workforce training.

For the UK, a sustainable manufacturing process for steel products requires all of the UK manufacturing assets working as a whole, as the downstream operations (coating and forming capacity) provide the infrastructure to deliver differentiated products and ensure supply. The process needs also to be driven and guided by customer demands and to embrace the concepts of the circular economy and industrial symbiosis.

The History

The steel industry was once synonymous with British industrial strength and pride and a significant number of innovations made in the UK have contributed to the modern industry. The Bessemer process was the first to economically mass-produce steel and Bessemer also developed the concept of continuous casting. Going even further back, the coke-based blast furnace was invented by Abraham Darby. There have also been innovations on the product side, e.g. the micro-alloyed steels invented by Gladman at Swinden laboratories in Rotherham. So, when did the steel industry morph into what it is today?

At the time of the merger that formed Corus group in 1999, British Steel was cash-rich with reserves of around $1Bn. The UK success was built on strong UK-based corporate RD&T and valuable UK-generated intellectual property on high-quality differentiated products. At the time the merger was heralded as a coup for Hoogovens as it provided access to the UK market that was dominated by British Steel.

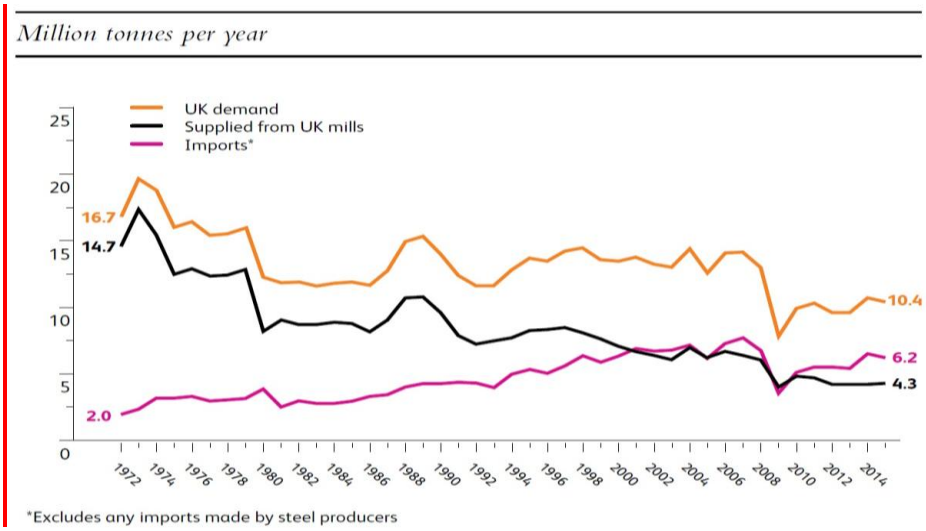
However, the ensuing years saw a significant lack of investment in the UK plants. Later, when speaking to the 2007 Welsh Globalisation Committee, the then CEO of Corus Mr. Philippe Varin reflected that "between 1999 and 2003 the company has not invested enough." and that during this period the focus on the development of differentiated products "…led to further investments in downstream operations … especially in Ijmuiden"[2]. This is illustrated by a study by a leading steel industry consulting company, which revealed that Port Talbot had only enjoyed 50% of the investment level compared to the industry norm. The study concluded that Port Talbot was over-achieving from a performance perspective given this low level of investment.

Since the merger, the UK steel industry, (i.e. Corus and Tata) has been starved of both research and development capacity and the necessary capital investment to ensure its sustainability. Indeed the numbers employed in RD&T in the UK declined from 900 to around 150 today, an 83% reduction, resulting in the closure of the Welsh Technology Centre, downscaling and divestment of the Teesside Technology Centre, and downscaling and forthcoming closure of the Swinden technology Centre. Meanwhile RD&T activities have been centralized and strengthened at Ijmuiden in Holland, which has around 450 employees, and new smaller facilities created at Warwick. The loss of locally-based expertise and knowledge has severely limited productivity development and innovation in the UK.

The Market

Despite the low growth rates for steel across developed economies, in the case of the UK, domestic supply now only supports around 40% of the country's needs. This represents a huge opportunity for domestic suppliers to recapture market share on the back of the weak pound and to further exploit opportunities to export high-value products into the automotive, construction and packaging sectors. The market for strip steels available to Port Talbot is in excess of 10 million tonnes annually and is supported by the automotive, construction, energy, general engineering, and packaging sectors.

These sectors are key contributors to the UK steel consumption of high technology products. Each of these market sectors has quite different technical requirements for steels during their own manufacturing and processing operations and also in terms of in-service requirements. This has led to the development of bespoke grades of steel, bespoke production methods for steel strip, and bespoke testing facilities to provide customers with the necessary assurances for product capability and conformance.



UK steel demand vs UK steel production and steel imports (Source: UK Steel).

In the case of the automotive sector the UK market is currently booming. The Society of Motor Manufacturers and Traders (SMMT) recently reported that British manufacturers made more cars in 2015 than any year since 2005, with UK automotive boasting a £71.6 billion turnover in the last year. In their 2015 report "Growing the Supply Chain – the opportunity ahead" they predicted that the demand for metal pressings and hot stampings, which are overwhelmingly strip steel products, would increase by 50% to £225 million by 2017. They expect that "the future opportunity to re-shore tier-1 supply chain activity is likely to be in the region of £4 billion per annum over the next four to five years"[3]. Furthermore, their 2016 sustainability report identifies ferrous materials as "the number one recycled material in the End of Life Vehicle (ELV) Directive," as increasing pressure is placed on automotive manufacturers to contribute to the circular economy by ensuring CO_2 reduction over the whole vehicle life cycle [4]. In support of this they cite "enhancing support measures for R&D that bolster the UK's manufacturing base and promote investment in new technologies" as one of their five priorities for the current government[5].

The construction sector market for strip steels relates to supplying coated and formed strip steels mainly for building cladding and roofing. Welded tubes produced from strip are also widely used in this sector. Coated strip produced for this sector is world-leading; together with the prospect of applying photovoltaic coatings to steel sheets, it will allow the UK steel industry to develop buildings capable of generating their own electrical power. Moreover, the SOLCER house built in South Wales is capable of becoming a net exporter to the grid, thus having the potential to have a major positive impact on the energy sector.

Electrical grade steels for transformers are also produced and the industry is working closely with the automotive industry to develop small-scale transformer units for use in electrically-propelled cars. Perhaps more critically, the national grid has ageing infrastructure with many of the transformers employing inefficient electrical steel core materials manufactured over 40 years ago. The production of modern grades will be essential in overhauling the UK's most important national asset.

Tin-plated steels are still widely used for food packaging and in many cases they are the only technically viable method for food storage. Whilst there has been significant growth of plastic packaging, plastics, unlike steel, cannot be easily recycled and are either consigned to landfill or exported to third nations as an energy source.

All this represents a lucrative opportunity for the future of the UK steel industry. However, it is also a strong opportunity for the European producers, especially if the domestic supply of such products can be controlled or even eliminated. This, combined with uncertainty in relation to the future trade

relations between the UK and the EU following the Brexit vote, represents the strongest possible argument for the strategic retention of a steelmaking capacity within the UK.

The Future

The question remains, if the UK government decides to strategically retain its steelmaking capacity, how and where should it commit resource?

In the short term the **Government needs to look at competitive energy, business rates and procurement strategy**. Procurement strategy should be used as a government vehicle to encourage innovation in more traditional sectors such as construction, for example through the adoption of low carbon, steel-based technologies in new house building, offices and other appropriate infrastructure projects.

The government also needs to **support the asset improvement plans outlined in the strategic document presented to the Tata Steel board** in 2015. This would bring about a significant improvement to the efficiency of the Port Talbot site and also differential product ranges.

Research into Electric Arc Furnace (EAF) production of strip steels or alternative steel technologies should be a key part of any government intervention including no-risk investments e.g. upgrading power plant.

In the USA, around 60% of steel is produced from scrap steel recycled by re-melting in Electric Arc Furnaces. Scrap reuse eliminates the energy needed to reduce iron ore and make coke, which eliminates more than half of the total energy cost and carbon footprint. The EAF route requires a fifth of the capital cost of traditional steel mills that start with iron ore. When coupled with good liquid metallurgical practices and control and high-speed casting technologies, this way of making steel is far more competitive and sustainable than integrated steelmaking.

So, why don't we shift to scrap recycling overnight, considering that UK energy costs are high, we have no domestic iron ore and we export our steel scrap? There are several key barriers that currently limit the technology:

1. Firstly, impurities in scrap such as copper and tin can cause cracking of the steel during casting and this prevents the manufacturing of high-quality strip where surface quality is mandated. Increasing levels of automotive scrap with more gadgets containing copper wiring degrades the total quality of scrap. Limitations may vary from plant to plant but generally are restricted to a maximum content in percent of Cu+Sn of 0.04 for IF sheet steels, while shredded car scrap contains nearly 0.3% of Cu+Sn. [6]. In the USA, the availability of cheap shale gas allows for so-called direct reduced iron (DRI) to be added to dilute the melt and thereby lower the content of harmful residuals. In the absence of cheap natural gas, significant breakthrough innovation is needed on developing processes for both eliminating/lowering copper and tin in the molten state in an economical way and to develop thermo-mechanical processes that allow for a crack-free processing path.
2. The electric energy needed for EAF would require significant infrastructural investments in the country's power grid.
3. Scrap sales may currently not be secured and some form of strategic policy may be needed to ensure a reliable supply chain, e.g. a revert agreement.

In the long term, scrap recycling would seem logical, given that innovations in power generation driven by society at large may bring electricity costs down, and regulations on carbon footprint may simply regulate fossil fuel-intensive processes such as blast furnaces out of business. However, a gradual transition towards a scrap-based process over 10-20 years would seem more logical to allow for the barriers 1-3 above to be overcome. This will also require government investment on

research, especially to tackle the issue of impurities in scrap. The lower-value grades where surface quality is less critical could - and should - be imminently transitioned to the EAF route when/if points 2-3 above are implemented by the government. Meanwhile, the higher-end steel strips that are needed for producing higher-value differentiated products - Corby for tubular products, Llanelli for packaging steels (tin plate), Newport for automotive and electrical steels, Shotton for construction steels - all need to be supplied through the integrated route.

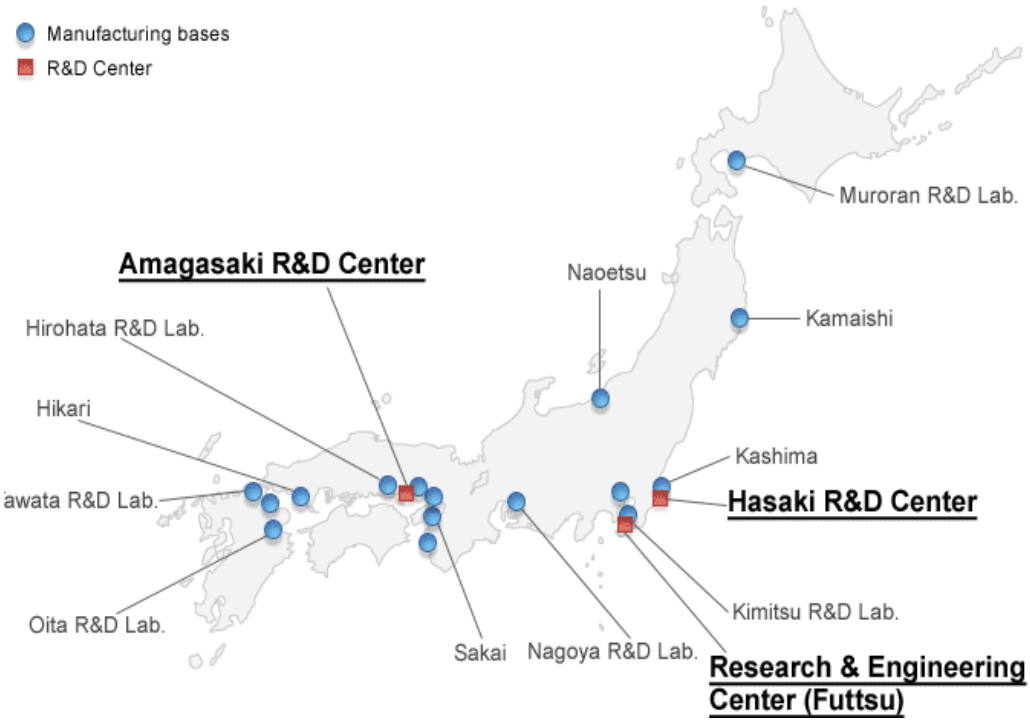
Reducing Port Talbot to a single blast furnace operation will ultimately increase costs; indeed, such a model has been evaluated and dismissed as unviable because of the negative effect on energy costs and other operational considerations. In the medium to longer term it should be possible to develop a hybrid production model where electric arc steelmaking using recycled scrap is integrated into the site's energy infrastructure allowing it to sit alongside traditional blast furnace technology. The purer form of pig iron can then be used as a dilutant for the contaminated steels produced from the EAF, which could obviate the need to import DRI. Furthermore, opportunities to explore industrial symbiosis with other industry clusters should be pursued as part of a UK and Welsh Government industrial strategy, which itself would improve the resource, energy and financial sustainability of the industrial sector.

Delivering Innovation

It is also **essential that the Government support an underpinning innovation agenda and research and development structure to support these activities**, with key R&D sites located close to manufacturing sites

In a subset of a much larger independent study covering 1,757 board-level executives responsible for innovation within their company, a 2014 PWC report on innovation in over 700 companies from the metals industry details current practice for innovation in the sector[7]. The report highlights the importance of a coherent strategy for research across the organisation, with 79% of respondents stating they have formal innovation structures in place in individual businesses units. The report confirms: "this makes good business sense, because aligning innovation to business units ensures the innovation teams do not become isolated from the rest of the organization".

All of the top 5 steel-producing companies globally, according to 2015 World Steel Association figures, have substantial research and development facilities sited at or within a few kilometres of their largest manufacturing sites. The largest producer, Arcelor, has 11 research and development centres globally; all of them are located at or very near to manufacturing sites. Nippon steel, generally regarded as one of the most innovative steelmaking companies, has centred its innovation capacity around manufacturing clusters, as seen in the figure below.



Location of Nippon Steel's R&D centres with respect to its manufacturing operations

In a 2012 report[8] published by the company it highlights its "total power and speed of development through the integration of R&D sites and practical application of R&D results" as one of its key strengths. It also highlighted "proximity of R&D labs at steelworks to customers and an established organization to support and cooperate with customers" as an advantage, suggesting that the provision of satellite research facilities focused on integration with specific customer sectors will reinforce this successful model. In South Korea, POSCO has gone even further with the opening of its Centre for Creative Economy in January 2015 close to its largest production facility. This $25M centre aims to conduct collaborative projects, nurture talented manpower and transform its Pohang plant and other production facilities into an eco-friendly, zero-waste industrial complex.

These strategies correlate well with observations of the most innovative metal companies made in the PWC report, but are in significant contrast to the remains of the steel innovation infrastructure in the UK. Currently there is no similar on-site/local provision for any of the UK's largest steelmaking sites, with the vast majority of the R&D infrastructure for Tata Steel Europe located at the site of their Ijmuiden integrated steelworks in the Netherlands.

The evidence from successful companies overseas suggests that a similar model – colocation of research and development with manufacturing sites - should be implemented to support the long-term sustainability of UK steel production.

Indeed, the Welsh economy is welded to a healthy steel industry and the Welsh government is to be commended on their commitment to support the delivery of networks for innovation and competence development. The UK Government needs to follow suit for the UK industry as a whole.

Summary

The recent performance of the Tata Steel UK Strip business, which includes the integrated steel plant on the Port Talbot site, is vastly improved, with the business having returned to profitability. The success or failure of the industry depends primarily on its resilience to fluctuations in the bottom line of the business, namely raw materials prices versus sales prices.

Now is the time to develop this resilience via targeted capital investment and the implementation of a coherent innovation infrastructure. Given that UK demand for steel far outstrips supply and the UK market conditions are strong, there is an excellent opportunity to secure the future sustainability of the UK steel industry.

The European arm of Tata Steel must now be reflecting on the success of its last British-run commercial steelmaking entity and the proportion of their own order book that feeds the UK downstream assets, and seriously considering the effect on their own business. Put in this context it is not so difficult to understand why Tata Steel has decided to reconsider selling its UK assets.

However, the prospect of a joint venture between TKS and Tata's European operations (including the UK) may not bode well for the long-term future of strip steel production in the UK and assurances should be sought with regard to this potential threat to the industry's future.

The UK government has committed up to a 25% stake in the future UK business, whosoever the buyer. But given the current indications, if this solution does not include assurances for Port Talbot and all of the downstream operations, this funding is likely to support a more sustainable steel industry in Europe but not in the UK.

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