Materials Processing Institute

FUTURE DEVELOPMENT OF THE UK STEEL INDUSTRY

A Speech Given at the 12th European Electric Steelmaking Conference

14 September 2021

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Materials Processing Institute

Good afternoon and thank you Richard for your introduction. It is a real pleasure to be here at the European Electric Arc Furnace conference, at such a critical time for our industry. In previous years this conference was of interest primarily to those steel producers who used electric arc furnaces, but this event has taken on huge new significance with the need to eliminate carbon dioxide emissions across the industry.

The majority of steel producers are looking for an alternative to their existing blast furnaces, which emit large quantities of carbon dioxide and are likely to be phased out in the coming decades. The EAF, combined with hydrogen ironmaking, is the best alternative technology and we can expect significant growth in electric steelmaking as production switches to this method between now and 2040.

In this talk I will outline how the industry in the UK may develop, but this is also intended very much as a call to action. With rapid progress being made in other nations it can be by no means certain that the UK steel industry will make this transition and it certainly cannot do this alone, without an improvement in the UK competitive environment and significant support for innovation and capital investment.

I have spent most of my career in technology and innovation and for the last 6 years I have been the Chief Executive Officer of the Materials Processing Institute, though I am also the Chair of the UK Metals Council, representing 10 trade associations and 30,000 employees in the UK metals sector.

The Institute is the UK's national centre for innovation for metals, having been established more than 75 years ago, to support the development of the UK steel industry. Over that time, researchers at the institute have worked in collaboration with industry and academia, to develop many technologies that are in standard practice in the steel industry globally, but in recent years our focus has broadened beyond steel to encompass the full metals supply chain.

We apply our expertise and facilities, to support industry in addressing the major societal challenges of our age and it is these challenges that are shaping the future of the steel industry.

> In Advanced Materials there is the development of new steel alloys and improvements in the efficiency of metals processes, to improve quality and productivity. Key facilities include our Advanced Materials Characterisation Centre, which has world leading, state of the art characterisation facilities, including for high temperature metallography.

> The second area is Industrial Decarbonisation where we are developing sustainable processes that avoid damaging climate emissions and will supply steel for the the new technologies we need for the rest of the green economy, such as offshore wind, nuclear energy and electric vehicles.

> Another aspect of sustainability is the Circular Economy which is about minimising the amount of material that we use and ensuring that at end of life, materials are extracted and recycled back into the supply chain. Our role in this area is in developing extraction and recycling processes.

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> The 4th area of innovation underpins the others and it is Digital Technologies. Across metals manufacturing we are identifying opportunities for major leaps in productivity enabled by new digital technologies. Our role here is demonstrating their application in a steel and metals environment. Sometimes this can be about ensuring that the technologies can survive in a hostile environment, or developing new instruments and sensors that can provide the essential data input to a digital architecture. Often this also involves application of our detailed processing knowledge to enable transfer of a digital technology from one environment to another. We are currently working on advanced data analytical techniques, AI enabled process control, wearable technology, robotics and blockchain for supply chain management, amongst others.

The Institute is currently delivering a £22m government funded programme of support for the UK steel and metals sector, that offers subsidies of up to 50% on research and innovation projects. The programme also includes investment in renewing the Institute's asset base, through investment in state of the art research facilities, including brand new, extensive metallurgical laboratories, both mathematical and physical modelling and our 7T scale pilot plant facility, which includes an electric arc furnace, continuous casting machine and both induction and vacuum induction melting.

In considering the future development of the UK steel industry, I want to turn first to the current position of the UK steel industry and it can be seen that, as a whole, the industry is failing to capitalise on the full potential of the UK market.

In 2017 my Institute undertook research for government. You can find the full report on the government website. We forecast a £3bn opportunity in steel to 2030, with construction as the main growth area. In fact most of the standard product lines showed growth potential. Since then, the UK government has announced plans for further major investment in infrastructure and defence, yet we have seen decline in absolute UK steel output and loss of

market share to imports.
Before considering how the UK steel industry can transform in the future, it is important to understand the underlying reasons for this performance gap. One major issue is the uncompetitive business environment for steel in the UK, that sees industrial energy prices significantly higher than European competitors.

We cannot expect the private sector to invest in steel in the UK, unless there is a level playing field with the competition. We need to acknowledge that all governments around the world rightly intervene to support their steel sector and so if we want a sustainable steel industry, then we must use policy to create a level playing field and energy is an important starting point.

A false equivalence is sometimes made, with an excuse that if energy prices for industry fall, then energy prices for the hard pressed consumer must rise, but where to place the burden for energy costs is actually a policy choice and we can be sure that consumers value highly paid jobs in a productive environment, one where they can earn enough to pay their energy bills, more than a subsidy that enables them to just about get by.

We must also acknowledge though that some of these issues with competitiveness are not just about the business environment, but also about shifts in technology and historic investment. The UK steel industry made steady progress on productivity improvement over many decades, meaning that after about 40 years we were able to make the same amount of steel with one tenth of the workforce. However, since the financial crisis this link has been broken and productivity in the UK, whilst not too far adrift from the best in Europe, is now low by best in the world standards. This presents a significant opportunity to invest in renewing UK capability to compete effectively, despite the higher energy prices, based on being world leading in productivity.

Such investment is, in any event, essential, given the need to decarbonise. Steel companies are under increasing pressure to decarbonise and the time is coming to make decisions on future technology.

We already know what the technology will be, a combination of electric arc furnaces, hydrogen reduction and, possibly, carbon capture and storage. The alternative of applying carbon capture to the blast furnace does not, in my view, present a viable solution, as it locks in low productivity technology that would leave the business struggling to compete.

Alongside the need to decarbonise, we are in the midst of the 4th industrial revolution and it is this, plus the development of new processing technology, that is driving the significant increases in productivity.

For the steel industry there are unique challenges in this digitisation in that even as we install new process technology, this must be retrofitted to and integrated with legacy plant and equipment. That is why at the Materials Processing Institute we are adapting our pilot plant facility to become a steel plant of the future, not as a green field, new build facility, but by demonstrating the applicability of the latest digital technologies, to standard unit operations such as the electric arc furnace and secondary steelmaking.

Instrumentation is another major challenge in the steel sector, with hot, dusty, hostile environments the norm in primary end production. We are overcoming this by the application of our specialist engineering skills and prototyping, both in our pilot facilities and on production sites.

There are also a number of issues connected with data handling that must be overcome, including validation of data, homogenisation of data, so that it can be automatically interrogated and data security.

These three challenges of integration with legacy equipment, robustness of instrumentation and data handling & security, are common across the application of many digital technologies and so once resolved they open the door to different applications.

There are many, emerging digital technologies that can be seen to have positive application in the steel plant. For instance the industrial internet of things, offers the opportunity for real time simulation and customised dashboard, whilst artificial intelligence allows for complex decision making tasks and machine learning.

Augmented reality can be used in conjunction with both of these technologies to provide a user interface, through wearable technology, that overlays digital information on the real world.

The link between digitisation and decarbonisation extends beyond steel production to the wider economy. Delivering the infrastructure of a zero carbon economy will require new renewable energy, electric vehicles and greater connectivity. It needs concrete, steel, copper and cobalt. All materials that are currently produced at a great carbon cost to the planet and, in the case of cobalt, at a great human cost. A zero carbon economy, requires zero carbon materials.

As we know, the nature of fourth industrial technologies makes process-oriented jobs more susceptible to displacement. Future Advocacy, a think tank focused on new technologies such as AI, broke down the impact by region in the UK, showing that there is a high degree of regional variation with the Midlands and north of England hit hardest.

The reason for this is that the most modern steel plants in the world, such as those in North America, operate not only with electric arc furnaces, but advanced downstream processes, that result in up to five times the efficiency of a conventional blast furnace plant, leaving traditional producers floundering, even with record steel prices.

Countries around the world are now competing in a race to zero.

In this race to net zero, we can see countries around the world competing hard to be the global leader and that race is now accelerating. Until recently, Sweden was seen to be the leading nation, with their flagship HYBRIT project, a collaboration of three industrial groups all either wholly, or partly state owned, aiming to introduce hydrogen produced Green Steel to the market in 2026. This project was joined in February this year, by a new start up steelmaker, H2GreenSteel[1], which aims to build a brand new, 'fully integrated, digitalised and automated greenfield steel plant', in Northern Sweden, to be start up production in 2024 and be fully operational by 2030.

Until recently the HYBRIT project was the front runner, but on 25th June HBIS, the world's third largest steelmaker, based in China, announced that as well as starting the World's first hydrogen direct reduced iron (DRI) plant in 2021, they will have a full scale hydrogen plant up and running by 2025[2]. In the same week, Austrian steel producer voestalpine, announced the commissioning of their pilot hydrogen DRI plant[3]. More recently we have seen commitments to hydrogen demonstration plants in Germany and Canada. All of these projects have required significant government investment.

This increase in productivity, whilst important for competitiveness, will lead to a significant reduction in employees, which needs to be carefully managed to achieve a Just Transition and avoid creating localised deprivation. Making the transition over a period of time, as I describe in these publications, is one way that this can be managed.

Alongside timing we also need to stimulate co-investment in the new, high growth and exporting industries of the green industrial revolution. These industries require a highly skilled workforce and

[1]https://www.h2greensteel.com/
[2]https://www.steelguru.com/steel/hbis-unveils-plan-for-low-carbon-steel-development-in-china
[3]https://www.steelguru.com/steel/primetals-hyfor-pilot-for-hdri-starts-at-voestalpine-in-donawitz

steelworkers have valuable, transferable skills. From electric vehicles, to offshore wind and nuclear, with investment and retraining, our steelworkers can provide the steel on which these industries will rely and the workforce to make them a success.

The improved competitiveness of the UK steel industry can become the foundation of a new era of growth, particularly in downstream activities where thousands of jobs could be created. By taking the needs of individual companies into account alongside the UK's wider industrial strategy, the steel industry can be decarbonised, allowing a smooth and just transition for the workforce.

The Materials Processing Institute, was established at a time of crisis in the steel industry. Towards the close of the second world war, just a few days before D-Day, Winston Churchill's government began the process of planning for recovery and established the Institute as a vehicle to support the transformation of the steel industry and the rebuilding of our country.

There are strong parallels here with today, where emerging from a pandemic and needing to rebuild a green and sustainable economy, requires a strong, resilient and zero carbon steel sector. Indeed, the commitments made by G7 leaders recently, on COVID recovery, on decarbonisation and on infrastructure, cannot be achieved without the steel industry. More than this the commitments made by the Prime Minister in his ten-point plan for a Green Industrial Revolution, in areas such as offshore wind, electric vehicles, the hydrogen economy and advanced nuclear technology, are all reliant on advanced steel capabilities in the UK. Achieving these aims requires investment in innovation in the steel and wider metals sector.

The strategic importance of domestic steel production has long been understood in terms of defence, but during the pandemic we also saw how we depend on the steel industry for our basic needs, with tinplate from South Wales for canned goods and steel tubes from Corby for beds in Nightingale hospitals. Looking to the future, particularly as global trade becomes less reliable, we need our steel industry to support advanced manufacturing and infrastructure, as government seeks to both decarbonise and invest to level-up, across the country.

We need to acknowledge that all governments around the world rightly intervene to support their steel sector and so if we want a sustainable steel industry, then we must use policy to create a level playing field. This morning, I will talk through how we can decarbonise by digitising, but also what this means for jobs in steel communities.

In summary then we can see that:

1. The UK has a strong and growing demand for steel, particularly in construction.

2. The domestic industry is under pressure from imports, due to a competitive gap arising from a less competitive business environment and some gaps in capability. At the same time the UK industry faces pressure to invest to decarbonise.

3. The best response from the UK industry would be to decarbonise by investing in the latest processing technologies, including hydrogen, electric arc furnaces and downstream processing, going smart and going green at the same time. This will result in an increase in productivity and competitiveness as well as eliminating carbon emissions.

4. To do this will require significant new investment in innovation and skills development, working in partnership with innovation providers, such as the Materials Processing Institute and universities, but as in other countries, this must be delivered as a partnership between government and the industry.

5. The consequences of this change will be a significant reduction in workforce, for which a just transition is required, but again this needs to be addressed by both government and industry working together.

I would like to close by offering my thanks to the chair and organising committee of the conference for their kind invitation to speak today and to say that if you are interested in finding out more about this topic, or about other aspects of industrial strategy and decarbonisation, then do head along to my Youtube channel, or twitter account.

Materials Processing Institute

Chris McDonald is the Chief Executive Officer of the Materials Processing Institute. The Institute carries out industrial research and innovation in advanced materials, industrial decarbonisation, digital technologies and the circular economy supporting the materials, processing and energy sectors for over 75 years. Chris led the divestment and return to independent, not-for-profit ownership of the Institute in 2014.

Chris's background is in industrial research and manufacturing, where he has worked internationally. A graduate of Cambridge University, Chris is a Fellow the Institute of Chemical Engineers and of the Institute of Materials, Minerals and Mining. He sits on industrial advisory boards at a number of universities, including Oxford and Sheffield.

Chris has an interest in innovation management and industry dynamics and in addition to leading the Institute, he provides expert opinion and consultancy support to companies, institutes, Governments and public bodies in innovation and technology strategy and management. He also advises on the technical due diligence aspects of mergers and acquisitions.

Chris is prominent in the development of public policy, around innovation, steel, SMEs, where he works to support growth and inward investment. Chris is the policy chair for Innovation and Enterprise for the Federation of Small Businesses, a member of the CBI Regional Council and Shadow Monetary Policy Committee for the North East, the Chair of the UK Metals Council and a member of the Steel Advisory Board for UK Steel (EEF).

Chris is often called to commentate in the media on innovation leadership and the steel industry.

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Chris McDonald
Chief Executive Officer
Materials Processing Institute

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The Materials Processing Institute is an independent, open access and not-for-profit technology and innovation centre working with industry, government and academia worldwide. Support ranges from small scale, site based investigations, through to long term collaborative research programmes.

The Materials Processing Institute is expert in advanced materials, industrial decarbonisation, digital technologies and the circular economy, specialising in challenging processes, particularly those involving high specification materials, high temperatures and difficult operating conditions.

The Institute has over 75 years' experience as a leading UK technology provider. Extensive materials processing knowledge is supported by state-of-the-art facilities with a broad range of equipment, from laboratories through to demonstration, scale-up and production plant.

Scientists and engineers work with industry and apply their expertise to develop and implement robust solutions to research and development and improvements for products and processes.

Expertise is spread across a wide range of disciplines, including:

- Materials Characterisation, Research and Development
- Simulation and Design
- Monitoring, Measurement and Control in Hostile Environments
- Process Development and Upscaling
- Specialist Melting and Steel / Alloy Production
- Engineering / Asset Management
- Materials Handling
- Minerals and Ores

Research and project management teams deliver support across a wide range of industrial and manufacturing sectors including:

- Metals and Metals Manufacture
- Chemicals and Process
- Nuclear
- Oil & Gas
- Energy
- Aerospace and Defence
- Mining and Quarrying

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75
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