Materials Processing Institute

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CRITICAL RAW MATERIALS: DECARBONISATION, DEMOCRATISATION AND DECENTRALISATION OF SUPPLY CHAINS

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The world has a long of history of conflict when it comes to valuable and scarce resources, be that the Conquistador's hunger for gold in South America, or European powers seeking control of the Spice Islands in South East Asia. For most of our modern history the resource has been oil and the conflict has been in the Middle East.

This is about to change. Access to rare earth materials is now vital for future technologies and we can now see the power play for resources such as cobalt and lithium as potential conflicts of the future if we don't act now.

Our global economy faces two major forces for change. The challenge is to decarbonise fast enough to prevent catastrophic global warming and the solution is in the emerging digital technologies of the 4th industrial revolution.

These two unstoppable forces are driving the rapid development and commercialisation of technologies that will reduce oil dependency, but also move the risk of conflict and exploitation to impoverished and unstable countries such as the Democratic Republic of Congo, where valuable resources are to be found.

To meet these challenges in a way that is both sustainable and avoids making the mistakes of the past, we need to consider how we can realise the potential of these technologies and secure the resources through the decarbonisation, democratisation and decentralisation of supply chains.

Decarbonisation

It can come as a surprise to learn that the technologies which will enable us to create the green industries of the future, are dependent on the highly resource and energy intensive industry of mining and yet everything has to be made out of something. Consider electric vehicle batteries, for example, where new technology relies significantly on the supply of materials such as copper, graphite, cobalt and lithium.

New technologies required to decarbonise our economy depend on a set of raw materials that are both critical and scarce. From platinum to palladium, niobium to neodymium, gallium to germanium, these elements are essential for fuel cells, photovoltaics and LEDs.

The manufacturing industries of the future depend on these materials, classed as critical by the British Geological Survey. The challenge is that few nations hold sufficient resources in sufficient quantities.

Democratisation

Fundamental as they are to economic growth, access to these materials is important for UK sovereign capability in industrial, defence, and foreign policy too. Just as the discovery of Borrowdale graphite in the 16th century enabled the UK to dominate the global writing instrument industry for almost 300 years, so Chinese dominance of the global graphite supply in the 21st century threatens ambitions for so-called 'giga factories' in Europe.

In fact, with 40% of global rare earth reserves combined with a canny foreign policy initiative in the 'Belt and Road', China could dominate the green technologies of the future, such as smart phones, electric vehicles and renewable energy.

Relying on primary sources of materials risks exploitation of both people and the natural world. It can place control in the hands of unstable, or undemocratic regimes and incentivises global powers to keep things that way. This may seem a matter for geopolitics, but addressing this supply chain vulnerability requires policy makers, technologies and manufacturers to recognise their interdependency and take a new approach.

For the EU to achieve its target level of electrification by 2030 would deplete the known world reserves of lithium within five years and cobalt within 12 months. It is generally assumed that industry would find more reserves, but even a trebling would present a huge challenge. China already controls 80% of supply and is leading the world in the implementation of many green technologies at scale.

UK and European governments need to support industry in unleashing the forces of innovation, to understand how these precious materials can be conserved, tracked, separated, reused and recycled. This can be an enabler for a circular economy, with a 'cradle-to-cradle' approach to manufacturing that is more environmentally sustainable, efficient and profitable.

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Decentralisation

There are also new manufacturing techniques that can help, such as additive layer manufacturing, also known as 3-D printing. This technology will render obsolete large swathes of the supply chain, from machining to welding and fabrication. Value in the supply chain is collapsing to two areas, materials and design. There are companies well positioned to take advantage of this, including Liberty Powder Metals, which recently announced a £10m investment at the campus of my own research institute, for the development of new metal powders.

The next challenge comes in upscaling these technologies. This requires new processes that either use fewer materials, or increase efficiency. As this industrial revolution takes hold, we will see the increasing importance of materials and materials science, in both driving forward and capturing value from the supply chains of the future.

Response

The technologies to decarbonise our economies must be commercialised, but this is best done in a way which allows both democratic control and decentralisation of supply chains. Legislators can help ensure that industrial policy takes a supply chain approach, whilst I have long argued that we industrialists and manufacturers need to be more concerned with the ethical supply of our materials and our environmental footprint.

We should not seek to pass off our global responsibilities to current and future generations so working conditions, sustainability and financial probity in the materials industry that makes up our smart phone is as critical as in the design and assembly.

Let us do more to realise the technologies that will enable a circular economy approach in rare earths and critical materials to both improve sovereign capability and reduce environmental impact. This is a particular area of interest for my own organisation, the Materials Processing Institute, where the circular economy, along with advanced materials, digital technologies and low carbon energy, form our areas of research priority.

These twin responses will enable us to both drive up ethical standards in primary extraction and reduce supply chain vulnerability.

Chris McDonald 14 July 2019
Chief Executive Officer

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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, low carbon energy and the circular economy. Chris's background is in industrial research and manufacturing, where he has worked internationally. He led the divestment and return to independent, not-for-profit ownership of the Institute in 2014, the year the organisation celebrated its 70th anniversary.

In addition to leading the Institute, Chris provides expert consultancy support to companies, Governments and public bodies, in technology strategy and the technical due diligence aspects of mergers and acquisitions. He is prominent in the development of public policy, around innovation, steel and SMEs, where he works to support growth and inward investment. He is the policy chair for Innovation and Enterprise for the Federation of Small Businesses, a member of the CBI Regional Council for the North East and is the Innovation Lead for the UK Metals Council. Chris is also a member of the Steel Advisory Board for UK Steel (EEF).

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.

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

> "Chris provides expert consultancy support to companies, Governments and public bodies in materials, technology and innovation strategy"

Chris McDonald
Chief Executive Officer
Materials Processing Institute

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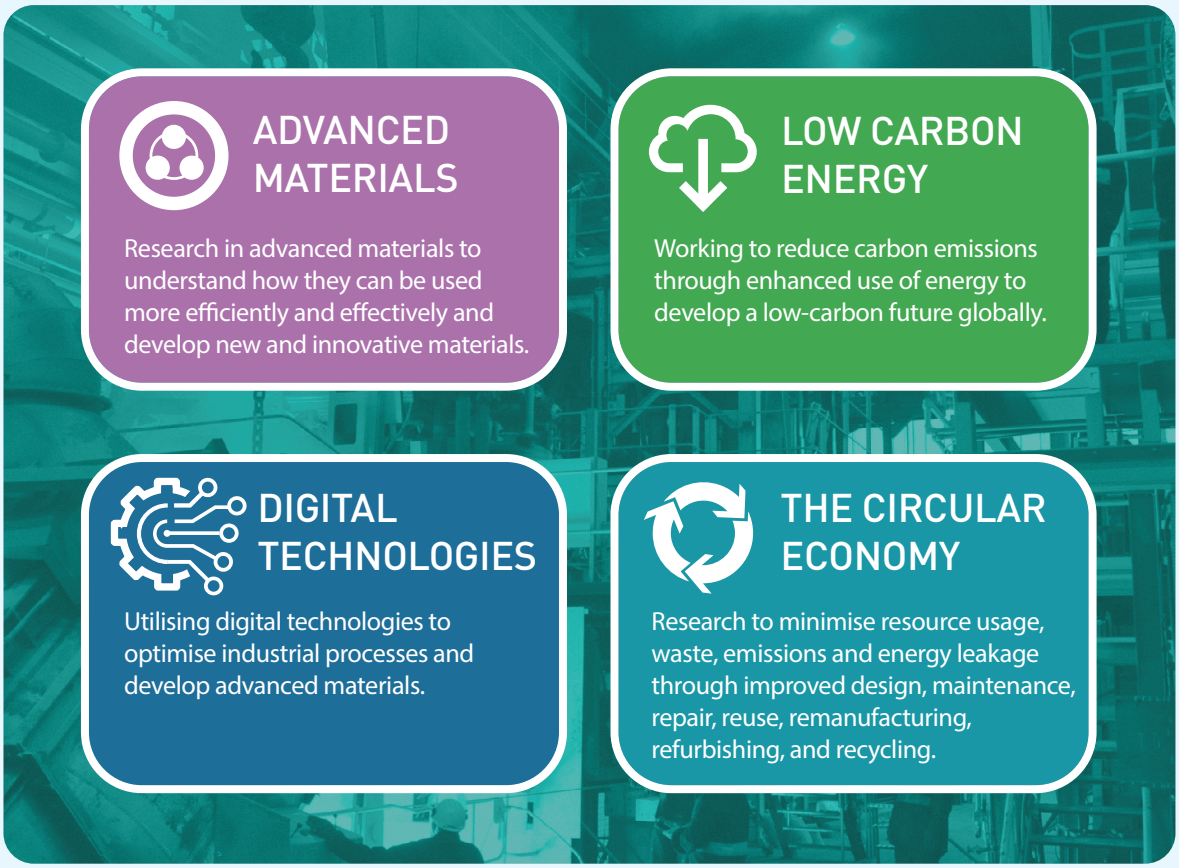
The Materials Processing Institute

The Materials Processing Institute is a research and innovation centre serving global steel and materials organisations, developing new technologies in advanced materials, low carbon energy, the circular economy and digital technologies.

Through collaboration with its customers, the institute provides a range of technology and R&D based services and consultancy. It also has pilot and demonstration facilities and an SME Technology Centre to support chain businesses with development of new technologies and products.



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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 has expertise in materials, materials processing and energy, 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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