Foreword

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These fact files demonstrate the continued importance of the Foundation Industries to the UK’s manufacturing supply chains, but they mean more to our society than that. On average 75% of the materials anybody sees when they look around them will have been made by one of six key industries (cement, metals, glass, paper, ceramics and chemicals), and they bring economic prosperity to many of the UK’s regions.

We will be using these materials in large quantities well beyond 2050 and so (as the Climate Change Committee 6th Carbon Budget report demonstrates that resource and energy efficiency will have an increasingly important part to play in the UK’s drive to Net Zero), we must find new ways to decarbonise these industries in a commercially sustainable manner.

Aligned with the appropriate policy actions it is vital that innovation in resource efficiency is embedded across these industries alongside the work already being done on energy efficiency. This is why the Transforming Foundation Industries challenge has been taken up by these industries with the support of UKRI.

It is also why, in conjunction with the ERC, we have undertaken further research into the factors that may prevent this happening if we do not take appropriate actions in the near term. Their report lays out the most important of these and which the Challenge, these industries, and policy makers must seek to address.
Cement is an essential ingredient of concrete – the most consumed man-made substance on the planet.

The cement industry accounted for just over £8.5 bn of turnover in 2018, while the 1,165 firms in the sector employ nearly 37,500 people.

Volatile performance over the past decade, with the sector experiencing sharp output contractions in 2012/2013 and 2018/19. The industry has seen an average annual fall in output of 0.2% over the past 10 years.

According to the Mineral Products Association (MPA), in 2019 members produced just over 9 million tonnes of cement – the lowest level of output since 2014.

Industry-government collaboration is trialling new fuel mixes involving biomass, hydrogen and plasma technology to demonstrate a net zero fuel is possible.

Another driver for innovation is the demand for high performance construction materials, which contribute to reduced emissions from lower energy requirements for heating and cooling buildings. There is active work in developing new cement formulations.

Growth potential is largely dependent on demand from the domestic construction market, so the Government’s plans for significant increases in infrastructure investment offer real opportunities.

The requirement for non-fossil fuel energy sources will be positive for the carbon impact of the industry and provide opportunities to supply into the construction of these projects.

Given the planned expansion of UK infrastructure investment, maintaining a strong and sustainable supply base in the concrete and cement industry will be an important underpinning for this ambition.

Developing low-carbon energy sources, alternative fuels and carbon capture and storage are crucial developments for the sector’s future cost base.

It costs around £250 million to build a modern-day cement plant, any capacity lost by falling demand may not return, leaving the security of supply to volatile international trading markets. It also risks declining investment in the UK, as the global owners can invest elsewhere for better returns.

New product development needs adoption from construction customers. In a low-margin sector, there is a risk any apprehension could slow innovation efforts and progress on meeting net-zero targets.
The industry produces a wide range of items from banknotes, books and magazines, to packaging from corrugated paper and board. Paper is predominantly manufactured from cellulose fibres, and, as part of a circular economy, recovered paper is manufactured into new paper alongside virgin fibre. 70% of recovered or recycled fibre is used to make paper products in the UK.

In 2019, there were 1,370 enterprises in this sector, a 2.1% decrease from 2018. There are just 40 large enterprises and multinational companies make up more than 75% of capacity in the sector – only one of which is headquartered in the UK, with most being pan-European businesses.

The paper sector continues to improve existing products and adding on new functions to further improve product quality. Despite being an energy-intensive sector, the industry has contributed to carbon emissions reductions and is committed to achieving its quota of the UK climate change targets.

However, 2019 ONS data on UK businesses by sector shows only a £0.1bn R&D expenditure in the pulp and paper sector. Compared to 31 other sectors analysed, paper ranked 28th and only ahead of the textiles industry, and iron and steel casting sectors.

The trend towards replacing non-renewable resources is an opportunity to develop a new range of renewable bio-based products for sustainable manufacturing. Also, re-shoring the reprocessing of some currently exported recycled paper can help grow the proportion of forest fibre produced in the UK. This can boost UK virgin paper production and increase share of the evolving bio-economy to build a stronger paper sector.

The steady increase in demand for tissue products and a similar growth in the need for paper-based delivery packaging, driven by e-commerce delivery needs, also represent good opportunities for the sector.

The paper sector has an important economic role, with 47 paper mills in the UK. In 2019, the turnover in the industry sector was £12.2bn, accounting for £4.2 bn of the Gross Value Added (GVA) to the UK economy – a per employee value of £73,000 in 2015.

The UK industries employ over 58,000 people at various locations across counties and regions.

In 2016, UK paper and paperboard production was 3.7 million tonnes, with UK consumption at 8.5 million in 2017 – the 10th largest global level.

In 2017, £5.3 bn worth of products were exported. This is growing due to increasing exported recycle rates, meaning almost a quarter of the paper products produced is exported abroad.

The sector faces strong competition in high-volume paper grades. Global competition and international ownership also mean companies are competing locally and internationally on product marketing and strategic investment. The sector also faces competition from substitute products, like plastics.

Paper production is both capital and energy-intensive, requiring significant investment to remain innovative and competitive. With long investment cycles, this makes it harder to secure investment.

The UK industries have the highest electricity cost in Europe, while energy policies have also made the UK less cost-competitive for papermaking.
The industry produces a diverse range of products including bricks, roof and wall tiles, tableware, giftware, drainage pipes and technical components.

The sector is long-established with origins dating back to the industrial revolution, but has recently seen a period of significant decline as a result of recessions and increased international competition.

The industry is a core part of the supply chain for a number of important markets for the UK. Around half of exports are to the EU.

The number of businesses in the sector fell significantly between 2009 and 2016. In 2016 there were just 350 ceramic manufacturing businesses in the UK, down from 470 in 2009.

The ceramics sector needs to drive up levels of innovation to maintain and strengthen its competitive position globally.

The UK also has unrealised potential stemming from the sector’s R&D and technical expertise, with design and product development expertise recognised worldwide – but the industry is yet to fully capture the advantage that this gives internationally.

Industry bodies are upbeat about the potential for growth in the sector. In part, this reflects anticipated expansion in global demand. The global ceramics market is expected to reach US$286 billion by 2022, up from US$158 billion in 2014.

Research and Markets suggested the UK ceramics industry may benefit as: “The increase in construction output, favourable economy and stable electricity prices in the future will provide impetus to overall sales. Other factors such as improved trading conditions and growing export market for tableware, bricks and roof tiles are also anticipated to guide industry development.”

The sector has experienced a recent revival with turnover and job growth both reaching 50% growth since 2010. According to UK Manufacturing “the industry slumped spectacularly in the global recession of the late 1990s... but it’s now staging a strong fightback.”

The sector is keen to improve the design, manufacture, performance, functionality and cost effectiveness of new and existing products and processes.

The sector must work more closely with the research base for early mover advantage over international competitors in the research, development, demonstration, deployment and exploitation of innovative ceramic-based materials.

The sector employed around 8,000 people in 2016, down from 9,000 in 2009. The British Ceramics Confederation (BCC) data from 2019 shows the sector made annual sales of £2 bn, had 22,200 employees and generated £720m in GVA and £550m in export sales.

UK-based ceramics manufacturers’ exports have grown 6% since 2011 to around £410 million in 2016.

The main challenges are: emerging economy competition in mass volumes of low-cost products, high energy prices, reliance on non-EU raw materials, trade barriers like tariffs or certification schemes, and lifestyle changes.

Other challenges include attracting and keeping a skilled workforce and the need to reduce environmental impacts in the industry.

Access to capital to fund development is also identified as a potential obstacle to future growth, as ceramic industries require long-term capital investment to remain competitive in world markets.
The UK metal sector is characterised by a wide range of sub-sectors, including basic metals, precious metals, metal forming, casting, manufacture of non-metallic products and non-ferrous alloys. The sector produces structural parts which make up a large part of the automotive, construction, nuclear, infrastructure, engineering and many other sectors.

In 2019, there were 2,030 metal businesses. Similar to many other foundation industries, the sector is an SME-dominated sector – with more than 98% SMEs. This sector directly employs approximately 69,000 employees in the UK, with an average of 21 employees per enterprise.

In 2018, ONS data indicates varying and low levels of investment in innovation by metal firms compared to the top R&D performing manufacturing sectors. While fabricated metal products reported an R&D expenditure of £0.2 bn, only £0.1 bn was reported for firms manufacturing non-metallic mineral products and non-ferrous metals. The iron and steel casting sector reported no R&D spend.

Growth is anticipated in the sector as demand from infrastructure projects is expected. Further support is expected to come from developing new generations of vehicles, aircraft, and other products.

Continued focus and upgrade of UK infrastructure should increase metal demand. Technological advancement also means production is less labour-intensive and geared towards further automation, higher efficiency, and sustainability.

Moves towards a more circular economy mean metals are reusable and recyclable, making the use of metals from a lifecycle perspective more attractive.

The sector plays a key role in UK manufacturing and global supply chains, providing high quality basic and fabricated metals to the nuclear, automotive, aerospace, food, and various other manufacturing industry sectors.

The industry has an £18.6 bn annual turnover and just under £4 bn GVA. The UK was the seventh biggest European producer of steel in 2016, contributing 0.1% of the UK economy (£1.6 bn) and 0.7% of manufacturing sector output.

The sector has had difficulties recently, as one of the five major negative contributors to the manufacturing sector between 2008 and 2018, contributing -1.6% to sector growth in 2018.

The sector has come under increasing pressure, with higher energy costs affecting competitiveness of the UK industry. For example, UK steel producers pay 62% and 80% more for electricity than their competitors in Germany and France respectively.

This, along with increased overall global production and competition from suppliers selling into the UK local metal market, has resulted in the closure or threatened closure of several large UK plants.

On top of this, as many UK companies are part of multinational, overseas-owned enterprises, they often have to compete for internal investment.
CHEMICALS

Foundation industry sector factsheet

**Key Features**

- **Sector diversity** includes manufacturing commodity and bulk chemicals, specialty chemicals, polymers, and consumer items for cleaning and personal care.
- It serves other sectors like aerospace and automotive, as well as ingredients for cosmetics, pharmaceuticals, agrochemicals, personal care, paint, and home care.
- Geographical clustering is important, so companies are located close to suppliers of feedstocks, end-users, and support services. Around half of UK production is in four main clusters: Yorkshire & Humberside, North East, North West and Scotland.
- With 70% of the sector headquartered overseas, it is trade intensive and competes globally for investment.

**Innovation**

- The UK has an international competitive advantage in innovative and high-value products due to its strong R&D base.
- The industry spends £4 bn each year on investment in buildings, vehicles, and machinery and invests over £5 bn each year on R&D. This impressive figure, given the sector’s size, has also contributed to productivity growth over the last 20 years.

**Growth Potential**

- The sector is well placed to achieve future growth and performance gains, as its importance to consumers and other manufacturing sectors, protects it from significant demand fluctuations and decline.
- Manufacturers can therefore take advantage of opportunities to grow their output and, crucially, improve their production processes.
- Make UK cites three opportunity areas: digitalisation in the industry can reduce costs by up to 3.9% within five years; the development of shale gas can reduce the dependence on imports; and increased demand for low-impact products means opportunities also lie in developing new bio-products.

**Economic Value**

- In 2016, sector sales were £21 bn and accounted for £12.1 bn of the UK’s GVA. According to the Chemical Industries Association, the UK is one of the world’s top global producers of chemicals and pharmaceuticals, and their 2014 data had the UK as the 12th largest global producer with sales of €54 bn.
- The wider sector is the UK’s largest exporter of manufactured goods, with over £50 bn of annual exports. 63% of these companies export, the highest proportion of any UK manufacturing sector. 60% goes to the EU and 75% of imports and raw materials come from the EU.
- Employment in chemicals was 104,000, up from 96,000 in 2014.

**Challenges**

- Despite being one of the most energy-intensive sectors, energy consumption has fallen by around 40% since 2007. Production has remained broadly stable – showing an ability for more efficient use of resources.
- The sector continues to grow and has negotiated challenges such as fluctuating oil and commodity prices, while improving labour productivity by around 25% between 2008 and 2016.
- High and volatile energy costs hold particular significance for the industry, due to the nature of their production processes. Any increase in energy prices affects manufacturers’ base costs, a continuous concern for manufacturers. UK industrial electricity prices are among the highest against international competitors.
- Shortages of skills for workforce, management, and leadership are well-recognised problems. As the sector requires a highly-dynamic workforce which can keep up with technological innovations, it can struggle to retain its skilled labour from higher-paying sectors like finance.
Due to high-temperature production methods, the sector is energy-intensive and has been subject to increasing regulation on environmental performance.

In 2018, there were 735 glass businesses, the vast majority being SMEs with fewer than 250 employees.

Two-thirds of value added in the UK glass sector comes from the manufacture of jars and bottles and the processing of flat glass.

Flat glass is made for glazing and vehicles. It is capital intensive, with plants designed to operate 24/7 and therefore more likely to take place in large manufacturers, rather than the large number of SMEs that dominate the sector.

The industry accounts for £1.3bn in GVA, which is less than 1% of total manufacturing sector GVA.

In 2019 the sector employed 23,770 people, which is less than 1% of manufacturing employment. The sector had some recent job growth, recovering from a low of under 20,000 during the financial crisis.

The emergence of low-cost imports, especially for consumer products, saw a decline in production at the lower value-added end of the market.

Glass manufacturing activity has, however relocated from countries such as the UK and Italy to Central and Eastern Europe in the 2000’s to take advantage of lower production costs and following the offshoring of automotive sector customers.

Pressure to reduce energy consumption is a major innovation driver. Glass Futures has been created to provide a funding vehicle for the bridge in technology between manufacturing now and a low-carbon future.

£7m of funding has aided Glass Futures’ research into alternative, low-carbon fuel technologies like biofuels, hydrogen, electric and hybrid concepts. This research will inform the sector’s long-term decarbonisation plan.

The move to net zero creates significant potential opportunities particularly around developing high-performance products for the construction sector. UK government commitments on future house building could offer additional upside to the sector’s outlook.

European collaboration will be important in energy technology development. The German ‘Furnace of the Future’ concept for climate-neutral glass packaging will be the first global large-scale hybrid oxy-fuel furnace to run on 80% renewable electricity.

If issues with colour separation and contamination of cullet are solved, this will improve competitiveness by reducing energy costs and emissions.
These foundation industry factfiles have been taken from the “Innovation Readiness in Foundation Industries” report developed by Enterprise Research Centre (ERC) on behalf of UKRI. The research was carried to provide an evidence-based understanding of the factors that shape innovation across six UK foundation industry sectors – metals, paper, chemicals, glass, ceramics, and cement – and in doing so to provide a better-informed basis for policy development.

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Summary report download [here](#)