**IOM3 response**

**Invest 2035: the UK's modern industrial strategy**

**Sector Methodology**

1. **How should the UK government identify the most important subsectors for delivering our objectives?**

Identification of the most important subsectors should include sector and subsector stakeholder engagement.

IOM3, and other professional membership bodies, act as trusted facilitators for multi-stakeholder discussions and can bring together professionals from across industry and academia. This can help contribute to identification of the most important subsectors in an impartial and unbiased manner.

IOM3 members are active across the growth-driving sectors identified – in particular advanced manufacturing, clean energy industries, defence and life sciences – and matters relevant to the industrial strategy from energy, advanced manufacturing, materials and biomedical applications to the circular economy, industrial resource efficiency and materials management before, during and after their use in products.

Additional useful networks include trade associations and policy forums such as the Environmental Policy Forum, National Engineering Policy Centre and Science Council Policy Forum.

A balanced approach should be taken when considering timeframes. Meeting the objectives of the strategy – including reaching net zero and energy security – will require focus on areas likely to make the most impact in a timely manner. It should also be considered that many industry sectors look at timescales of 10, 20 and 30 years. Significant opportunities in, for example, 10 years could be missed if only short-term market needs are considered. For example, the next generation single aisle aircraft from Airbus is unlikely to go into service until 2035 at the earliest, but technology decisions, along with decisions on the placing of potential manufacturing contracts, will be made over the next five years. Support from government must consider relevant timeframes to ensure that the UK capitalises effectively on potential benefits.

1. **How should the UK government account for emerging sectors and technologies for which conventional data sources are less appropriate?**

Identification and prioritisation of emerging sectors and technologies requires a rigorous and independent approach. Where there are data gaps, cross-government co-ordination, stakeholder engagement and collaboration from industry will be key. Best practice and learnings from methods used by business should be considered and applied.

As outlined in response to Q1, IOM3 and other professional bodies provide insight from a range of expert perspectives and can help to inform the analysis even where data sources are less appropriate. Together with other sources of complementary information such as the RTOs, Catapult Centres and specialist bodies (for example APC and ATI) this can help to build a reliable picture. It is important to develop impartial and balanced assessments and engaging specialists in technology areas to undertake horizon scanning would be beneficial.

1. **How should the UK government incorporate foundational sectors and value chains into this analysis?**

IOM3 welcomes the acknowledgement of the underpinning capabilities in foundational sectors and value chains that are necessary if the UK is to be successful in the identified priority sectors.

It is important to adopt a broad perspective when thinking about foundational industries, capturing not only traditional "foundation industries" but also wider materials sectors along with their value chains and lifecycle management. Materials underpin all growth sectors, and their value chains are integral to success of the strategy. We cannot have secure, competitive growth driving sectors if there is not access to a secure and stable supply chain for materials, components and sub-systems.

Conducting value chain analyses of growth sectors and their subsectors will help identify critical inputs and infrastructure, revealing likely overlaps and interdependencies. Some of these foundational sectors may warrant and require their own sector plans given their contribution to the objectives of the strategy including growth, net zero, regional growth and economic security and resilience.

In line with objectives of the Strategy, the analysis should consider the UK's capabilities, comparative advantages, and how these sectors support national resilience.

To address the fundamental nature of materials and their key underpinning role, a cross-government cross-economy materials strategy should be developed and implemented. Within the framework of this Industrial Strategy, given their vital role across multiple areas, a sector plan for materials could be developed.

Materials and minerals and the ability to transform them into key goods are essential to the current and future prosperity, wellbeing and security of UK society. The extraction and conversion of materials to goods and services underpins our economy and our daily life. In an increasingly uncertain world, our national security could depend not only on access to specific materials, but also on the industrial capacity to exploit them.

Recent global events and changes in geopolitics have highlighted the vulnerability in supply chains of materials. This has been reflected by resource policy developments in a number of countries and business action to restructure supply chains and reduce risks. Alongside supply vulnerability, the demand for many materials – including critical materials – continues to grow significantly to support modern demands and clean energy industries. This surge in demand presents a significant resilience risk for the UK, impacting both decarbonisation efforts and economic prosperity.

Many of the technologies we are counting on within the growth driving sectors and to reach net zero greenhouse gas emissions rely on materials, minerals, and mining. These include lithium and cobalt for batteries, composites for lighter vehicles, packaging solutions to avoid food waste, and concrete and steel for wind turbines. Furthermore, substantial parts of medicine and health protection rely on materials and novel applications, such as hip replacements, anti-viral surfaces, or implanted devices as well as diagnostics, delivery of vaccines, personal protective equipment and advanced therapeutics. Advanced technologies such as smart phones, quantum computing, and nuclear fusion are dependent on the materials used to build them.

The technology and equipment we rely on to protect our national security requires key materials to be available, as well as the materials-based industrial capacity and capability to produce them. The UK defence sector adds £9.8 billion in value add to the UK economy, exports £7.4 billion worth of products and directly employs over 147,000 people across all regions and nations of the UK, including 6900 apprentices [[1]](#footnote-1). The sector requires a variety of materials and custom-made components to manufacture products and is currently heavily reliant on imports, including for critical materials. Materials research, development and innovation is fundamental to the future of UK defence and securing strategic and operational technological advantage.

There is an increasing urgency for the development and application of a range of materials innovations to meet the global challenges. The timescales to bring new materials to market need accelerating including through development at multiple levels in parallel rather than in sequence and using new computational tools. In addition to underpinning the growth driving sectors, materials innovation is a growth boosting activity in and of itself. It increases productivity and creates opportunities for the UK to capture a higher market share in fast-growing sectors. Materials are therefore important both as an input into key sectors and for productivity-boosting innovation.

Whilst critical enablers of the transition and fundamental to healthy living, materials and their extraction and processing are also a significant source of greenhouse gas emissions alongside environmental and social impacts and must therefore be managed as responsibly as possible.

Points to consider for incorporation into the analysis include:

* Consider the entire materials supply chain from raw materials to end-of-first-life to maximise the benefit to the UK
* Develop a joint up approach to materials across UK government
* Lead a shift from the current approach, which assumes that materials challenges will be largely overcome by the end use sectors, to a more strategic and holistic view of our future needs.
* Consider and protect capabilities, supply chains and technologies of strategic importance.
* Support development of the manufacturing capability to transform materials into the products we need.
* Develop the UK’s materials processing industry so that it can capture as much value for its own economy as possible and compete more successfully in global markets.
* Ensure coordination and collaboration between UK industry and the UK’s world-class R&D ecosystem.
* Create a regulatory and standards environment across diverse market sectors to enable the safe, secure, timely and transparent use of new materials and technologies and maximise benefit from international engagement.
* Develop technical standards with industry to achieve interoperability in key technologies.

Sectors

1. **What are the most important subsectors and technologies that the UK government should focus on and why?**

Materials and their effective management underpin all eight growth-driving sectors, in particular advanced manufacturing, clean energy industries, defence, digital and technologies and life sciences.

Materials will provide essential wide-ranging solutions for current and future needs including for new energy systems (including hydrogen) sensing, communications, integrity monitoring and structural capabilities.

**Materials stewardship and the circular transition** – the UK has significant strengths and growth potential in the circular economy and source traceability including reprocessing of waste to recapture high value raw materials.

Advancing the transition to a resource efficient and resilient society is a priority. Resource efficiency and productivity should be embedded across government policy, driving the transition to a more circular economy where materials are kept in circulation at their highest value for as long as possible, contributing to UK economic growth and building resource and energy security.

Access to responsibly sourced, reliable and affordable supplies of the materials, minerals and products that sustain our way of life, our economy, our security, and the transition to net-zero fundamentally underpins opportunities for growth and is a growing risk to the UK. This includes security of supply of materials through both primary and secondary processing.

The UK has access to large quantities of materials and minerals in products already in the economy. Increased recovery, reuse and recycling (aka urban mining) as well as business models and design for durability, longevity, repair and reuse can make use of those already in circulation alleviating pressure from growing demand on primary extraction and its associated impacts and risks. For example, the UK currently exports over 70% of its scrap steel, which is an essential input for the electric arc furnaces being contemplated across the country.

The current macroeconomic model, however, does not promote circular practices and consumption reduction, nor reward waste prevention sufficiently to drive the behaviour alone, so government intervention is essential. Whilst strategies that focus on recycling are important, it is not sufficient – a whole system approach that encompasses every stage of the materials cycle is required. The government’s industrial strategy must therefore align with and mutually reinforce its circular economy strategy.UK infrastructure and end markets for recycled materials are required to ensure valuable resources are captured and not exported. This will also help to improve the quality of recycled material for example, through standards, design principles and greater data capture, meaning it can be fed back into processes more easily and effectively.

Cross-sector approaches should be explored in particular where it isn’t currently feasible to reuse materials within the same subsector. For example, carbon fibre composites recycled from aerospace and wind turbines could feed successfully into automotive applications, construction and medical usage.

There is significant opportunity for the UK to build on the strength of the UK academic sector for materials extraction and existing specialist players such as JM, Advanced Alloys, Mastermelt, N2S and others to capture value and secure raw materials from 'waste' streams.

There are opportunities for the UK to lead in developing UK and international capacity for recycling critical material intensive products, such as wind turbines and batteries, reducing dependence on existing supply chains and providing domestic sources of critical materials.[[2]](#footnote-2)

**Material decarbonisation and transition of the foundation industries** **–** in particular where this supports UK sovereign capability and resource security.

Foundation industries (the cement, glass, ceramics, paper, metals, and bulk chemical sectors) are vital for UK manufacturing and construction. They produce over 75% of the materials we see around us, comprise over 7,000 businesses, more than 250,000 employees, and are worth £52 billion annually to the UK economy[[3]](#footnote-3),[[4]](#footnote-4). As these materials are used in almost every industry, their impact also reaches far greater. They underpin activity across a wider segment of the economy with two-thirds of output sold to other UK businesses. However, they tend to be energy intensive, consume significant quantities of raw materials, produce large amounts of waste and are responsible for over 10% UK CO2 emissions. These sectors also face significant challenges to transition as they tend to be capital intensive, often with large legacy facilities with limited additional physical space. They have high process emissions and the novel technologies needed tend to have a difficult risk profile.

Supporting these crucial industries to decarbonise at the urgent pace required, move towards a more circular economy, and remain internationally competitive is essential. Otherwise, the UK will not be able to secure domestic supplies of vital materials, avoid import dependency and reduce associated impacts of emissions.

**High value manufacturing** – robotics and automation, smart factories and integrated through manufacture data capability.

**Aerospace –** is a major contributor to UK economic prosperity, exports and national security.

* Airframes/structures e.g. Airbus/BAE
* Propulsion e.g. Rolls-Royce
* Systems, sub-systems and avionics e.g. BAE, Collins and others
* Materials science and associated cost effective and high rate, automated manufacture are key as well as high temperature alloys, coating systems and composites for lightweight structures. For example high-rate manufacturing of composite materials critical for securing UK workshare on the next generation single aisle aircraft (NGSA) and for enabling successful entry into the advanced air mobility market (eVTOL, drones). The use of additive manufacturing to enable a greater uptake of titanium in NGSA is similarly key for UK workshare.

**Automotive –** will benefit from advances in materials and manufacturing processes. In this sub-sector a key technology that requires support is recycling and end of life solutions that can facilitate the use of materials which could otherwise be excluded.

**Clean energy technology –**

* Wind
* Nuclear energy and services – essential for energy security and a key area of potential economic growth, in particular small modular reactors.
* Geothermal energy has the potential to provide clean and sustainable energy with appropriate support.
* Carbon capture usage and storage (CCUS).
* Battery technology translation, scale up and manufacture.

**Space/satellite technology** – an area of UK strength underpinned by a range of capabilities in materials science, light weight structural engineering, electronic systems, and telecommunications.

**Materials innovation** – Materials are critical in enabling advances in growth-driving sectors with materials innovation including optimising/adapting properties and expanding applications of existing materials, developing new materials to meet application challenges, and enhancing and developing processes that produce, process, integrate, or use materials.

Findings from the important work the Henry Royce Institute is carrying out to develop a National Materials Innovation Strategy should be considered during the next steps of the Industrial Strategy. The sub-strategies in development hold a wealth of information about priority subsectors and opportunities for the UK.

**Energy materials innovation** – expanding the opportunities to drive the energy transition including advanced batteries (for example next-generation battery chemistries to improve performance and diversify supply chains) and solar cells, low energy semiconductors, thermal storage, energy-harvesting coatings for various applications, electrolyser materials for hydrogen production and fuel cell materials for power generation.

Permanent magnets are critical to the energy transition due to their applications in electric motors and wind power and are indispensable for today’s technology, including transportation, medical equipment, consumer electronics and defence applications. Capturing and recycling these magnets at end of life will provide a two-fold benefit. Firstly, recovering the materials in them will reduce the need for imports of virgin materials, reducing UK reliance on sometimes uncertain supply chains. Secondly, it can stop the inappropriate disposal of magnets, which otherwise can lead to the leaching of toxic chemicals in the environment. This will require both improving materials design and better recycling technologies. In addition, developing alternative materials or approaches can also help.

**Biocompatible materials** – natural or synthetic materials used in the formation of most commercially available medical devices and implants. Market analysis of biocompatible materials reveals significant growth potential. The UK has a clear opportunity to lead in several key areas in the field. The global market for biocompatible materials is growing at a CAGR of 8.8% and is expected to reach US$ 436.4 million by the end of 2033, creating significant economic opportunities for the UK.[[5]](#footnote-5) Materials to enhance soft tissue and wound repair offer significant opportunities with the annual cost of wound care in the UK estimated at over £8bln per annum.

**Structural materials** – From applications in defence, transport and aerospace to construction and energy, innovation in structural materials will be important. Structural materials also underpin many sustainability impact innovations and are essential for industry’s growth across multiple sectors.

Significant market segments rely on structural materials, and innovation in these materials can potentially increase the UK’s share of growing global markets. For example, the global lightweight materials market value is estimated to be US$276.4 bn by 2030 at a CAGR of 8.3% during 2023-2030. Lightweighting is a key priority across many sectors, from transport and construction to health. The green cement market value is estimated to be US$73.1bn by 2030 at a CAGR of 10.76%. Reducing the carbon footprint of cement has substantial potential to reduce CO2 emissions.[[6]](#footnote-6)

**Materials for surface enhancements** – surface enhancements and protection materials play a vital role in safeguarding and enhancing assets across energy, advanced manufacturing and life sciences and play a key role in boosting productivity. Important innovation focus areas include corrosion protection, thermal barriers and coatings to extend operational lifetime in extreme environments. The global cost of corrosion is estimated to be US$2.5 trillion, which is equivalent to 3.4% of global GDP.

Reducing corrosion in materials based on existing technologies could realise between 15% and 35% savings. Through innovation in this field, economic benefits could be even greater.

**Materials for digital and technologies –** materials innovation holds the opportunity to improve design and manufacture of electronic components with improved efficiency, durability, sustainability and extend operating environments.

**Defence** – there is significant capability in aerospace and land and sea systems as well as electronic systems and equipment. A key need in the defence sector is hypersonic weapons which require high temperature, lightweight materials to operate. This need can be effectively satisfied by ceramic matrix composites which also provide solutions for containment in the nuclear fusion sector. Sovereign UK capability in this area has lapsed over the last decade but is re-emerging and should also be nurtured.

**Electronic materials** – potential opportunity for electronics and next generation semi-conductors. There is academic strength in semi-conductors and device materials. Funding is required for industrialisation as well as research**.**

1. **What are the UK’s strengths and capabilities in these sub sectors?**

The UK has significant strengths across materials including excellent research capabilities, defence, aerospace, biomedical applications, automotive and pioneering recycling technologies. It is home to world class universities, institutes and facilities and these are complimented by centres of excellence in various materials technologies across the regions of the UK.

This strength must be built on to help the UK to develop its materials processing industry so that it can capture as much value for its own economy as possible and compete more successfully in global markets.

Please see response to question 4 for further strengths and capabilities and examples below:

* Aerospace propulsion (Rolls-Royce) and airframe (BAE etc.)
* Innovative (and unique) processing of carbon fibre composites, e.g. Rapid Tow Sheering pioneered by ICOMAT, spin out from Bristol university.
* High rate infusion processing of large composite parts, pioneered by McLaren for automotive and developed for large aerostructures at AMRC Composites which could transform EVTOL production rates.
* Recycling technologies such as Deecom process develop by BM Longworth for use in automotive sector.
* Recovery and reformatting of short fibres from recycled composites into aligned high performance feedstock, pioneered by LINEAT spin out from the University of Bristol.
* Critical material midstream and recycling innovation such as HyProMag working to develop a full recycling supply chain for rare earth magnets based upon neodymium iron boron. The Hydrogen Processing of Magnet Scrap technology extracts NdFeB magnets from electrical products such as hard disk drives which can be re-processed into different forms and sold back into the supply chain for rare earth magnets. [[7]](#footnote-7)

1. **What are the key enablers and barriers to growth in these sub sectors and how could the UK government address them?**

Cross cutting enablers include research and development, a skilled and sustainable workforce, long term stable policy frameworks, systems thinking, and effective data.

Cross cutting barriers include high research and development costs, regulatory challenges or unclear regulatory regimes, supply chain disruptions, finance and insurance, terms for liability and IP, digital infrastructure, lack of support for translation stage including late-stage research and development and intermittent funding mechanisms.

**A cross-cutting, strategic approach to materials** – to successfully drive growth across the sub-sectors and transition to a low-carbon, resilient and resource efficient society, a national materials strategy is required.

**Transition to a resource efficient and resilient society** – to achieve the objectives of the strategy including growth, net zero, security and resilience, a greater focus is required on keeping materials in circulation at their highest value. Ways to address the key enablers and barriers to growth include:

* Implementing an effective Circular Economy Strategy that aligns with and mutually reinforces the Industrial Strategy. Introducing a national mechanism to map and track stocks and flows of materials and minerals through the economy to support secondary markets, enabling better management and infrastructure planning, for example by pursuing the ONS National Materials Data Hub project.
* Developing a regulatory framework, design principles and standards that promote the transition to a more circular economy including resource efficiency, enabling reuse, ease of disassembly, improving the economic viability of recovering materials, circular business models, certification for the performance properties of recycled materials and waste prevention. This could be based on the proven eco-design regime.
* Mandating the measurement and reporting of whole life carbon emissions in building construction, driving more resource efficient and circular practices.
* Using procurement spend to drive demand for products and services that promote a more circular economy.
* Creating mechanisms that leverage public and private financing to develop strategic domestic capability or address where the market is not working.
* Investing in vital infrastructure for the circular economy including facilities for recycling, repair, remanufacture and reuse.
* Introducing fiscal mechanisms to reflect full lifecycle economic and environmental benefits such as by ensuring VAT rates on repair and refurbishment services and building retrofitting do not act against greater circularity.

**Transitioning energy intensive industries** – ways to address the key enablers and barriers to growth include:

* Establishing a clear policy direction, framework and enabling environment for decarbonisation and the investment in technology and infrastructure required.
* Building on research, development and innovation funding to transform the foundation industries promoting productivity, competitiveness, resource and energy efficiency, and collaboration to address common challenges.
* Delivering targeted interventions, funding R&D and employing programmes to overcome the challenge of commercialising novel low-carbon, resource efficient technologies.
* Effective implementation of a UK carbon border adjustment mechanism (CBAM) linking closely with the EU mechanism, providing a level playing field with EU competitors and avoiding trade distortions.
* Using tax incentives, minimum quality standards for export and capital allowances for processing machinery to improve scrap collection, advanced sorting and domestic processing incentivising the supply of valuable scrap and waste materials to UK industry rather than the export market.
* Reforming the legal definition and requirements associated with waste to maximise the potential of secondary raw material use.
* Accelerating the deployment of clean energy to support electrification solutions and incentivise the rapid scaling of low-carbon infrastructure and technologies through fiscal incentives.
* Providing a prioritisation plan for the use of low-carbon fuels and technologies such as electrification and hydrogen to give clarity on decarbonisation pathways alongside a blueprint for the infrastructure needed.
* Enhancing planning and streamlining processes and permitting to accelerate the deployment of critical infrastructure.
* Publishing a roadmap for decarbonising businesses located outside of industrial clusters including planning and permitting guidance for local authorities.
* Promoting industrial symbiosis and facilitating collaboration across sectors.
* Employing demand-side policies to create demand for low-carbon products and materials such as mandatory product standards on embodied carbon content or recycled material content, labelling schemes to empower consumers, fiscal incentives for the value chain and risk mitigation such as Government-backed insurance schemes.

**Green-shoring** – it is important to address green-shoring (manufacturing in low-carbon regions rather than high-carbon regions), not only to ensure material security but also avoid outsourcing carbon intensive industries elsewhere.

**Research, development and innovation** – aim to lead the G7 in research and development (R&D) intensity with a rising annual public R&D budget from £22billion by 2026-2027. Implement a regulatory framework that fosters innovation and collaborative approaches, develop scale-up and build investment confidence to translate the UK’s world-leading fundamental science into products, services and systems.

**People and skills** – Having a suitably skilled workforce is a key enabler, and the difficulty that many industries have in recruiting and retaining these people is a significant barrier. Please see response to Q7 for more detail on the issues and to Q8 for some potential government actions to tackle this.

Business Environment

1. **What are the most significant barriers to investment? Do they vary across the growth-driving sectors? What evidence can you share to illustrate this?**

**Access to materials –** uncertainty about reliable access to materials (primary or secondary) can prevent investment, for example in clean energy scale up.The energy transition is reliant upon access to materials, and at a time of a changing global environment, geopolitical tension and building international competition for resources. A strategic approach to materials is required to provide the certainty businesses need to invest.

A strategic and clear approach to the transition to a circular economy would help to develop access domestic sources of materials and greater supply chain security.

**Confidence in secondary materials** – currently recycling and end of life concerns can restrict the uptake of secondary materials, especially into industries subject to strict safety legislation such as aviation, automotive, construction, etc. The development of secondary resource value chains within the UK would provide a mechanism to allow the uptake of new materials, favouring UK industry.

**Perceptions** – there is an apparent low cultural importance of materials in the economy and society in the UK. Public and media discussions around materials can commonly focus on negative impacts such as emissions and material pollution. There is a need for cultural change and a shift in the narrative to ensure materials are properly valued and recognised for their far-reaching benefits and their role in underpinning the strategy and our society.

**Regulations, codes and standards** – for example, for both composites and parts produced by additive manufacturing, certification and performance-based standards are complex and requires considerable testing. A route to qualification via virtual testing could provide the UK with a competitive advantage and allow more imaginative design concepts to be realised. In other areas such as energy, incomplete or insufficient regulatory regimes can be a significant barrier. For product and environmental regulations, lessons could be learnt from EU legislation such as the proven eco-design regime.

**Upfront costs and investment risk** – for example, energy such as CCUS or the foundation industries have significant upfront costs that can be prohibitive.

**Planning and procurement** – long timelines, inconsistent outcomes, complicated processes and access to appropriate skills can act as barriers to investment.

**People and skills** –there are significant and growing skills gaps across materials, minerals and mining sectors that play vital roles underpinning the growth-sectors.

There is a shortage of professionals in general across all skill levels. Where companies wish to introduce new manufacturing processes skilled labour familiar with the new processes are difficult to find. Similarly new design methods, required to take advantage of new materials and processes require specialists which are in limited supply.

Meeting the growing demand for materials and ensuring their responsible and resilient sourcing and management will only be possible if we have enough people with the necessary skills and access to the right training. These people will be needed by industry to carry out the activities **and** by regulators to ensure these activities are carried out to the necessary high standards.

At the same time that an increase in the workforce is required, there is simultaneously a decline in the availability of skilled people. Many professionals are reaching retirement age and insufficient new talent is entering and developing through the industry to fill the positions. In many materials, minerals and mining sectors there is a recognised skills and knowledge continuity gap between an older generation of qualified and competent persons set to retire, and replenishment of those skills from too small a number of new people coming through the system and into the industry. This can be seen in the age demographic of qualified mining-related professionals in the UK – in 2022, of the 1,237 mining and mineral processing engineers registered with the Engineering Council via IOM3, 80% were over the age of 50, with 39% over the age of 66 with other related sectors seeing similar trends.

In addition, skill sets are changing, reflecting the evolving needs of the sectors, with advancements in technology and a greater focus on data skills and environmental, social and governance standards. Greater integration of skills, combining different skill sets and understanding different aspects of the value chain is becoming increasingly important.

With other countries facing similar shortages and moving to secure their supplies, the UK will be competing in an increasingly challenging and competitive labour market.

The growing demand for and shortages of key skills professionals across materials and minerals are a significant risk to the UK economy. The challenges include:

* Across minerals value chains, from extraction to end-of life, including declining provision of higher education courses and critical shortages of metallurgical skills. [*The talent gap: critical skills for critical materials* report](https://www.iom3.org/resource/iom3-submits-report-on-critical-minerals-value-chain-skills-gaps-to-uk-government.html?_gl=1*5haxu2*_up*MQ..*_ga*MjE0NDQyMTU1MC4xNzE3NjY2ODA3*_ga_FS09K3G91Q*MTcxNzY2NjgwNi4xLjAuMTcxNzY2NjgwNi4wLjAuMA..)[[8]](#footnote-8) highlights that industry has benefited from skilled professionals exiting the coal sector in the UK, but this suppressed demand for new entrants as companies found it easier to recruit trained former coal mining professionals than to sponsor new students and apprentices. The UK is reaching the end of this legacy that has largely sustained the industry to date.
* The polymer industry suffering impacts on recruitment following negative media related to plastics.
* The construction sector is facing growing pressures and shortages, such as for retrofit designers.
* The nuclear industry is experiencing skills shortages delaying projects and issues with attraction and retention in the sector.
* Industrial decarbonisation projects face recruitment challenges due to skills shortages with 87% of foundation industry businesses citing a difficulty in recruiting technical skills[[9]](#footnote-9).
* The composites sector is facing significant shortages of trained staff at all levels.
* Defence, safety and security technology is developing at significant pace with the lack of available skills posing a significant risk including concerns around attracting talent to the sector.

Addressing these skills challenges can only be achieved by attracting and retaining the best talent, yet there remains a concerning lack of diversity within the workforce. For example, in the occupation census for 2021 in England and Wales 7,220 people were counted as ‘mining and quarry workers and related operatives’. Men made up 96.2% and women just 3.8%, compared with 52% and 48% across the whole working population[[10]](#footnote-10). As of mid-2021 just 16% of core and related engineering occupation roles were held by women compared with 47% of the overall UK workforce[[11]](#footnote-11) and 18.5% of engineering and technology first degree undergraduate entrants were women, which is low compared to 56.5% of students across all subjects[[12]](#footnote-12).

There is wide-ranging and substantial evidence demonstrating the benefits of a more diverse team and workforce, from increasing innovation, through non-linear novel thinking, to increased productivity, and greater effectiveness.

It is crucial to engage individuals from a young age and continuously throughout their education to inform their perceptions and career choices. School education has an important role in supporting a sustainable talent pipeline over the medium and longer term and offers an opportunity to help address inequalities in the workforce. Research has shown that children are influenced about their future education and career choices by the age of seven, making early engagement essential. However, there are serious and concerning teacher shortages in science, technology, engineering and mathematics subjects.

There are also inequalities that can significantly affect children’s experience of and access to high quality education[[13]](#footnote-13),[[14]](#footnote-14). For example, research shows that, in England, careers provision is ‘patterned’ around social inequalities and students who are most in need are less likely to receive careers education[[15]](#footnote-15). A good quality well-informed system for career advice and guidance, with up-to-date information about the careers available, that expands focus beyond the university route is crucial to attracting more people to consider a position in materials, minerals and mining.

At university level there’s still an appetite to provide courses but the demand isn’t there from students and courses are struggling to get the numbers required. If the challenges highlighted such as the perception issue can be overcome, university courses could likely scale to meet the demand. However, vocational and technical training is unlikely to be able to respond in the say way as the absence of demand means organisations aren’t stepping into the marketplace.

Business Environment – People and Skills

1. Where you identified barriers in response to Question 7 which relate to people and skills (including issues such as delivery of employment support, careers, and skills provision), what UK government policy solutions could best address these?

There are numerous opportunities available to address the skills gaps and challenges. A multifaceted approach will be required, implemented in tandem to ensure the immediate challenge is overcome and the future of the industry is sustainable. A plan for skills and workforce development should be delivered that:

* Builds on the qualitative assessment of skills gaps[[16]](#footnote-16) identified in *The talent gap: critical skills for critical materials* with quantitative skills forecasting for materials, minerals and mining to understand the future workforce and skills needs, plotting the changing labour market and mapping competences.
* Conducts a gap analysis on education and training provision and provider capacity for materials, minerals and mining needs in the UK.
* Takes forward the actions outlined in ‘*The talent gap: critical skills for critical materials*  to stimulate a pipeline of strategically important skills[[17]](#footnote-17) working with industry and academia.
* Develops a strategy and sets targets to fill the gaps in line with the timing of job creation including through options such as dedicated, funded apprenticeships, T-Levels or Higher Technical Qualifications available to workers of all ages.
* Plans for skills transfer for example for individuals moving away from jobs in industries such as oil and gas.
* Embeds measures to actively advance equity, diversity and inclusion attracting individuals from underrepresented backgrounds and ensuring inclusive and equitable education, training and working environments.
* Sets out to a plan to work with industry and other relevant bodies to increase the visibility of careers and update perceptions to communicate their importance to the economy, society and low-carbon transition including a programme of public engagement.
* Includes a mechanism to include modern materials, minerals and mining career opportunities into careers provision within a wider education and skills plan.
* Forms part of a wider strategic approach to addressing skills shortages and the UK’s changing labour market needs that co-ordinates relevant activity across government departments and brings together current activity for more targeted joined-up action to equip the UK with the skilled and sustainable workforce it needs. This should link closely with an education and skills plan that:
  + Reforms apprenticeships to improve uptake and value to learners including introducing bespoke qualifications to support niche apprenticeships, ensuring End Point Assessment is delivered by assessors that are technically competent in the field, addressing the challenges from removal of mandatory qualifications and building visibility and appeal.
  + Delivers careers provision to schools and colleges that is reflective of current and future career opportunities. This should ensure focus expands beyond the university route. The ease of access to information can have a significant impact on students’ decisions. EngineeringUK showed 82% of young people aged 11 to 19 who said they knew quite a lot or a lot about engineering would consider a career in the sector, compared to just 40% who reported not knowing a lot about engineering.
  + Implements strategic initiatives and investment to improve teacher recruitment, ongoing training and retention.

A clear signal from government on the valuable role UK’s scientists, engineers and environmental professionals play in the growth agenda is required. Many students begin degrees with genuine passion for the subject but pursue a career in finance or management consulting due to the salaries and high regard of such sectors rather than manufacturing or science and technology.

There must be not only an emphasis on education and training but also on retention of skilled people in the workforce.

1. **What more could be done to achieve a step change in employer investment in training in the growth-driving sectors?**

To achieve a step change in employer investment in training in the growth-driving and necessary foundational sectors, several strategies can be considered including financial incentives, fostering collaboration between industry and training providers, promoting apprenticeships, leveraging online and digital learning resources, and sharing success stories that showcase the benefits employers reap from investing in their workforce.

As outlined in response to Q8, a plan for skills and workforce development is required to ensure a strategic and targeted approach.

Upskilling existing employees is a significant issue and support for in work training is required.

Business Environment - Innovation

1. **Where you identified barriers in response to Question 7 which relate to RDI and technology adoption and diffusion, what policy solutions could best address these?**

**Late-stage R&D** – strengthen and scale existing initiatives, institutions and infrastructure.[[18]](#footnote-18) Financial mechanisms to support research and development for Technology Readiness Levels 5 to 9 through programmes designed in collaboration with industry.

**Improved links** – support to facilitate translating academic research into industrial applications would be beneficial. There can be a negative perception in academia about working with industry. Conversely, there can be a perception in industry that the timescales for materials development, screening and implementation can be slower than is required by industry.

**Virtual testing and qualification routes** – government support to develop work in this area being undertaken in universities and collaboration with the relevant certification **bodies.**

**Comprehensive support packages –** including advice and guidance on technology, business, sills, leadership and funding opportunities.

1. **What are the barriers to R&D commercialisation that the UK government should be considering?**

The UK has strength in science and technology with leading capability in many areas through its world-class academic base.  The UK has great strength in universities in many areas of science and engineering and a willingness in many academic groups to engage in challenges of economic and industrial relevance. The UK has also demonstrated the capability of industry and academia to work closely together to deliver technological advances through to product and market.  However, the system does not come near to maximising the true potential this could have in terms of economic impact.  The emphasis on academic metrics of citations is one-dimensional and biases towards emergent, fundamental science not necessarily aligned with UK exploitation capability.  This coupled with many other factors, including the lack of mid-TRL funding and difficulty in scaling new business, leads to much UK derived technology being ultimately exploited overseas.  The focus here on technology with maximum UK potential and addressing funding for technology translation and growth and other factors such as energy costs would help address this.

Barriers to R&D commercialisation and opportunities that the UK government should be considering include:

* Building on existing open-access infrastructure provision and improving availability, affordability and accessibility to support scale-up and commercialisation.
* Collaboration – between academia and industry including ensuring processes support industrial context and research aligns with industry applications or market demands.
* High costs and significant upfront investment
* Difficulty finding investors for unproven technologies and new materials
* Complicated regulatory framework
* Skills – combining technical expertise with commercial knowledge

Business Environment - Data

1. **How can the UK government best use data to support the delivery of the Industrial Strategy?**

Data is essential to inform development, monitoring and evaluation of the strategy. It can provide useful insights on investment, jobs, sector analysis and good practice.

See response to Q13 for where data can help to implement the aims of the strategy.

1. **What challenges or barriers to sharing or accessing data could the UK government remove to help improve business operations and decision making?**

Quality data and a suitable regulatory and standards environment, is essential to enable the uptake of innovative materials. Without it, legacy materials will continue to be chosen in favour due to their perceived lower risk and data availability (for example to demonstrate ‘green’ credentials and safety).

Introducing a national mechanism to map and track materials stocks and flows data through the economy will play a vital role in supporting secondary markets, enabling better management and infrastructure planning, for example by pursuing the ONS National Materials Data Hub project and/or extending the University of Exeter circular economy data observatory.

Mapping the main elements of supply and value chains for key markets will reinforce the identification of value-creation opportunities that generate the most economic, societal and environmental value.

A significant challenge faced by materials design engineers is the lack of literature on choosing the correct algorithms for dealing with different types of data that cover various aspects of application of artificial intelligence algorithms to real-world problems. Shared access to public databases created through government could substantially help to address this challenge

**Business Environment - Infrastructure**

1. **Where you identified barriers in response to Question 7 which relate to planning, infrastructure and transport, what UK government policy solutions could best address these in addition to existing reforms? How can this best support regional growth?**

**A UK Materials Strategy** – is necessary to properly inform and enable infrastructure planning and development including to ensure supplies of the materials required for the clean energy technology necessary to reach net zero (e.g. critical materials, steel, concrete, composites).

**Transition to a circular economy** – a range of solutions such as product regulations, material data, and infrastructure investment is required. For example, regional recycling centres focused on transforming complex engineering waste (both postconsumer and process waste) need to be established which will require support for companies dismantling, sorting, processing, and converting recycled materials into new product forms (either directly or via intermediate products).

**Alignment and mutual reinforcement between government strategies** – including the decarbonisation and circular economy strategies.

1. **How can investment into infrastructure support the Industrial Strategy? What can the UK government do to better support this and facilitate co-investment? How does this differ across infrastructure classes?**

* A plan for infrastructure delivery that incorporates both new infrastructure and maintaining (including extending life) and managing existing infrastructure.
* Circular economy infrastructure – including facilities for recycling, repair, remanufacture and reuse.
* Incentivise the rapid scaling of low-carbon infrastructure and technologies through fiscal incentives.
* Enhance planning and streamlining processes and permitting to accelerate the deployment of critical infrastructure.
* Demonstration and training facilities to allow companies to gain experience with new processing/manufacturing methods and the use of new materials. This should be over and above that provided by the existing Catapult Centres and improving accessibility.

**Business Environment - Energy**

1. **What are the barriers to competitive industrial activity and increased electrification, beyond those set out in response to the UK government’s recent Call for Evidence on industrial electrification?**

**Reliable access to materials –** including foundation materials and critical materials. With significant growth in global demand, a changing geopolitical environment and race to secure supplies, reliable and predictable access to materials will only continue to increase in importance.

**Business Environment – Crowding in Investment**

1. **What are the main factors that influence businesses’ investment decisions? Do these differ for the growth-driving sectors and based on the nature of the investment (e.g. buildings, machinery & equipment, vehicles, software, RDI, workforce skills) and types of firms (large, small, domestic, international, across different regions)?**

Factors that influence businesses’ investment decisions include economic stability, access to talent, access to materials with secure and resilient supply chains, the policy and regulatory environment, capital costs and support, transport and connectivity, technological advances, public procurement and environmental, social and governance considerations.

**Partnerships and Institutions**

1. **How can the Industrial Strategy Council best support the UK government to deliver and monitor the Industrial Strategy?**

Constant change is problematic and impairs both investment and innovation. The Industrial Strategy Advisory Council could be a key element in reassuring investors and innovators that there is a long-term consistent direction of travel for industrial strategy in the UK. It can also provide reassurance that Government measures are soundly based in evidence from all stakeholders. It would be helpful to all this if the ISAC had the power to provide advice to Ministers that it then would make public, along the lines of the Climate Change Committee.

1. **How should the Industrial Strategy Council interact with key non-government institutions and organisations?**

The Institute of Materials, Minerals & Mining (IOM3) is a professional engineering, environmental and scientific institution, a registered charity and governed by a Royal Charter. IOM3 supports professionals in materials, minerals, mining and associated technical disciplines to be champions of the transition to a low-carbon, resilient & resource efficient society. With around 15,000 members, IOM3 brings together expertise across the full materials cycle.

IOM3, acting as a trusted facilitator, has the capability to bring together professional members for informed and impartial discussions across a range of issues relevant to the industrial strategy – from energy, advanced manufacturing, materials and biomedical applications to the circular economy, industrial resource efficiency and materials management before, during and after their use in products.

IOM3 is also a member of a number of policy forums that bring together professional organisations across engineering (National Engineering Policy Centre, led by the Royal Academy of Engineering), the environment (Environmental Policy Forum, led by Society for the Environment) and Science (The Science Council Policy Forum, led by the Science Council).

1. <https://www.adsgroup.org.uk/facts-figures/ads-defence-outlook-2023/> [↑](#footnote-ref-1)
2. [Critical materials: demand-side resource efficiency measures for sustainability and resilience](https://raeng.org.uk/media/qutgamxj/nepc-critical-materials-report.pdf) [↑](#footnote-ref-2)
3. <https://www.iom3.org/resource/transforming-foundations-industries.html> [↑](#footnote-ref-3)
4. <https://iuk.ktn-uk.org/materials/foundation-industries> [↑](#footnote-ref-4)
5. <https://www.royce.ac.uk/content/uploads/2024/04/Royce-National-Materials-Innovation-Strategy-April-2024.pdf> [↑](#footnote-ref-5)
6. <https://www.royce.ac.uk/content/uploads/2024/04/Royce-National-Materials-Innovation-Strategy-April-2024.pdf> [↑](#footnote-ref-6)
7. <https://hypromag.com/rare-earth-magnet-recycling/> [↑](#footnote-ref-7)
8. <https://www.iom3.org/resource/iom3-submits-report-on-critical-minerals-value-chain-skills-gaps-to-uk-government.html> [↑](#footnote-ref-8)
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11. <https://committees.parliament.uk/writtenevidence/42416/pdf> [↑](#footnote-ref-11)
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14. <https://www.sciencecampaign.org.uk/app/uploads/2023/03/CaSE-Inspiring-Innovation-education-review-2021.pdf> [↑](#footnote-ref-14)
15. <https://www.engineeringuk.com/media/232354/our-future-our-careers-2020.pdf> [↑](#footnote-ref-15)
16. <https://www.iom3.org/resource/iom3-submits-report-on-critical-minerals-value-chain-skills-gaps-to-uk-government.html> [↑](#footnote-ref-16)
17. <https://www.iom3.org/resource/the-talent-gap---critical-skills-for-critical-materials-pdf.html> [↑](#footnote-ref-17)
18. [Late-stage R&D: business perspectives](https://nepc.raeng.org.uk/media/fagnccc3/nepc-_late_stage_r-d_business_perspectives.pdf) [↑](#footnote-ref-18)