Biomanufacturing

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CATAPULT
High Value Manufacturing

Connect with us

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UKRI Innovate UK · University of Sheffield AMRC Advanced Manufacturing Research Centre · cpi · mtc where progress happens · ncc innovating for industry · NMIS National Manufacturing Institute Scotland · WMG THE UNIVERSITY OF WARWICK

Biomanufacturing

A process of production which uses both natural and engineered biological systems, such as microorganisms and cell cultures, to produce materials across numerous sectors including industrial biotechnology, materials, pharmaceuticals and food.

Biomanufacturing and engineering biology are unlocking a new era of sustainable, high-value production for the UK. By uniting HVM Catapult capability with world-leading academic partners, material innovators and industrial end-users, we are accelerating the scale-up of biologically derived materials, therapeutics, green chemistries and circular processes. From novel bio-based feedstocks to sustainable and economic manufacturing pathways, there is a clear opportunity to position the UK as a global leader in clean, resilient, bio-enabled industry.

Why: Demand drivers

- Next-generation therapeutics require innovative biological production methods
- Biomanufacturing processes seek optimisation for efficiency and sustainability
- Global food systems need sustainable and secure production solutions
- Industries are transitioning to sustainable bio-based materials and chemicals
- Healthcare diagnostics require biomanufactured components for reliable, precise and innovative detection and monitoring.

What: Priority industry capability needs

- Sustainable and cost-effective biomanufacturing advancing greener production methods to replace traditional processes and reduce environmental impact
- Alternative antimicrobials enabling innovative biological approaches to combat resistance and protect global health across diverse applications
- Food, feed and agri-biologicals production for sustainable, secure and resilient supplies supporting human and animal nutritional needs
- Circular material systems using waste as feedstocks to develop next generation green materials
- Develop and maintain a world-class UK workforce.

How: Priority innovation requirements

- Develop novel biomanufacturing capabilities including new modalities, bioreactors, analytics, formulation, characterisation and access to scale-up or scale-out for innovative production processes
- Leverage digital capabilities including digital twins, integrated analytics and automated process control to enhance biomanufacturing efficiency
- Support cutting-edge biomanufacturing facilities and capabilities underpinning public health and strategic priority response
- Develop agreed tests and standards across sectors from chassis to feedstock, improving efficiency and adoptability of biomanufacturing.

Key HVM Catapult capabilities in biomanufacturing

Intracellular Drug Delivery Centre, CPI (Sedgefield)

Specialises in advanced intracellular delivery technologies, including lipid nano particles (LNPs), offering formulation, characterisation and translational expertise to enable next-generation therapeutics.

Medicines Manufacturing Innovation Centre, CPI (Renfrew)

Provides state-of-the-art medicines manufacturing, enabling collaborative innovation, regulatory engagement and sustainable production methods to reduce time-to-market for life-changing pharmaceuticals through pilot-scale development, advanced processing facilities.

National Biologics Manufacturing Centre, CPI (Darlington)

Delivers biologics manufacturing capability, across therapeutics and vaccines bridging academia and industry. Home of the RNA centre of excellence, the UK's first RNA-LNP phase 1 GMP facility.

National Formulation Centre, CPI (Sedgefield)

Enables advanced formulation development, including food, feed and agribiologicals to commercialise next-generation formulated products efficiently at reduced technical and scale-up risk for industry. Home of the IDDC.

National Industrial Biotechnology Facility, CPI (Wilton)

Provides industrial biotechnology scale-up, de-risking sustainable bioprocesses through specialist facilities for product development, commercialisation, process innovation and pilot scale manufacturing. Home of the Novel Food Innovation Centre.

Novel Food Innovation Centre, CPI (Wilton)

Provides pilot-scale processing, fermentation and scale-up capabilities for novel foods, feeds and nutraceuticals, enabling rapid development, validation and commercialisation of sustainable food technologies.

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Connected technology platforms

Through cross-domain analysis, eight connected technology platforms have been identified. They underpin both the core advanced manufacturing process technologies and the cross-cutting enabling technologies set out in this strategy.

They provide a shared foundation of insight and collective capability, showing where coordinated effort across our domains can best strengthen, connect and accelerate the technologies that matter most to UK industry.

An industrial AI for advanced manufacturing UK adoption plan is now being developed in partnership between Made Smarter, Make UK, HVM Catapult and the Department for Business and Trade, led by the AI Champion for Advanced Manufacturing.

Priority: Artificial intelligence enabled advanced manufacturing

Enhancing human capabilities with industrial AI technologies applied across the product development and operational lifecycle

Harmonised life-cycle assessment

Standardising assessment methods and data ontologies to consistently measure environmental impact across a product's lifecycle

Value retention

Preserving the life of products, components and materials through recycling, repair, remanufacturing etc (Re-x)

Manufacturing with advanced materials

Accelerating the deployment of next generation materials across the full value chain, and supporting the development of an agile and responsive UK supply base

Capability development

Advanced and interconnected process modelling

Integrating detailed simulations and enabling interoperability across the value chain to optimise manufacturing performance

Automation of processes and digital integration

Streamlining manufacturing processes through digitally connected systems and interoperability

Digital thread

A seamless flow of data connecting design, production and operations across a product's life cycle

Intelligent manufacturing assurance and regulatory engagement

Leveraging smart systems to ensure quality and compliance, and early-stage dialogue to decrease barriers and accelerate validation and verification

Interpreting our roadmaps

The strategy structure

Why: Demand drivers
External pressures or opportunities that create the need for new or improved manufacturing capabilities.

What: Industry capability needs and priorities
The practical abilities industry must have to remain competitive in the future and the priorities for HVM Catapult.

How: Innovation requirements and priorities
The specific technologies, tools, processes, data, skills or system enablers that must be developed, improved or integrated to meet future industry capability needs, and the priorities for HVM Catapult.

Connected technology platforms
Highlight where coordinated effort across our domains can best strengthen, connect and accelerate the technologies that matter most to UK industry

Priority industry capability needs
The most critical capability gaps identified through industry consultation that must be addressed first to deliver impact.

Roadmap activity examples

Establish test beds to develop, integrate and validate novel inspection, measurement and test techniques and processes. → Demonstrated the trustworthy comparative robustness of emerging inspection, measurement and test technologies

The above 'what' items are linked and dependent – denoted by the overlapping boxes

Deployment of increased mechanization to remove variability and increase standardization linked to respective process specifications → Standardised digital weld procedures, reusable qualification libraries, harmonised standards

The above 'how' discreet items that are not linked and occur in different time horizons

IUK Strategic imperatives

Alignment with the Innovate UK vision
Each demand driver is colour-coded to align with the four imperatives of the Innovate UK materials and manufacturing vision 2050.

Innovative and digital
Businesses drive continuous and transformative innovation and create, adopt and export advanced digital technologies

Resilient and responsive
Mitigating risks from supply chain disruptions, national/global crises, and climate change.

Resource-efficient and regenerative
Sectors maximise circularity of materials, energy and water and aim for a net positive impact on the environment

Skilled and empowered
Workforces are highly skilled in executing advanced tasks and are empowered by configurable, open technology stacks

Biomanufacturing

Further details of the **demand drivers, industry capability needs** and **innovation requirements** are available online. Follow the QR code or click here.

Vision

Build UK resilience through sustainable biomanufacturing that delivers chemicals, materials and therapeutic products via efficient, low-impact processes, scalable technologies and renewable feedstocks. This will ensure cost competitiveness, food security and health innovation while supporting economic growth, national security and environmental sustainability.

2026

Next-generation therapeutics require innovative biological production methods

Biomanufacturing processes seek optimisation for efficiency and sustainability

Global food systems need sustainable and secure production solutions

Industries are transitioning to sustainable bio-based materials and chemicals

Healthcare diagnostics require biomanufactured components for reliable and innovative detection and monitoring

2030

Manufacturing skills and workforce development across the value chain

Develop and maintain a world-class UK workforce

Early detection and diagnostic standardisation to develop reliable, standardised diagnostic workflows and reagents to enable earlier disease detection and intervention

Support cutting-edge biomanufacturing facilities and capabilities underpinning public health and strategic priority response

Establish agreed quality standards and consistent laboratory methods to ensure reliability and reproducibility in biomanufacturing

Food, feed and agri-biologicals production for sustainable, secure and resilient supplies supporting human and animal nutritional needs

Alternative antimicrobials enabling innovative biological approaches to combat resistance and protect global health across diverse applications

Sustainable and cost-effective biomanufacturing advancing greener production methods to replace traditional processes and reduce environmental impact

Enable access to scale-up for novel innovative products and production processes

Develop novel biomanufacturing capabilities including new modalities, bioreactors, analytics and formulation

2035

Accelerating safe, ethical therapeutic approval through standardised regulations, virtualised manufacturing and robust data governance

Circular material systems using waste as feedstocks to develop next-generation green materials in localised ecosystems

Scaling cost-effective, GMP-compliant manufacturing for complex biologics and personalised medicines to meet growing demand

Leverage digital capabilities including digital twins, integrated analytics and automated process control to enhance biomanufacturing efficiency

Develop integrated multi-omic analytical capabilities and harmonised data systems for genomics, proteomics and metabolomics insights

Develop standardised digital models, in-line analytics and fast computational tools to optimise biomanufacturing quality

Develop scalable drying, purification and formulation technologies – including bioprinting – to enable efficient production of alternative proteins and advanced materials

2040

Key

Demand drivers
Why change is needed.

Industry capability needs
What capabilities industry needs to respond to these changes.

Innovation requirements
How capabilities must develop.

Priority industry capability needs
The most critical capability gaps identified through industry consultation that must be addressed first to deliver impact.

Biomanufacturing – Demand drivers

Next generation therapeutics require innovative biological production methods

Growth in phage, microbiome, RNA, oligonucleotide, and gene therapies demands advanced, flexible clinical manufacturing platforms.

Personalised medicines and theragnostics require small-batch, high-precision biomanufacturing with rapid scale-out capability.

Synthetic biology and cell-free expression
enable novel drug development and complex therapeutic delivery systems.

Nano-system delivery technologies increase manufacturing complexity and require new process innovations.

Antimicrobial resistance drives adoption of phage technologies and microbiome-based therapeutics.

Biomanufacturing processes seek optimisation for efficiency and sustainability

Process intensification and automation reduce energy, cost, and resource use while improving productivity.

Transition from single-use plastics to circular, certified second-life materials supports sustainability goals.

Standardised LCA and carbon accounting frameworks enable transparent sustainability measurement and compliance.

Energy-efficient organisms and biocatalysis methods support greener, low-impact production pathways.

Defossilisation and sustainable feedstocks reduce reliance on petrochemicals and improve supply chain resilience.

Global food systems need sustainable and secure production solutions

Alternative proteins and cellular agriculture improve food security and reduce environmental impact.

Gas fermentation and vertical farming enable scalable, controlled production of food and pharma ingredients

Bio-derived agri-stimulants and animal health solutions meet growing population
and climate resilience needs.

Novel bioproducts for space travel and planetary colonisation highlight strategic biomanufacturing importance.

Food safety standards and traceability systems ensure consumer trust and regulatory compliance.

Industries are transitioning to sustainable biobased materials and chemicals

Bio-based feedstocks and defossilisation strategies reduce petrochemical dependency and emissions.

High-performance biopolymers and bio-recovery technologies enable circular economy adoption.

Hydrogen and carbon as building blocks support advanced materials and sustainable fuels.

Consumers demand clean and sustainable ingredients in all products with safe traceable ingredients.

Sustainable packaging and standardized metrics drive eco-friendly manufacturing practices.

Healthcare and diagnostics require biomanufactured components for reliable and innovative detection and monitoring

Early disease detection drives demand for diagnostic reagents and biologically derived components.

Animal-free testing and ethical in vitro models accelerate innovation and regulatory acceptance.

Data science and real-time release technologies enable rapid certification and deployment of diagnostics.

Virtualised manufacturing supports smart design and faster regulatory approval processes.

Multi-omics approaches required to enable early disease detection and liquid biopsy approaches.

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Innovate UK

Strategic summary

UK biomanufacturing must advance agile, sustainable platforms and facilities to meet healthcare, food, and industrial demands. Innovations in therapeutics, diagnostics, and materials, coupled with circular processes and ethical standards, will drive resilience and global competitiveness. Regulatory clarity, automation, and scalable design underpin a future-ready, low-impact biomanufacturing ecosystem.

IUK Strategic imperatives

Innovative and digital

Resource-efficient and regenerative

Resilient and responsive

Skilled and empowered

Biomanufacturing – Industry capability needs

	2026	2030	2035	2040
Technology domain specific	Expand analytical technologies for phage characterization, potency, stability, and microbiome CQAs.	Sustainable and cost-effective biomanufacturing advancing greener production methods to replace traditional processes and reduce environmental impact		
	Establish 100–1000 L drying, extrusion, purification and formulation capabilities for productization.	Scaling cost-effective, GMP-compliant manufacturing for complex biologics and personalised medicines to meet growing demand		
	Manufacturing skills and workforce development across the value chain	Develop and maintain a worldclass UK workforce		
	Understand capability and capacity gaps for large and novel biomanufacturing approaches across the UK	Develop novel biomanufacturing reactors and processes including access to pilot facilities		
Digital thread	Implement integrated LIMS/MES with equipment connectivity, robust metadata, and compliant data governance.	Creation of models and digital twins of fermentation and cellular processes for prediction, optimisation and troubleshooting		
	Data mining and standardisation to enhance machine learning (ML) for process improvement and control			
Embedded AI for advanced manufacturing	Multiomics integration through converging genomics, proteomics, transcriptomics, metabolomics data with agreed standards and formats	Computational 'Omics' tooling developing scalable computational pipelines, fast analysis tools, and harmonized outputs for interoperability		
Manufacturing with advanced materials	Engineer extracellular matrix mimics, tuneable biostability polymers, and structured culture materials improving yields for alternative proteins	Alternative antimicrobials enabling innovative biological approaches to combat resistance and protect global health across diverse applications		
	Food and feed production for sustainable agriculture and secure, resilient supplies supporting human and animal nutritional needs	Circular material systems using waste as feedstocks to develop next generation green materials in localised ecosystems		
Value retention	Influence and enable funding and investment incentives through partnerships with IUK, UKRI and other groups such as BIA and BBIA			
Advanced and interconnected process modelling	Deploy model predictive control in in line process analytical technologies (PAT) for critical quality attributes (CQAs) and critical process parameters (CPPs)			
Intelligent manufacturing assurance and regulatory engagement	Agree data, quality, and lab method standards to ensure comparability and regulatory confidence in non-pharma sectors including developing open source engineered strains			
	Accelerating safe, ethical therapeutic approval through standardised regulations, virtualised manufacturing, and robust data governance			

Biomanufacturing – Innovation requirements

	2026	2030	2035	2040
Technology domain specific	Access to pilot scale infrastructure, that is either specific of flexible, to support the needs across biomanufacturing sectors			
	Personalised therapy supply, generating products for small numbers of patients in localised institutes			
	Sustainable and cost-effective biomanufacturing advancing greener production methods to replace traditional processes and reduce environmental impact			
	Food and feed production for sustainable agriculture and secure, resilient supplies supporting human and animal nutritional needs			
	Optimised and available bioproduction hosts (chassis) for engineering biology	Incentivised adoption and integration into the NHS as viable alternatives to antibiotics		
	Alternative antimicrobials enabling innovative biological approaches to combat resistance and protect global health across diverse applications			
Digital thread	Intensified manufacturing to increase efficiency, and sustainability and costs of bio manufactured products			
	Increased process analytical technologies (PAT) improving process monitoring, modelling and development of digital twins			
Automation of processes and digital integration	Chemical processing integration for feedstock generation / product formulation	Development of modular biomanufacturing to ensure adaptability and flexibility of UK capabilities		
Manufacturing with advanced materials	Formulation and stability of bio-actives for long term storage / application including encapsulation	Circular material systems using waste as feedstocks to develop next generation green materials		
	Access to sustainable and consistent feedstocks	Phage production for human compassionate use in the UK		
Value retention	Cost-effective biomanufacturing enabling position in competitive chemicals and materials sectors			
Harmonised life cycle analysis	Standard LCA across biomanufacturing methods sectors			
Intelligent manufacturing assurance and regulatory engagement	Sustainable and consistent feedstock, standardised feedstock testing to understand process efficiencies			
	Regulatory guidance on alternative antimicrobials further developed across sectors	Real-time release to enable manufactured products to be rapidly deployed at the point of manufacture		
	Legislative support prioritising the use of sustainable biobased alternatives across all sectors	Analytical characterisation of multispecies microbiome products and phage therapies		

Biomanufacturing - Priority pathways

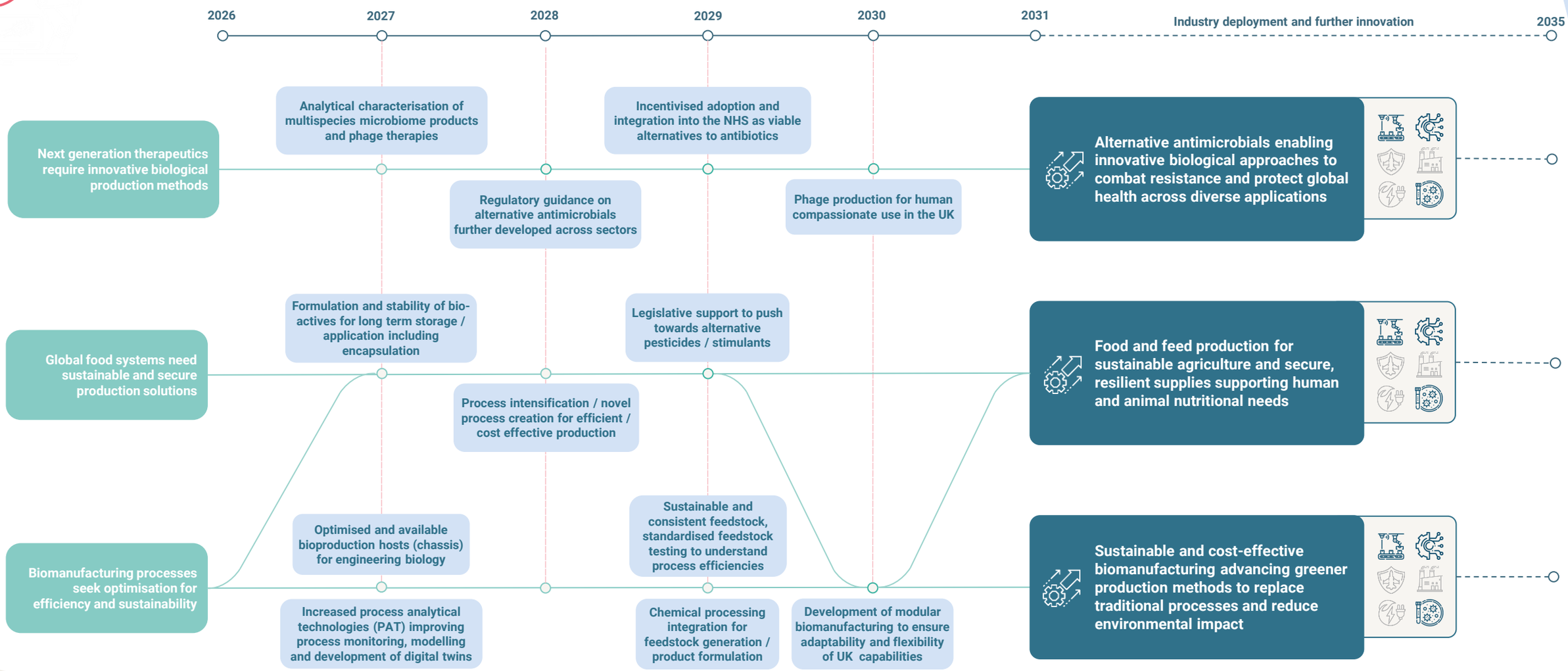

Diagram Legend

Demand drivers
Why change is needed

Industry capability needs
What capabilities industry needs to respond to these challenges

Innovation requirements
How capabilities must develop

Priority industry capability needs
The most critical capability gaps identified through industry consultation that be addressed first to deliver impact

Industrial strategy growth-driving sectors

Department for Business & Trade

- Foundation Industries
- Clean Energy Industries
- Digital & Technologies
- Life Sciences
- Advanced Manufacturing
- Defence