

Near net shape

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CATAPULT
High Value Manufacturing



Connect with us

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Near net shape

Forging, forming, casting and powder consolidation technologies that produce complex components close to final shape.

Why: Demand drivers

- Standardised, sustainable manufacturing and materials circularity practices by minimising waste, maximising upcycling and enabling re-use
- Increased capacity for large-scale advanced manufacturing for aerospace, nuclear, offshore and hydrogen sectors
- Resilient UK supply chains to manufacture large, complex components for varied operating conditions
- Cost-effective, resource-efficient and carbon-optimised manufacturing, through advanced tooling, design and simulation
- Materials innovation and certified circular material supply chains.

What: Priority industry capability needs

- Viable methods to reconstitute critical metals into high-quality, complex components, using higher recycled content, high-strength and longer-in-use materials
- Improved process control and assurance through intelligent monitoring, metrology, self-calibrating tooling and AI-enabled interoperability
- Accelerated at-scale process development, optimisation and qualification through advanced process modelling and digitalisation
- Standards to support remanufacturing, enabling an increasing use of high-value, recycled materials
- Low-carbon feedstocks, electrified heating systems, energy-efficient tooling and precise digital process controls to reduce emissions and material waste.

How: Priority innovation requirements

- Hydrogen and electric furnaces to enable cleaner thermal processing by replacing fossil fuel-based heating in high-temperature operations
- Advanced, localised heating technologies to improve energy efficiency and precision in forming, forging and casting processes
- Integrated modelling, digital twins and system architecture to support real-time process optimisation and predictive control across manufacturing stages
- Scaled-up testing and prototyping capabilities to accelerate the validation of sustainable manufacturing technologies and complex component designs
- Increased automation and digitalisation to enhance production efficiency, consistency and data-driven decision making.

Near net shape (NNS) technologies have diverse applications, spanning cutting-edge aerospace to clean energy industries and underpin the manufacture of the world's most complex, high-value components. By exploiting advancements in casting, forging, forming and powder consolidation, we are cutting waste, energy and cost with the view to boost precision, productivity, performance and sustainability. HVM Catapult centres are pushing the boundaries of what is possible, such as the development of Field Assisted Sintering Technology (FAST) and the next step is to support UK industry to be a global leader in near net shape innovation for large-scale, sustainable manufacturing.

Key HVM Catapult capabilities in near net shape

Advanced Forming Research Centre, NMIS (Renfrew)

Advanced forming and forging capabilities, including superplastic forming and flow forming and friction welding, plus Europe's largest digital hot-forging platform with FutureForge, real-time data and robotic automation.

Powder metallurgy hot isostatic pressing, AMRC (Rotherham)

Advanced powder metallurgy and hot isostatic pressing capabilities, enabling near net shape components with superior density and performance, supported by integrated process modelling, real-time monitoring and fully automated handling for high-integrity applications.

Design and encapsulation for hot isostatic pressing, MTC (Coventry)

The UK's largest R&D powder hot isostatic pressing encapsulation line, delivering world-leading canister fabrication, powder filling, vibration, evacuation and sealing for large, near net shape components.

AMRC Castings, AMRC (Rotherham)

Unique ferrous and non-ferrous casting capabilities, including Europe's largest titanium capacity, with in-house pattern and mould manufacture, serving unavailable applications while developing low-carbon casting processes.

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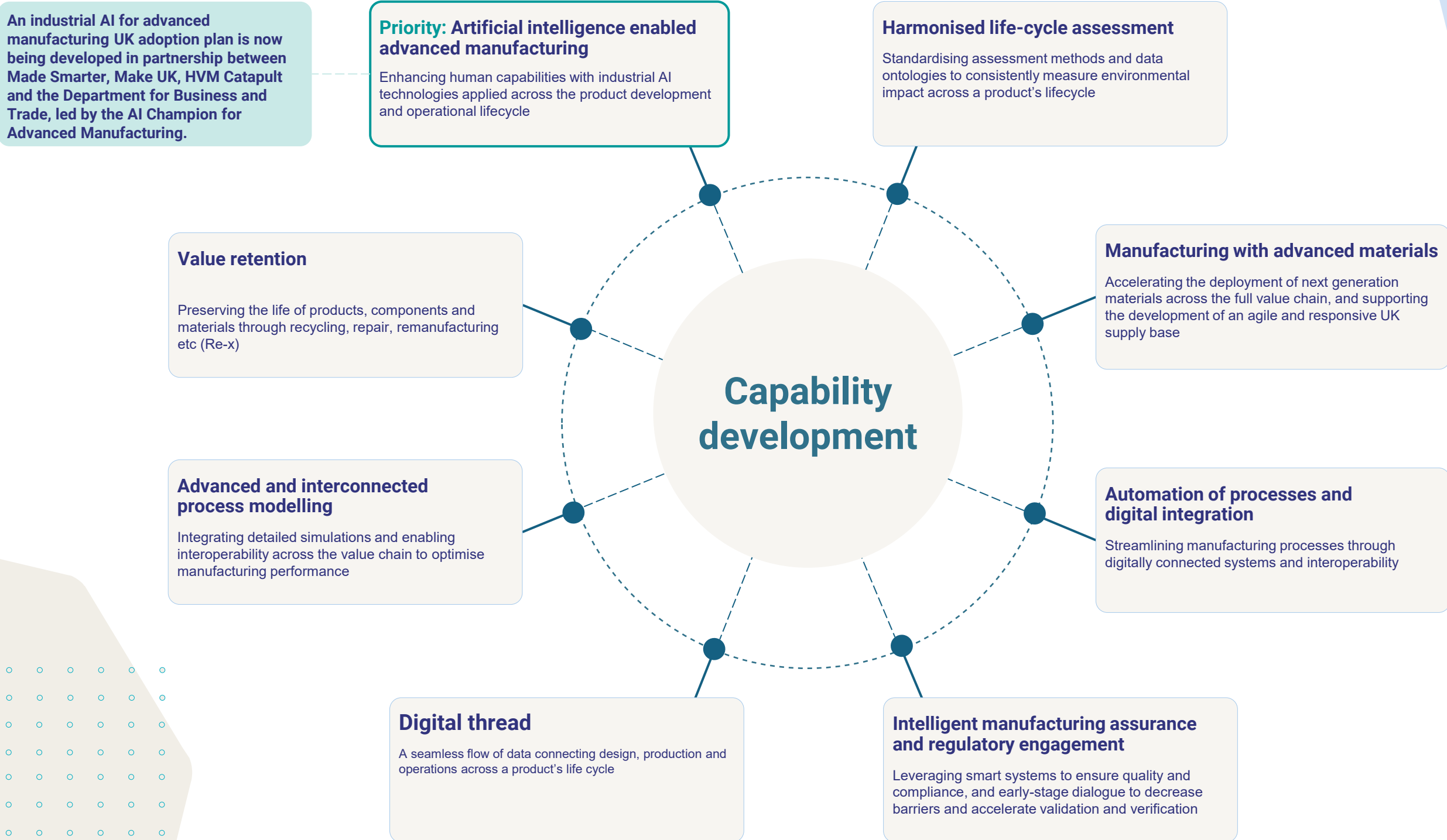
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Connected technology platforms

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.



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.



Priority industry capability needs

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

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

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' discrete 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

Resource-efficient and regenerative

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

Resilient and responsive

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

Skilled and empowered

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

Near net shape



Further details of the demand drivers, industry capability needs and innovation requirements are available online. Follow the QR code or [click here](#).

Vision

Leading innovation for near net shape technologies and strategies by pioneering new techniques, reducing waste, digitalisation and enabling sustainable, large-scale manufacturing across the UK's high-growth sectors.

2026

2030

2035

2040

Standardised, sustainable manufacturing and materials circularity practices by minimising waste, maximising upcycling and enabling re-use

Materials innovation and certified circular material supply chains

Resilient UK manufacturing supply chains to manufacture large, complex components for varied operating conditions

Increased capacity for large-scale advanced manufacturing for aerospace, nuclear, offshore and hydrogen sectors

Cost-effective, resource-efficient and carbon-optimised manufacturing, through advanced tooling, design and simulation

Innovative end-of-life strategies, optimised material usage through simulation, and design for sorting and remanufacture

Build UK supply chain intelligence, material datasets and demand forecasts aligned to high-performance applications

Recycled content for hybrid and sustainable forming processes

Viable methods to reconstitute critical metals into high-quality, complex components, using higher recycled content, high-strength and longer-in-use materials

Efficient heating for hybrid and sustainable forming processes

Improved process control and assurance through intelligent monitoring, metrology, self-calibrating tooling and AI-enabled interoperability

Accelerated at-scale process development, optimisation and qualification through advanced process modelling and digitalisation

Expand UK strategic capability in incremental forming

Create national materials database, digital passports, smart testing facilities and demand mapping for circular manufacturing

Hydrogen and electric furnaces to enable cleaner thermal processing by replacing fossil fuel-based heating in high-temperature operations

Low-carbon feedstocks, decarbonised heating systems, energy-efficient tooling and precise digital process controls to reduce emissions and material waste

Standards to support remanufacturing, enabling an increasing use of high-value, recycled materials

Advanced, localised heating technologies to improve energy efficiency and precision in forming, forging and casting processes

Integrated modelling, digital twins and system architecture to support real-time process optimisation and predictive control across manufacturing stages

Scaled-up testing and prototyping capabilities to accelerate the validation of sustainable manufacturing technologies and complex component designs

Combine additive, casting and forming technologies with hybrid tooling to create tailored composite structures and components

Increased automation and digitalisation to enhance production efficiency, consistency and data-driven decision-making

Partner with powder suppliers and universities to develop and qualify materials for extreme environments and formability

Embed modularisation, DFX and dismantling principles into design/data standards and materials processing knowledge base

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.

Near net shape – Demand drivers

Standardised, sustainable manufacturing and materials circularity practices by minimising waste, maximising upcycling, and enabling re-use

Process efficiency through precision forming Near net shape techniques reduce machining allowances, material waste, and embodied carbon by producing components closer to final geometry.

Closed-loop material systems Enhanced scrap recovery and alloy re-melting practices enable circular use of high-value metals such as titanium, aluminium, and nickel superalloys.

Digital twins for lifecycle optimisation Data-driven modelling of forming and forging processes supports predictive control of yield, recyclability, and material flow.

Cross-sector knowledge transfer Lessons from aerospace, defence, and energy sectors drive scalable, sustainable near net shape solutions for wider UK manufacturing adoption.

Increased capacity for largescale advanced manufacturing for aerospace, nuclear, offshore and hydrogen sectors

Scalable near net shape processes Development of high-tonnage forging, forming, & casting capabilities to produce larger, more complex structures efficiently and repeatably.

Integration of digital manufacturing technologies Use of advanced simulation, in-process monitoring, and adaptive control to ensure dimensional accuracy and traceability in large-scale components

Investment in advanced infrastructure Expansion of national facilities and testbeds across HVMC centres to support industrial-scale trials and qualification of large components.

Cross-sector design and material innovation Shared R&D in alloys, coatings, and forming methods to meet demanding performance and safety standards across aerospace, energy, and offshore sectors.

Cost-effective, resource-efficient and carbon optimised manufacturing, through advanced tooling, design and simulation

Optimised process design Using advanced simulation and digital twins to minimise trial-and-error, reduce material use, and optimise forming sequences for cost and carbon savings.

Innovative tooling solutions Developing adaptive, long-life tooling and dies that improve process accuracy, extend service life, and reduce waste.

Integrated design for manufacturability Embedding near net shape principles early in product design to reduce machining, energy use, and production time.

Data-driven performance monitoring Leveraging in-process sensing and analytics to continually improve yield, efficiency, and sustainability metrics.

Materials innovation and certified circular material-supply chains

Advanced alloy development Designing new high-performance alloys optimised for near net shape forming, improving formability, strength, and recyclability.

Recycling and re-melting innovations Establishing efficient re-melt and reuse pathways and standards for high-value metals such as titanium, nickel, and aluminium to close the materials loop.

Design for circularity Embedding circular economy principles in component and tooling design to enable easier recovery, repair, and re-use of materials.

Process-material co-optimisation Using simulation and data-driven control to match materials and forming processes for maximum yield and minimum waste.

Resilient UK manufacturing-supply chains to manufacture large, complex components for varied operating conditions

Map and strengthen regional supply chains Building regional manufacturing supply chains through networked efforts for casting, forging, and forming to strengthen domestic capacity and reduce reliance on imports.

Material and process agility Developing flexible near net shape processes that can accommodate multiple alloys and component geometries across sectors.

Digital connectivity and traceability Implementing end-to-end digital twins & data standards to ensure transparency, quality assurance, and rapid response to supply chain disruptions.

Sustainable and secure sourcing Promoting the use of recycled feedstocks, UK-based material supply, and circular economy principles to enhance long-term resilience and sovereignty.



Strategic summary

There is a strong and growing demand for low-carbon, energy-efficient production, expanded large-scale manufacturing capabilities, and resilient domestic supply chains across the UK's high-growth sectors. To achieve sustainable and scalable growth, it is essential to position and support the UK's advanced manufacturing sector as a leader in high-value, circular, and precision-engineered manufacturing for NNS.

IUK Strategic imperatives

- Innovative and digital
- Resource-efficient and regenerative
- Resilient and responsive
- Skilled and empowered



Near net shape – Industry capability needs

2026

2030

2035

2040

Technology domain specific

Efficient heating for hybrid and sustainable forming processes

Expand UK HIP furnace mapping and capacity, reuse existing equipment, and scale up forming of ceramics and refractory metals

Recycled content for hybrid and sustainable forming processes

Promote right behaviours across industry to support adoption of sustainable and advanced manufacturing practices

Address UK skills gap (capability, competency & capacity) in heavy industry through targeted training, workforce development and RTO/academic engagement initiatives

Artificial intelligence enabled advanced manufacturing

Improved process control and assurance through intelligent monitoring, metrology, self-calibrating tooling & AI enabled interoperability

Manufacturing with advanced materials

Enable recycled metals in NNS, improve formability, and validate performance against virgin and mixed material inputs

Build UK supply chain intelligence, material datasets, and demand forecasts aligned to high-performance applications

Low-carbon feedstocks, electrified heating systems, energy-efficient tooling and precise digital process controls to reduce emissions and material waste

Viable methods to reconstitute critical metals into high-quality, complex components, with higher recycled content, high-strength & longer in use materials

Value retention

Innovative end-of-life strategies, optimise material usage through simulation, and design for sorting and remanufacture

Advanced and interconnected process modelling

Reduce joining, optimise models for PM-HIP, ceramics, and tooling cost reduction through robust simulation tools

Intelligent manufacturing assurance & regulatory engagement

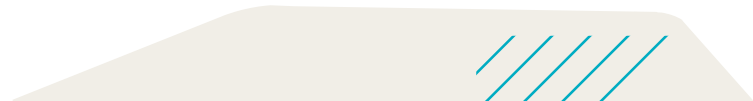
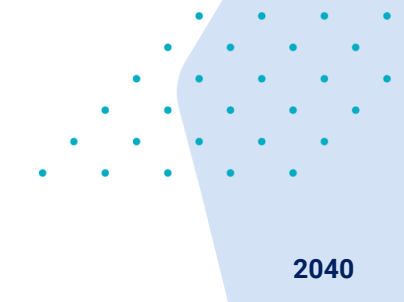
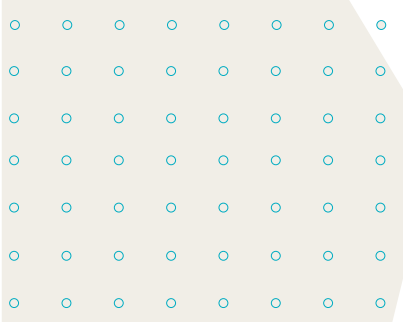
Accelerated at-scale process development, optimisation and qualification through advanced process modelling and digitalisation

Intelligent monitoring, flexible tooling, and advanced metrology for improved assurance and thermal control

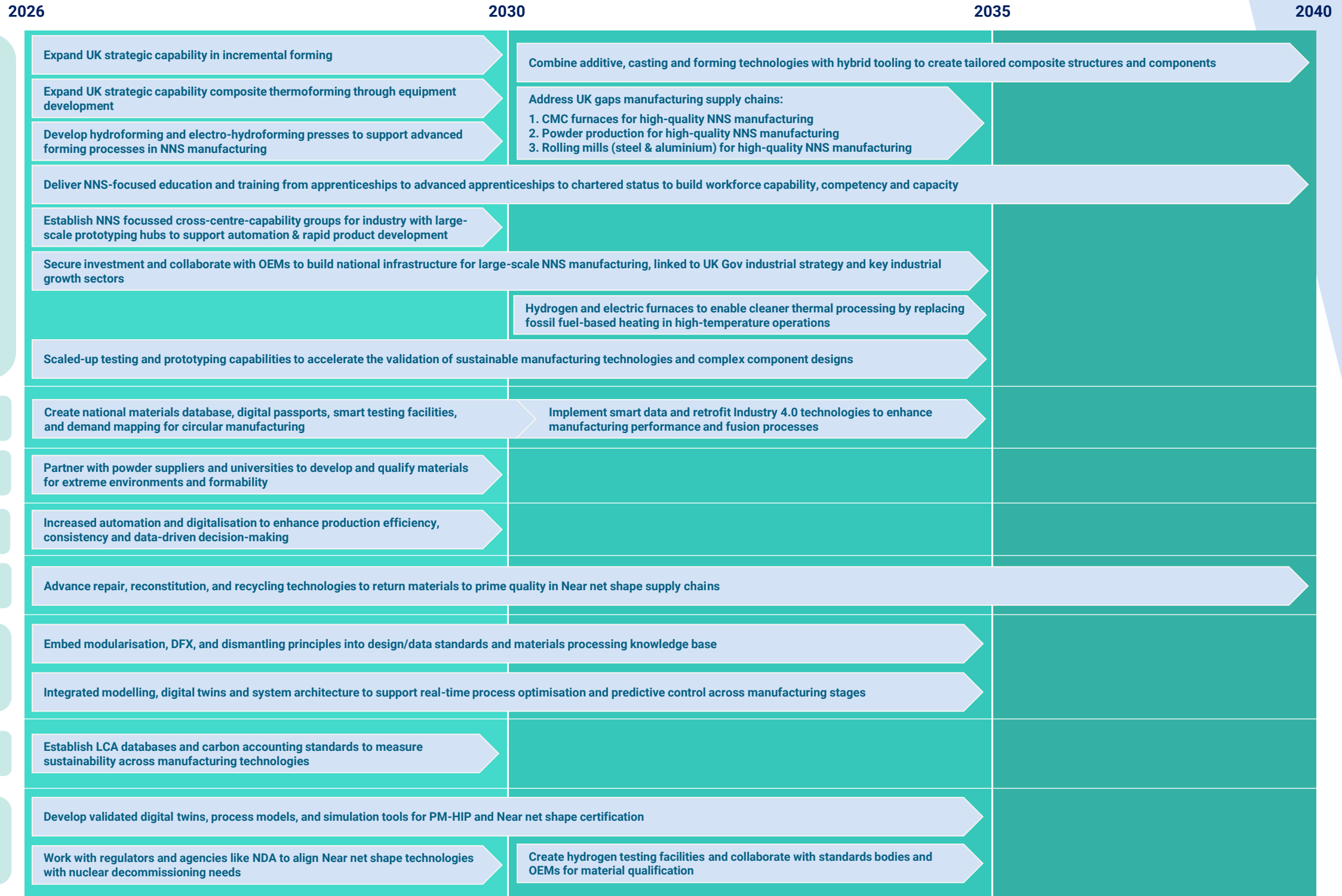
Standards to support (re)-manufacturing, enabling an increasing use of high-value, recycled materials

Harmonised life cycle analysis

Develop LCA, repair, and recycled material standards; accelerate certification and centralise carbon and performance data



Near net shape – Innovation requirements



Near net shape: priority pathways

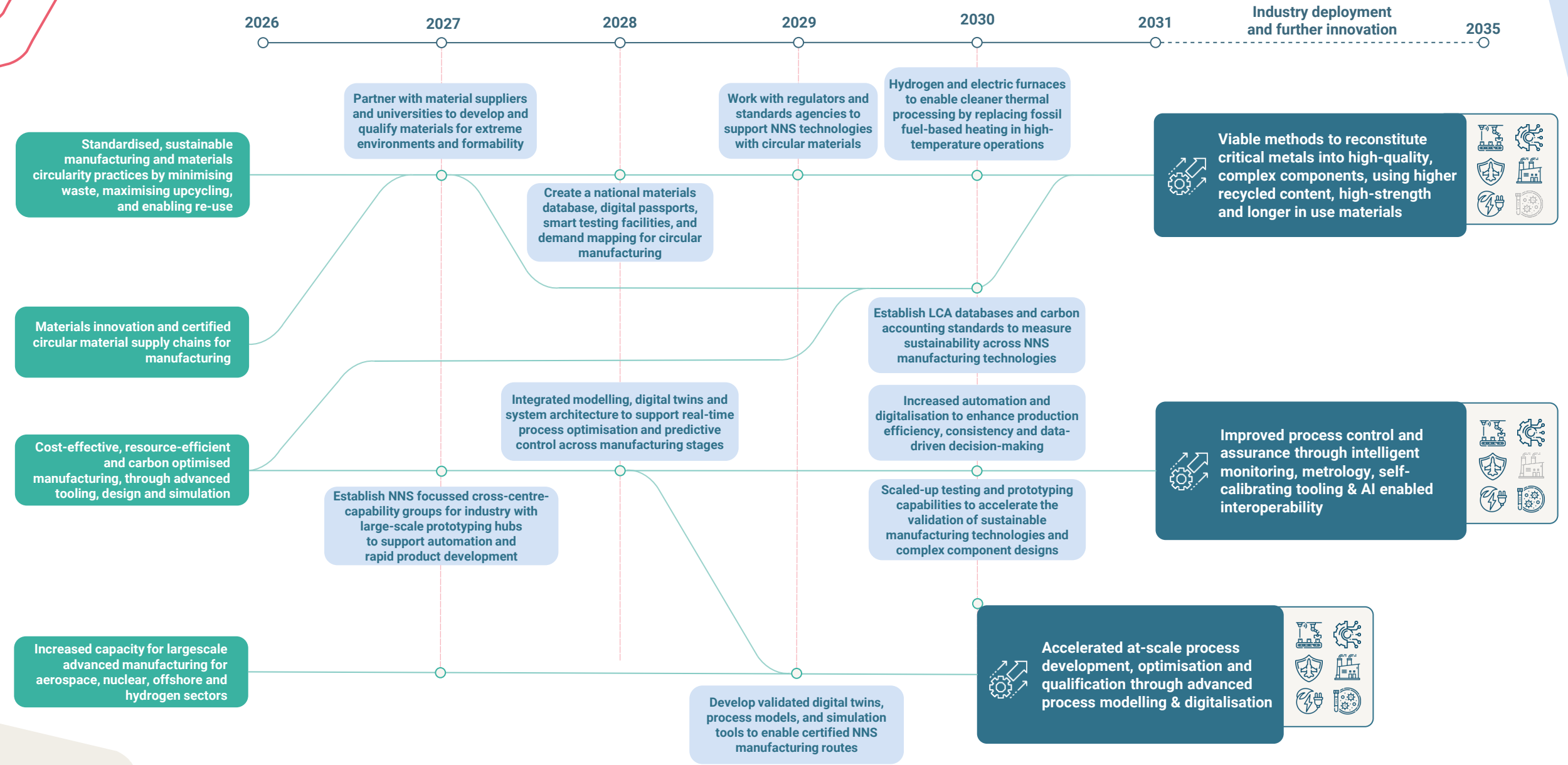


Diagram Legend

- Demand drivers**
Why change is needed
- Innovation requirements**
How capabilities must develop
- Industry capability needs**
What capabilities industry needs to respond to these challenges
- 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

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