



# Supporting the Growth of Advanced Materials in the North

An independent report commissioned by the Science and Technology Facilities Council (part of UK Research and Innovation)

July 2024




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


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**The North’s Advanced Materials proposition**




 <p><b>Research and Assets</b></p> <p>¼ of the UK universities and a diverse range of established research partnerships</p>	 <p><b>Businesses</b></p> <p>40% of the UK spatial clusters of advanced materials businesses are in the North.</p>	 <p><b>Policy</b></p> <p>Advanced materials is a focus in 5 of 6 Northern Investment Zone</p>
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**Challenges for Advanced Materials in the North**

 <p><b>Scale up challenges hinders the realisation of material innovations.</b></p>	 <p><b>Industry and materials fragmentation leading to siloed development and working</b></p>
 <p><b>Recognition of importance and awareness of opportunities</b></p>	 <p><b>Emphasis on academic pursuits overshadowing practical applications and industry needs.</b></p>

*There is a strong case to support the advanced materials ecosystem in the North given its centrality to key sectors and national strategic priorities, and the challenges arising due to the cross-cutting nature of materials in the economy*

**Three priority areas for intervention in the North to build on existing strengths and opportunities, address the market failures, and complement ongoing work:**

 <p><b>Co-ordination</b></p>	 <p><b>Commercialisation</b></p>	 <p><b>Communication</b></p>
<p>Facilitate greater co-ordination across the North’s materials ecosystem and create an entry point for businesses with materials opportunities.</p>	<p>Increase commercialisation of advanced materials, creating new businesses, driving adoption in existing ones, and deploying yet-to-be commercialised materials</p>	<p>Improve communication on the role and opportunities that exist around advanced materials to raise mainstream awareness of materials and their significance.</p>

*The structure of ecosystem support which seems suited to addressing the three strategic priorities, with the flexibility to work across different areas of activity and respond to new activities, is a team of local network managers, working as part of a pan-northern structure*

# Executive Summary

## Purpose

Materials Innovation and Manufacturing is consistently highlighted as one of the key technology families with potential to transform the future economy.<sup>1</sup> However, to date there has yet to be any place-based co-ordination or management for the development of materials in the UK.

In this context, the Science and Technology Facilities Council (STFC) commissioned Metro Dynamics to consider mechanisms to support the development of the North of England's advanced materials ecosystem. A key catalyst for this work has been the success of activity to bring together other sectors in clusters across the North. STFC's 2024 Cluster Strategy highlighted how the establishment of clusters to manage the sector ecosystems in Space, HealthTech and Digital is helping to connect capabilities, intelligence, and insights across regions and between different parts of the ecosystem (e.g. research and businesses).

The commission considered what type of approach should be explored to grow the advanced materials ecosystem to deliver economic growth in the North, a part of the country with a rich industrial and materials heritage, which today has significant materials assets and the potential to lead for the UK.

The report draws on recent national, regional, and sectoral reports, data analysis and engagement with stakeholders from government, research, and businesses, and engagement with the team delivering the National Materials Innovation Strategy (NMIS)<sup>2</sup>, to explore:

- What is the North's advanced materials proposition and is there a case for supporting the ecosystem?
- What should the priorities for this support be?
- What approach to management is best suited to advanced materials in the North of England?

## Findings

The North's advanced materials position is a strong one: it has a critical mass of researchers and research assets, a demonstrated and continuing ability to bring forward new initiatives and infrastructure, concentrations of businesses directly involved in advanced materials, and strengths in sectors that are large users and adopters of advanced materials. The challenges facing the sector in the North are not substantively different from national challenges.

Advanced materials is a technology with very broad potential applications and the scale of the potential opportunity is large. However, given the full scope of activity is difficult to

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<sup>1</sup> National Innovation Strategy, 2021.

<sup>2</sup>Engagement has also enabled us to recommend an approach which is additive to other ongoing work in this space, particularly the NMIS.

## Metro—Dynamics

clearly delineate, the full scale of the opportunities is frequently unclear for policymakers or to the businesses who could gain from developing or adopting new materials or processes.

Engagement has identified that, as with the UK as a whole, the North needs to address challenges including scaling up businesses, the slow pace of taking a material from the lab to the market, and fragmentation of the ecosystem, all of which were highlighted repeatedly during engagement. Recognition from policymakers and funders, as well as from businesses, is a key area that needs to be addressed to deliver on the full potential.

Through the work undertaken we have found:

- A strong case to support the advanced materials ecosystem given the centrality to key sectors and national strategic priorities and the challenges that arise due to the cross-cutting nature of materials in the economy.
- A strong case to do this in the North, which has a critical mass of materials research capabilities and assets, businesses who require/produce advanced materials and a pre-existing policy emphasis on materials<sup>3</sup>.

## Recommendations

Given the current strengths, opportunities, and challenges in the North, and after considering options for support mechanisms ranging from establishing a shared post across major stakeholders, to pursuing growth in specific materials or sectors, to setting up physical hubs, **we recommend that this support be delivered by a team of local ecosystem managers working** as part of a pan-northern structure. This approach is recommended as it is well suited to have a positive impact across three strategic priorities to deliver economic growth:

- Increase the rate and volume of **commercialisation of advanced materials**, targeting the creation of new businesses, greater adoption of new materials by existing businesses and deployment of advanced materials that have not yet been applied in commercial ways.
- Facilitate greater **co-ordination across the North's materials ecosystem** and create an entry point for businesses with materials opportunities and requirements who may not currently see themselves as advanced materials businesses.
- Improve **communication about the role advanced materials play in the economy and opportunities** that exist around advanced materials both internally and to external companies, policymakers, and investors to raise more mainstream awareness of materials and their significance.

## Next Steps

The next steps in this process are to disseminate this independent report and discuss the findings and conclusions with the advanced materials community to agree a set of shared objectives for support, based on the options and recommendations within.

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<sup>3</sup> Though the policy emphasis does vary across the North, to a greater or lesser extent all areas recognise materials as important to local economic development and future growth.

# Introduction

### Purpose of this work

With a growing awareness of the importance of advanced materials across climate objectives, energy security and national resilience, the North of England is seeing greater policy emphasis on materials and the growth opportunities that they could represent in a region with a deep history of materials innovation and production. This is seen in major recent developments across a diverse range of applications, including but not limited to, Atom Valley - between Greater Manchester and Leeds City Region, the Centre of Expertise in Advanced Materials and Sustainability in Greater Manchester, Space Nuclear Battery development in Lancashire & Cumbria and the Infection innovation consortium (iicon) in Liverpool, where advanced materials play a crucial role.

While the North has a large and diverse variety of advanced materials assets, researchers, and large complementary/dependent industries, there has been no place focused cluster development in the North or elsewhere in the UK for advanced materials. Since the launch of the North West Health Cluster in 2019 the Science and Technology Facilities Council (STFC, part of UK Research and Innovation) has supported the development of a number of regional clusters, launching Digital Tech in 2021 and Space in 2022. STFC's approach to clusters, set out in their [Cluster Strategy](#) (published in January 2024), focuses on how leadership through clusters can support innovative businesses, business creation and growth (including of existing businesses) and greater collaboration across local and regional ecosystems by helping to connect capabilities, intelligence, and insights across regions and between different parts of the ecosystem.

The success of these and other clusters in bringing together stakeholders and facilitating collaboration is a catalyst for this work, which looks at how to best support advanced materials in the North. This independent report has been commissioned by the Science and Technology Facilities Council (STFC) to support stakeholders understand what mechanisms could be best deployed to accelerate the development and connectivity of the North of England's advanced materials ecosystem.

Metro Dynamics was commissioned to deliver an independent report exploring whether there is a case for introducing support for the ecosystem in the North to drive economic growth through advanced materials activity. We have drawn on a literature review of national, regional, and sectoral reports, analysis of relevant datasets and engagement with stakeholders across the North<sup>4</sup> to explore:

- What is the North's advanced materials proposition and is there a case for supporting the ecosystem?
- What should the priorities for this support be?

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<sup>4</sup> Stakeholders have included representatives from central and local government, research institutes, research councils, universities and businesses. It has also included conversations with the team delivering the National Materials Innovation Strategy to ensure alignment and complementarity.

## **Metro——Dynamics**

- What approach to management is best suited to advanced materials in the North of England?

The report is not a strategy setting out actions to support the ecosystem in the North. Rather, it is part of an earlier stage of development, focussed on reviewing the North's proposition to identify first whether there is a case for ecosystem support and, given if there is a case, what approach to delivering this support would be well suited to meet the needs of the North's advanced materials ecosystem.

### **Report Structure**

This report is divided into five sections, first describing the approach we have taken to understanding what is meant by advanced materials. This is followed by a summary of the North's advanced materials proposition, setting out the strengths that are there to build upon as well as the challenges that are present and impacting growth at present. The third and fourth sections set out the priority areas to address through pan-northern ecosystem management and identify a recommended approach to do this. The final section sets out possible next steps to take forward the recommendations of this report.

# Advanced Materials

### What do we mean by advanced materials?

Advanced materials is best conceptualised not as a sector or industry but as a cross-cutting technology or capability. As with other technologies and capabilities (such as AI or engineering) it is possible to identify businesses directly engaged in the development and production of advanced materials, but without also considering current and potential users materials this gives only part of the true scale and significance.

Defined variously as materials...

*“... specifically designed for targeted properties”<sup>5</sup>*

*“... that are rationally designed (...) in order to fulfil the functional requirements of a certain application”<sup>6</sup>*

*“... intentionally designed and engineered materials to display superior performance or special functions”<sup>7</sup>*

... the term ‘advanced materials’ covers a huge breadth of materials, which are used across sectors.

Ongoing work on a national strategy being led by the Henry Royce Institute, the UK’s national institute for advanced materials research and innovation, has eschewed the term advanced materials, and is instead looking at materials innovation, which is defined as:

**“the process of discovering, developing, and exploiting new materials or applying existing materials to new processes.”<sup>8</sup>**

This reflects one of the key challenges with advanced materials: the sheer breadth of potential applications makes it difficult to define what activities and businesses are (or indeed are not) part of it. Given that advanced materials span a very wide range of applications, which themselves span multiple current and potential applications, it can be difficult to grasp conceptually. The term is not one that all stakeholders who are involved in using new materials in different ways understand and identify with.

Businesses interact with advanced materials in different ways, as producers, users or some combination of the two. The interaction model below demonstrates the ways in which businesses can be part of the materials ecosystem, and the areas where businesses which could be participating are not doing so. When thinking in the future about specific interventions or activities to deliver growth these different categories of businesses will be a useful frame of reference, with very different approaches to deliver growth through core advanced materials businesses who are both producing and using advanced materials,

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<sup>5</sup> A study to assess UK strategic advantage in advanced materials, BEIS. 2022

<sup>6</sup> [Advanced Materials: Working Description](#). OECD. 2022

<sup>7</sup> [Advanced Materials for Industrial Leadership](#). European Commission. 2024

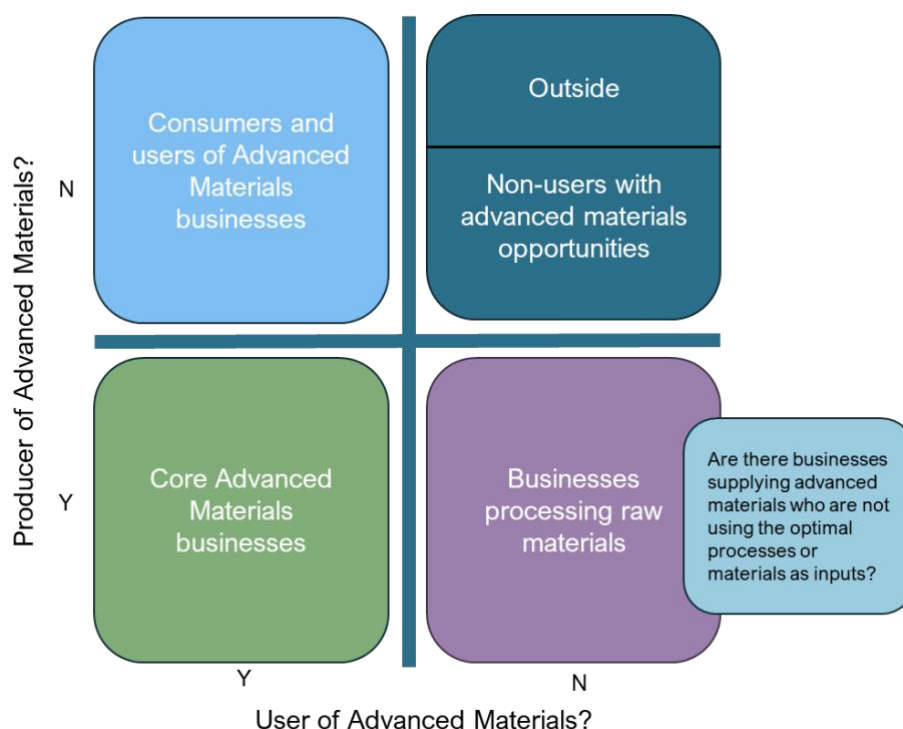
<sup>8</sup> [Materials Future: Growing the UK’s Critical Capabilities in Materials Innovation](#). Henry Royce Institute. 2023



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versus those who are not currently producing or using but who could see positive impacts from switching to doing so.

**Figure 1. Advanced Materials Business Interaction model**

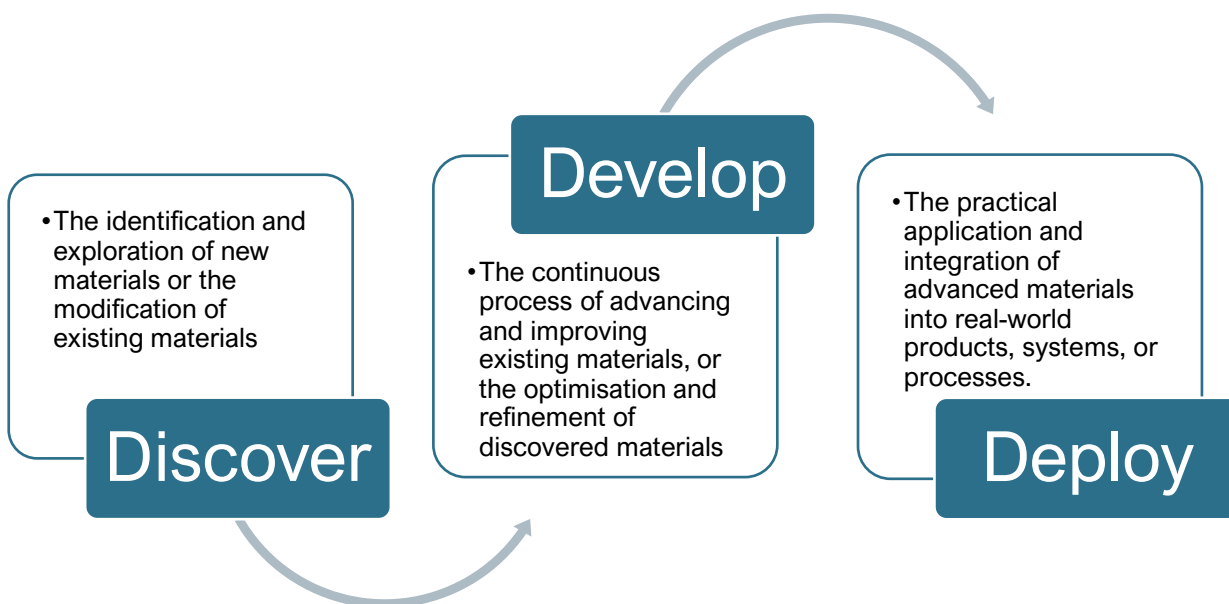


This project has not sought to offer a new definition, nor has it adopted a single definition from elsewhere. Given that the goal has been to identify ways to develop advanced materials in the North to deliver economic growth, this is best served by taking a broad definitional view. This has incorporated brand new discovered materials, materials enhanced in some way, or materials which are usefully applied in new contexts/processes.

We have however, reviewed the activities that are part of the advanced materials development process and categorised these activities into three broad areas, which are loosely aligned with Technology Readiness Level (TRL) stages. This activity-based categorisation helps to conceptualise the full scope of activity, understand the North's proposition and the areas where intervention could be targeted. As work to develop the sector moves forward this categorisation of activities should also support considering how to apply materials to deliver growth.

# Metro—Dynamics

Figure 2. Categories of material activity



## Advanced materials in the modern economy

The 2021 UK Innovation Strategy highlighted advanced materials (along with advanced manufacturing) as one of the seven technology families. In the more recent Science and Technology Framework (2023) advanced materials is not mentioned specifically, but **the five critical technologies emphasise the central role for advanced materials**, which will be important for the advancement and deployment of each of these.

Figure 3. Critical Technologies and potential materials requirements/applications



Emerging analysis from the National Materials Innovation Strategy captures the current scale of advanced materials in the UK economy, these numbers show a significant economic role played by materials. With the continued development of new and enhanced materials in the UK essential to achieve Net Zero targets and deliver increased economic growth and prosperity, these numbers should be considered as lower bound on the full significance to the economy today and going forward.

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Figure 4. Economic Contribution of Materials Innovation<sup>9</sup>



Globally, Asia-Pacific dominates the advanced materials market, due to increasing demand from various end use industries such as automotive, aviation, building & construction<sup>10</sup>. However, there is a growing western cognisance of the importance of materials development capabilities. The EU has recognised the strategic and economic importance of advanced materials capabilities. In February 2024 the European Commission published a communication titled “**Advanced Materials for Industrial Leadership.**” This report predicts significant increases in the demand for advanced materials across numerous applications over the next few years and highlights a need to accelerate development in advanced materials and build more capacity to scale up innovation and manufacturing. It also emphasise the importance of advanced materials by industry and existing businesses.

As part of this the EU has committed £250m to invest in public-private partnerships on advanced materials between 2025-27, with the aim of supporting companies to scale and accelerate advanced material deployment. In addition, it has set out further actions and emphasises the importance of advanced materials for industrial competitiveness and as building blocks for resilience, strategic autonomy and achieving climate goals.

<sup>9</sup> [National Materials Innovation Strategy: Interim Report](#). 2024

<sup>10</sup> <https://www.industryarc.com/Report/15380/advanced-materials-market.html>

# Advanced Materials in the North

## The North's Advanced Materials Proposition

Across the North of England, innovation in materials production and use has driven industrial heritage. Through the development, production, sale and use of new materials, industry in the North transformed the organisation of society and the economy. From the cotton, steel, glass and ceramics which drove growth in the early days of industry, the region today continues to excel in the discovery of advanced materials in universities and research institutes and has a diverse range of industries, including advanced manufacturing, aerospace, energy, chemicals and life sciences, where the use of advanced materials plays a pivotal role in driving technological advancements and growth within sectors.

Obviously, industry has changed, as have the pathways to materials innovation, but materials remain a key part of the North's economy and its potential.

### Research Base and Assets

With ¼ of the UK's universities and a diverse range of established research partnerships and institutions, including the Henry Royce Institute, the range of scalable laboratory facilities at Sci-Tech Daresbury, the Knowledge Centre for Materials Chemistry (KCMC), North East Advanced Materials Electronics (NEAME) and Print City at Manchester Metropolitan University the North has a critical mass of materials research expertise and capabilities.

The strength of academic research across the region was highlighted in engagement, and across the region universities have developed research assets in advanced materials, hosting equipment, assets and multi-disciplinary groups of researchers. The assets include institutes as well as courses across the northern universities, including within the University of Manchester, University of Liverpool, Lancaster University, University of Leeds, University of Sheffield, University of York, Durham University, University of Huddersfield, Manchester Metropolitan University, University of Salford, University of Central Lancashire, University of Chester, Teesside University and Newcastle University.

For example, across the University of Manchester there are 10 separate institutes dedicated to various aspects of material science, and within the University of Liverpool, there is a dedicated Materials Innovation Factory and a Digital Innovation Facility, purposely developed to foster collaboration between academic and industry researchers and to drive advanced materials innovation.

Examples of active, UKRI funded projects being led by Northern universities include:

- £12.25m to continue funding the National Epitaxy Facility, led by the University of Sheffield
- £7.7m to develop a new approach to delivering material functionalisation based on Nanoscale Advanced Materials Engineering (NAME) led by the University of Manchester
- £8.7m for the digital navigation of chemical space for function, using computer science to boost the ability to navigate the space of possible materials, led by the University of Liverpool

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- £6.6m for Combining Advanced Materials for Interface Engineering, a project aiming to design materials to enable less energy intensive information processing and Storage, led by the University of Leeds.

Stakeholders in the North continue to bring forward new assets, demonstrating an appetite and ability to collaborate to deliver new assets, such as the Centre of Expertise in Advanced Materials and Sustainability (CEAMS) in Rochdale, launched in early 2024 to support businesses to commercialise sustainable materials and develop ways to make materials they use sustainable. Also launched in 2024 was the Industrial Biotechnology Innovation Catalyst<sup>11</sup>, led by the University of Manchester's Institute of Biotechnology along with the Universities of Liverpool, Salford, and Manchester Metropolitan, Innovation District Manchester and other partners it is a £5m initiative to strengthen links across the industrial biotechnology ecosystem in the North-West, focusing on knowledge exchange, skills and innovation.

UK Research and Innovation is also to add an important new asset at the Sci-Tech Daresbury campus. Relativistic Ultrafast Electron Diffraction and Imaging (RUEDI) has been awarded over £120m from the UKRI Infrastructure Fund and will be the most powerful high energy electron microscope in the world for ultrafast imaging and the world's fastest electron diffraction facility, supporting scientific discovery in advanced materials and other subject areas.

A critical mass of researchers and assets from materials discovery and development is an essential ingredient for a successful ecosystem and this is present across the North, with a wide range of leading assets, expertise in a range of fields and a track record of globally significant materials discoveries including Graphene and 2D materials.

### **Advanced Materials Businesses**

Engagement during the research process emphasised the importance of the North's industrial heritage in materials. It also highlighted the importance of large industries that are key adopters and consumers of advanced materials, and the potential for demand in sectors like nuclear, defence and advanced manufacturing (among others) to drive growth in advanced materials, a process which could be supported by developing stronger connections across the ecosystem and raising the profile of the North's advanced materials capabilities and the opportunity they represent for other industries.

Using data from Data City we have been able to look at the geography of advanced materials businesses across the North. Spatial clustering analysis of these businesses finds concentrations of activity across the North, with 40% of the spatial clusters identified in the UK located in the North.

This captures only businesses who describe themselves as advanced materials businesses, with the categorisation not capturing businesses who are advanced materials businesses but

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<sup>11</sup> [Industrial Biotechnology Catalyst](#)

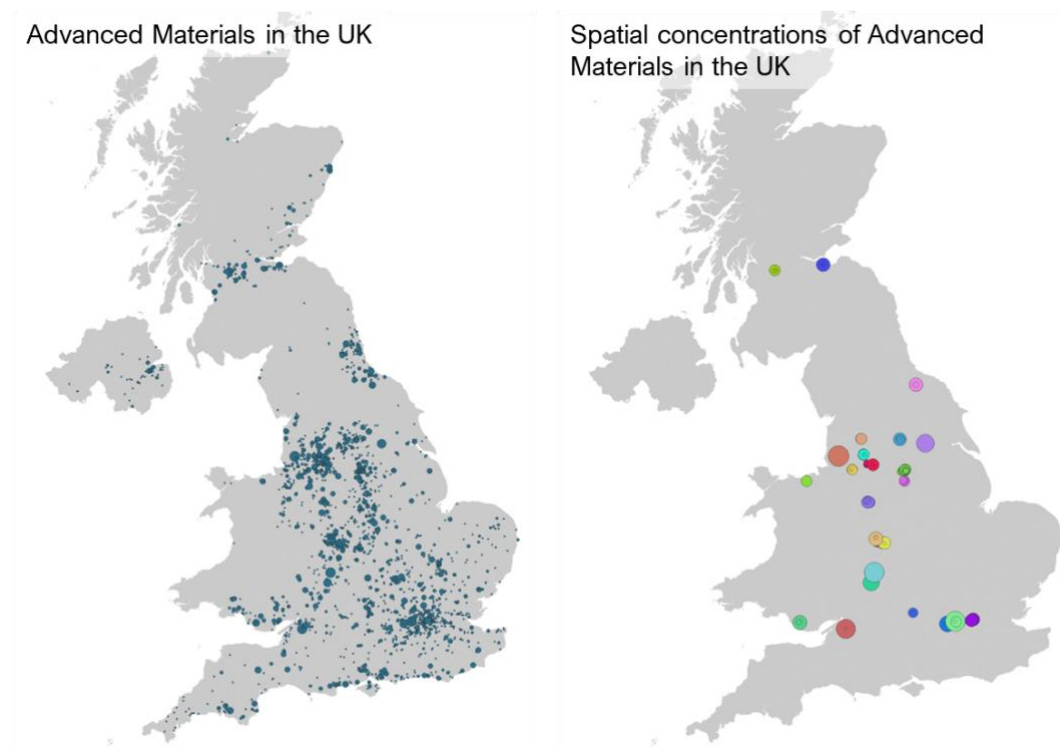
## Metro—Dynamics

do not primarily describe themselves as this (with Unilever and BAE examples of businesses in the North not captured).

Using data from Data City we can map the businesses which have been assigned an advanced materials Real Time Industrial Classification (RTIC).<sup>12</sup> The left of Figure 5 shows the distribution of these businesses across the UK, with larger points representing the number of advanced materials businesses located at a postcode. To identify spatial clusters we implement DBSCAN analysis.<sup>13</sup> The results of this analysis are shown on the right of Figure 5, with each colour indicating one of the 21 clusters identified across the UK, with 8 of these in the North.

These spatial clusters are the places where there are dense geographic concentrations of businesses, there are other parts of the country (including the North East) where we can observe the presence of businesses but these are less densely located than in other places, which could be related to the geography of the area or to the nature of the businesses.

**Figure 5. Advanced Materials businesses in the UK**



Source: Metro Dynamics analysis of Data City data.

### Advanced Materials in Northern Policy and Priorities

<sup>12</sup> RTICs are assigned by a machine learning algorithm, which uses text from company websites to determine whether the company is part of an emerging economy sector or activity.

<sup>13</sup> Using 1km as the distance threshold and setting the cubed root of the total number of observations as number of points which must be within this distance for a cluster to be identified.

## Metro—Dynamics

For each of the previously known 11 Local Enterprise Partnership (LEP) area geographies<sup>14</sup> in the North, we have reviewed their comparable economic strategy documents, to understand the role of advanced materials in different parts of the North. We have categorised the policy emphasis placed on advanced materials in one of four ways:

- **Explicit Focus:** in Liverpool City Region and Greater Manchester advanced materials is an explicit priority area for growth in its own right. Liverpool City Region, whose [Local Industrial Strategy](#) highlighted materials chemistry as one of three smart specialisms, to drive innovation led growth.
- **Explicit Focus (instrumental):** in these areas growth of the advanced materials sector is targeted to support the development of other priority sectors. The Tees Valley [Local Industrial Strategy](#) identified advanced materials as an anchoring strength of the ecosystem, important for advanced manufacturing and clean growth going forward.
- **Implicit Focus (instrumental):** in these areas advanced materials are not mentioned explicitly but successful growth of the priority sectors will require they play an important role. Cheshire and Warrington's [Strategic Economic Plan](#) highlighted strengths in manufacturing, chemicals, energy and nuclear, all of which depend on advanced materials for continued growth.
- **Narrow explicit focus:** a subset of advanced materials are part of the wider sector focus (bioeconomy). York and North Yorkshire's [Local Industrial Strategy](#) (and the recent [devolution deal](#)) have focused on developing the region's bioeconomy, with the production and use of biomaterials an important part of this.

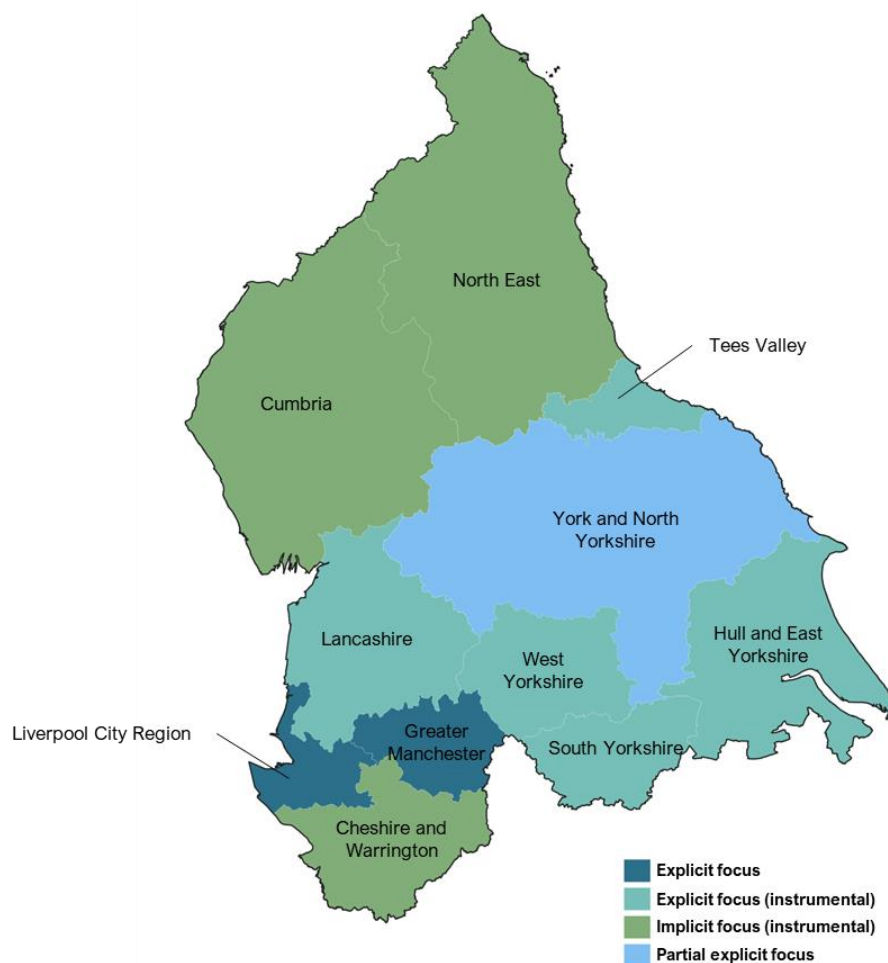
This exercise, the results of which are shown in Figure 6 demonstrates the centrality of materials to Northern economic priorities and objectives, showing that advanced materials play an important role in all parts of the North. Given the challenges around conceptualising and understanding the importance of materials this explicit centring of materials is important in the awareness it indicates among policymakers.

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<sup>14</sup> In areas where a Combined Authority exists CA strategies were used, in other areas the most recent LEP strategy was reviewed.

## Metro—Dynamics

Figure 6. Level of Emphasis on Advanced Materials



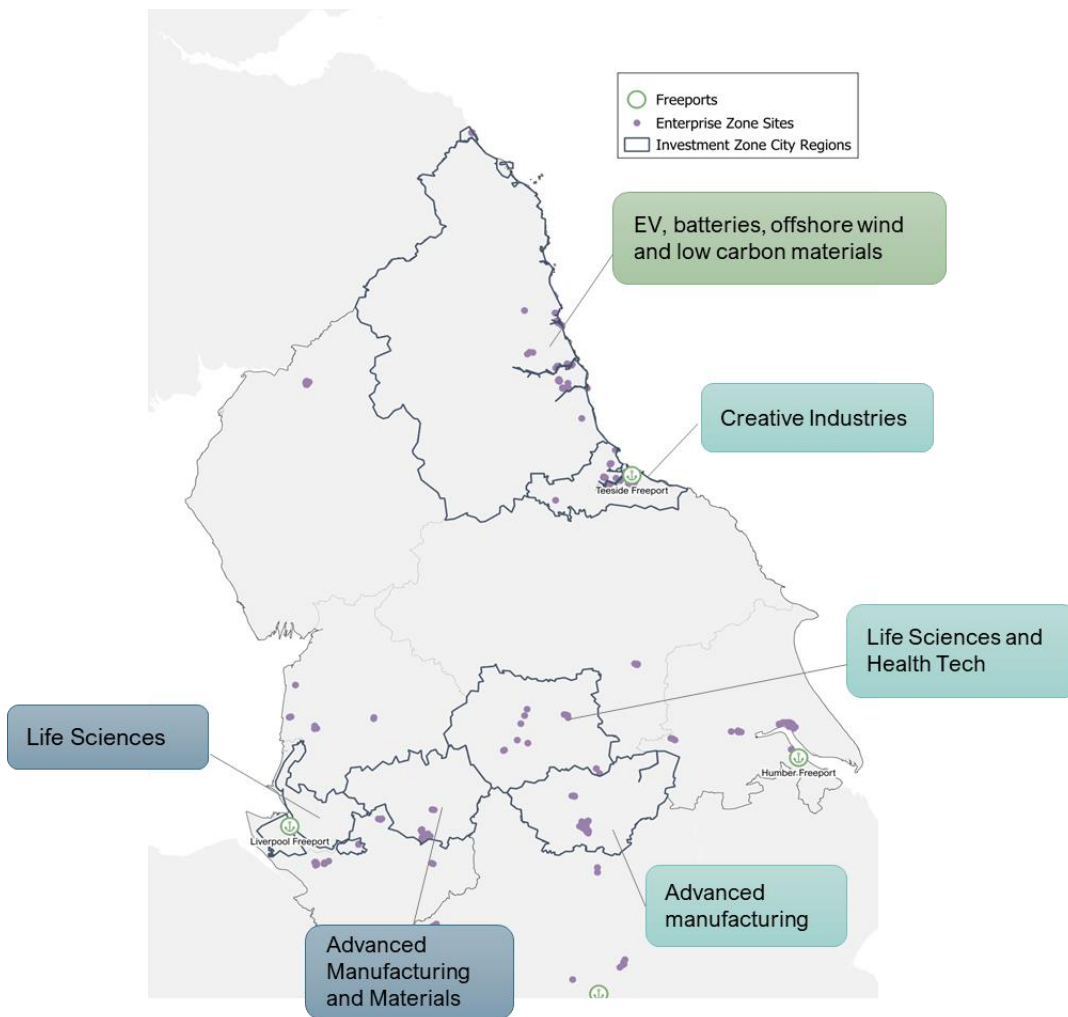
The instrumental role identified across the North reflects the fact that, in addition to concentrations of advanced materials businesses, the region is strong in complementary sectors like advanced manufacturing and digital as well as sectors which are key adopters of advanced materials (and therefore possible drivers of discovery and development). These key sectors include nuclear power, renewable energy generation, construction, aerospace and defence.

The economic importance of materials is also evident in the alignment with 5 of the 6 Northern Investment Zones. These zones and their sector focus, along with the freeports and enterprise zones, are shown in Figure 7 and are part of the North's materials proposition, representing as they do attractive opportunities for investment and for new commercial and industrial activity.



## Metro—Dynamics

Figure 7. Investment and growth initiatives in the North



However, for advanced materials to deliver economic growth, and to fulfil the instrumental role that many places have identified as necessary, there is a need to go beyond discovery. This is where many of the strengths and much of the emphasis currently lies, but when thinking of economic growth it is only the very tip of the iceberg.

### The Case for Intervention

With a critical mass of researchers and research assets, a demonstrated and continuing ability to bring forward new initiatives and infrastructure, concentrations of businesses directly involved in advanced materials, and strengths in sectors that are large users and adopters of advanced materials, the North's proposition is strong

However, there are significant challenges in the North that, unless addressed, risk preventing the region from realising the full economic potential of materials and holding back national efforts to achieve important strategic goals around Net Zero and energy security. Findings from engagement suggest that the set of challenges identified nationally through a call for information led by the Department for Business, Energy & Industrial Strategy (BEIS) apply in the Northern context:

- The slow pace of the materials development cycle, with it taking up to 20 years to commercialise a new material in the UK.

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- High levels of fragmentation within the sector, leading to issues such as silo working and a lack of investment.
- Limited access to facilities and a lack of data/market knowledge for small companies and start-ups.
- Lack of scalable and long-term funding for advanced materials.
- Critical workforce skills and capabilities.
- Lack of public and policy recognition and investment within the sector, leading to slow application and commercialisation.

These challenges reflect both wider factors in the UK (particularly around investment in novel technologies and businesses innovation) and characteristics of advanced materials as a technology. The breadth of advanced materials and the ubiquity of materials makes it difficult to recognise it as a single technology family and therefore difficult to co-ordinate (a problem compounded when potential users are also across multiple industries). Also inherent to some degree is a lengthy development cycle<sup>15</sup>, which is challenging to secure investment for.

Many of the challenges we see with advanced materials can be thought of as forms of information failures, the scope of advanced materials (both in the breadth of different materials and in the potential applications) makes market knowledge and communication more difficult.

The salience of national challenges to the North has been emphasised in engagement for this project, which has also highlighted that key challenges in the North include:

- **scale-up challenges**, particularly for large-scale materials, which hinders the realisation of material innovations.
- **fragmentation** and difficulties in industry engagement impede collaborative efforts and prevent a clear understanding of deployment requirements for new materials.
- **pressure of funding end dates often limits** the time available for thorough development before market entry, necessitating strategic planning and resource allocation to optimise outcomes.
- **emphasis on academic pursuits** can overshadow practical applications and industry needs.

With the strengths the North has in research, continued work deepening links between universities and businesses, the presence and ongoing development of key assets (not just supporting the discovery of materials, but also for testing and validation including the growing catapult network presence in the North, including CPI, MTC, AMRC and more, the National Nuclear Laboratory and expanding presence in the region of the National Physical Laboratory (NPL; in Huddersfield and now Manchester), the presence of key adopting sectors and the baseline policy awareness, strengthening the ecosystem in the North can

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<sup>15</sup> There will always be a necessary degree of caution in the widespread deployment of new materials, with salient examples in recent history where new materials have had unintended and tragic consequences. However, given the needs of society accelerating the development of safe materials with the required properties is essential and it seems likely that current long development cycles are driven by factors beyond caution.

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help the UK to achieve its strategic objectives and deliver growth through supporting new industries, improving productivity in existing industries and enabling the industrial net zero transition.

The issues facing the North are not substantively different that those identified elsewhere in the UK, however the richness of its assets means that it is extremely well placed to drive forward solutions to these national issues.

# Priority areas for intervention

The primary objective of an intervention to support the ecosystem is to deliver economic growth through the development of advanced materials across the North. This is in line with STFC's Cluster Strategy, published in January 2024, which describes how STFC's leadership through clusters has worked to support innovative businesses, business creation and growth (including of existing businesses) and greater collaboration across local and regional innovation ecosystems.

Given the challenges identified across advanced materials in the North there is significant scope for intervention to have a positive impact. Bringing together the findings from a literature review, analysis of secondary data and stakeholder engagement, we have identified three priority areas to build on existing strengths and opportunities, address the market failures highlighted previously and complement the range of work already ongoing:

- 1. Co-ordination:** Facilitate greater **co-ordination across the North's materials ecosystem** and create an entry point for businesses with materials opportunities and requirements who may not currently see themselves as advanced materials businesses. Improved co-ordination will reduce the impact of fragmentation and by creating stronger links between research and business can help to accelerate the materials development cycle.
- 2. Commercialisation:** Increase the rate and volume of **commercialisation of advanced materials**, targeting the creation of new businesses, greater adoption of new materials by existing businesses and deployment of advanced materials that have not yet been applied in commercial ways.
- 3. Communication:** Improve **communication about the role advanced materials play in the economy and opportunities** that exist around advanced materials both internally and to external companies, policymakers, and investors to raise more mainstream awareness of materials and their significance.

These priorities areas are those which have the potential to deliver economic growth and strengthen the ecosystem and are best suited to being addressed at the regional level, through active management of the ecosystem.

It is recognised that there are other priorities for advanced materials, such as facilities, infrastructure, funding, regulation and skills, but these are likely to be less well suited to being addressed through pan-regional action. For example:

- Skills strategies already sit with LEPs and CAs and ecosystem management is not going to be able to impact these in a substantive way, though it could provide a voice to lobby for regional needs if these are identified through its operation.
- Regulation is a national policy question (and in many cases it has international determinant through insurer requirements, standards in trading partners etc), again this is not an area that a regional function could directly impact, though there may be benefits of a shared Northern voice to lobby for changes that would benefit northern partners.

## **Metro—Dynamics**

- Infrastructure is important for all stages of advanced materials activity but the focus of this work is to help grow the ecosystem and connect more businesses and researchers to expand the benefits from existing and emerging assets.

Developing new assets and facilities is an existing area of strength in the North, with different organisations continuing to show the ability to work in partnership to bring forward new research centres and assets (e.g. the Centre of Expertise in Advanced Materials and Sustainability (CEAMS) launched in early 2024), support for the ecosystem should complement this existing strength by helping to connect more businesses and stakeholders to these assets and raising their profile regionally and beyond.

# Supporting growth in the North

## Recommended approach

Various models exist for ecosystem/sector support. Ranging from doing nothing, to establishing a brand, to setting up a network of hub buildings. A total of 10 options, listed in Table 1 below, have been reviewed, more detail of which is provided in Annex C.

**Table 1. Potential approaches to intervention**

Option	Description
Do nothing	No Northern-focused intervention
Brand	Establish a Northern Materials brand with collateral for stakeholders to use.
Brand and a shared Northern post	Overarching brand and a shared Northern post connecting major leaders in materials (e.g. Institutes, Catapults, Universities etc )
Team of local network managers	Appoint local network managers to work as a team under an overarching Northern-focused structure.
Single Northern hub	Create a single physical hub as a central node for materials in the North with a mixture of space, facilities and support.
Northern hubs	Network of hubs offering mix of space, facilities and support in different parts of the North with concentrations of materials activity.
Pick a winner' - material led	Identifying a small number of materials to focus on and drive the development and deployment of these materials across the North.
Pick a winner' – sector led	Choose industries where there are opportunities for growth unlocked by new materials.
Place leadership	Places within the North taking leadership for materials that are best aligned with their strengths.
Materials networks	Select key materials which are opportunities (where there is research expertise and business/industry demand) and establish pan-northern networks to drive growth.

Consideration of how these structures could deliver on the three priorities across the North identified the following as essential to success, based on the features of Advanced Materials across the north:

- Positive impact across the three strategic priorities.
- Support activity across discovery, development and deployment.
- Ability to respond to new opportunities (both through new discoveries and new industrial needs).

Based on this the recommended approach is a **team of local ecosystems managers working as part of a pan-northern structure**. This approach is well suited to a networking function, facilitating new and stronger connections across the ecosystem and working to expand the size of the ecosystem by bringing more partners (particularly businesses) into it.

## Metro—Dynamics

This format is likely to be well suited to address the three strategic priority areas and would have the ability to respond to new opportunities (e.g. newly discovered materials or new requirements from industry):

- **Co-ordination:** local network managers will be able to facilitate connections between organisations and partners, identify where there are new opportunities for collaboration and facilitate these. Through the pan-Northern structure they can do this both in local ecosystems and across the wider region.
- **Commercialisation:** local managers can support commercialisation in several ways. Either directly or through networking and connecting different parts of the ecosystem they could:
  - support the creation and growth of new businesses;
  - identify where there are opportunities to develop and deploy materials discoveries;
  - identify where there are industry needs that require new materials discovery or development.
- **Communication:** establishing a pan-northern body can raise the profile of advanced materials in the North and offer a voice for the sector while the presence of local managers will help to raise awareness of what is happening in advanced materials locally (and across the region) and the opportunities that may be available.

### Options for ecosystem support

We have considered a set of options for pan-northern ecosystem support and considered the extent to which these would address the priority areas across the three broad phases of materials activity. This latter point is an important one as fulfilling the ecosystem potential means supporting advanced materials discovery, development, and deployment, not just one area<sup>16</sup>. The options considered are a set of approaches to support/management, not a set of activities to be delivered, which we view as a second order question to be determined by the established structure along with partners across the region.

These have been assessed based on the likely impact across the three strategic priorities. A number of these options involve 'picking winners' in some capacity, either by identifying materials groups to target, while these could address the priority areas for the identified material group/sector this represents only part of the opportunity and seem poorly suited as a structure to support a broad and evolving technology.

Based on these assessments, the structure which seems best suited to addressing the three strategic priorities, with the flexibility to work across different areas of activity and respond to

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<sup>16</sup> There may be a case for placing stronger emphasis on the development and deployment parts of this initially given the UK and the North's recognised research strengths but this should be considered in more detail in the setting out in more detail of how management will be approached.

## Metro—Dynamics

new activities is the team of local network managers, working as part of a pan-northern structure.

### Next Steps

The first step will be to disseminate and socialise this report, its findings, and the recommendations for discussion with stakeholders across the North and in central government to agree a set of shared objectives to bring the ecosystem together. These should focus on the areas that are best tackled by the proposed ecosystem team.

To ensure that they build on existing strengths these should emphasise the importance of existing assets and activity and helping connect more businesses and potential partners to these opportunities. Also important is building links across the North, across different parts of advanced materials and between those focused on the discovery, development, and deployment. The strategic priority areas identified through this work are strong starting points to set these objectives, but these should be agreed collectively and may benefit from slightly more focused definition of the priorities.

These objectives should then guide the development of a strategy for the ecosystem, setting out the activities to be undertaken (and by whom) and the timelines for doing so.



# Appendices: Research Findings

## Annex A: Policy and Literature Review

### The UK Advanced Materials landscape

Valued at £90.4 billion<sup>17</sup>, the UK advanced materials economy supports over 100,000 jobs across 2,758 companies. With the necessary policy support, there is the opportunity for advanced materials to add over £10 billion a year to the UK economy by 2050.<sup>18</sup>

This growth is driven by the foundational role advanced materials plays within some of the UK's largest industries, including aerospace, healthcare, energy generation, defence, and Advanced Manufacturing. This influence is determined through Advanced materials driving innovation across a range of important technologies, important to future UK economic growth.

#### National policy context

In July 2021, the UK Innovation Strategy by BEIS and DSIT, highlighted advanced materials as part of one (Advanced Materials and Manufacturing) of 7 technology families of UK strength and opportunity, setting the ambition for the UK to be a global leader in safe and sustainable design across the full materials life cycles<sup>19</sup>. Driving growth in advanced materials sector and creating high quality jobs throughout the UK.

The Henry Royce Institute is currently leading the development of the National Materials Innovation Strategy, to be published later in 2024. The strategic framework for this work sets out a process for formulating a strategy to enhance and organise the UK's capabilities in materials innovation. As this framework evolves, it will contribute to shaping a robust UK materials innovation strategy. The framework outlines three primary rationales for establishing a national advanced materials strategy in the UK:

4. To deliver a coherent approach across government, industry, and the wider materials technology community.
5. To address the critical weaknesses in the lengthy and expensive commercialisation cycles of all material classes, providing coherence across all parts of the materials life cycle.
6. To encourage the translation of research into adopted solutions through an effective commercialisation system.

It has also highlighted the significance of advanced materials is underscored across six national policy drivers, with the below describing how they will be important across the drivers:

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<sup>17</sup> [UK Advanced Materials Industry](#), Data City.

<sup>18</sup> [Materials and manufacturing vision 2050](#). Innovate UK, 2023

<sup>19</sup> [UK Innovation Strategy, 2021](#)

## Metro—Dynamics



### Policy driver 1: Getting to net zero

- The creation and use of technologies that lower greenhouse gas emissions and enable sustainable practices



### Policy driver 2: Growing a high-wage, highly skilled workforce

- The fostering of productive industries that provide employment opportunities for skilled workers.



### Policy driver 3: Strengthening the UK as a global technology leader

- Extending our world-leading capabilities in research, development, innovation, and commercialisation



### Policy driver 4: Rebalancing the UK economy

- Winning investment for growth across the regions through the application of research and the commercialisation or scaling of solutions.



### Policy driver 5: Supporting national resilience and security

- Maintaining a technology-enabled national security capability and building resilience to global supply chain disruptions.



### Policy driver 6: Enabling healthy, happy lives

- Delivering healthcare and creating a built environment that supports a thriving population.

## Strengths, Challenges and Opportunities in UK Advanced Materials

The table below summarises the main strengths, challenges and threats, and opportunities within advanced materials in the UK, identified through review of national and regional policy. Whilst the UK has the potential to be global leader within advanced materials and success of the sector is necessary for the UK to reach net zero goals, the threat of a loss of expertise and IP due to lack of organisation of and within the sector, weakens the UK's advantage<sup>20</sup>.

<sup>20</sup> [Threats to the UK Advanced Materials Sector](#), National Cyber Security Centre, 2022

## Metro—Dynamics

<p><b>Strengths</b></p>	<p>The UK maintains global competitiveness, supplying distinct materials such as metals, polymers, and ceramics, as well as supplying finished components and systems for medical, energy, and aerospace sectors</p> <p>Materials underpins the manufacturing industry in the UK, an industry which contributes £203 billion every year to GVA and support 5 million jobs.</p> <p>The UK has a strong academic presence in advanced materials.</p> <p>Existing partnerships, including at the Advanced Manufacturing Research Centre in Sheffield, Warwick Manufacturing Group in the Midlands, and the Royce Institute in Manchester.</p>
<p><b>Challenges</b></p>	<p>In the UK, it can take 20 years for a new material to be commercialised.</p> <p>High fragmentation within the sector, leading to issues such as silo working, lack of investment, and potential duplication of efforts.</p> <p>The UK suffers from an absence and decline in critical workforce skills and capabilities in advanced materials.</p> <p>Limited access to facilities and a lack of data/market knowledge for small companies and start-ups.</p> <p>Lack of scalable and long-term funding for advanced materials.</p> <p>Lack of public and policy recognition and investment within the sector, such as the lack of a national strategy, leading to slow application and commercialisation.</p>
<p><b>Opportunities</b></p>	<p>Advanced materials are crucial for achieving the country’s net zero strategy and energy transitions and has the potential to create thousands of new jobs with aerospace, construction, and health sectors.</p> <p>Significant investment opportunities, including £81 million state-of-the-art facility at MIF at the University of Liverpool, a Nanotherapeutics Centre for the North, led by University of Liverpool, and £95m investment to the Henry Royce Institute at University of Manchester.</p>

## Advanced Materials in the North

### The North’s heritage

The North, the birthplace of the first industrial revolution, has a rich history in materials and materials innovation. Along with cutting-edge research, the North has clusters and specialisms across industries, including advanced manufacturing, aerospace, and life sciences, where the use of advanced materials plays a pivotal role in driving technological advancements and growth within sectors. Across the North:

- The North West is at the forefront of advancements in materials, recognised as the birthplace of transformative inventions from the programmable computer to graphene. Cities like Manchester and Liverpool played pivotal roles in revolutionising the cotton industry during the industrial revolution, and currently play a critical role driving forward

## Metro—Dynamics

advancements within technical textiles, surfaces and coatings, composites, and light alloys. Additionally, hubs like Widnes pioneered processes for essential chemicals, while areas like Wigan and Warrington contributed significantly to the iron and steel industry. Today, the estimated gross value added per employee of advanced materials in the North West is 25% more than the UK average<sup>21</sup>.

- The North East has a history of technological innovation, making significant contributions to railways, lightbulb development, and large-scale power generation. The region is a hub for microelectronic and electronic device companies, with companies including Siemens, Atmel, and Fujitsu. Across both sides of the Tyne, the North East has historically been a significant centre across a range of industrial sectors, including coal mining, shipbuilding, steel production, glass, and ceramics while Teesside was a historic centre for steelworks and chemicals, with the later an enduring area of strength.
- Yorkshire and Humber is emerging as a leader in advanced materials innovation, driving advancements in aerospace, construction, medicine across universities in the region, particularly within Leeds and Sheffield. The region also has historic strengths in steel, textiles, and chemicals, and is home to large organisations such as Rolls-Royce, BAE systems and the Nuclear Manufacturing Park.

### Policy

Regionally, advanced materials gets notable policy attention. The Northern Powerhouse Independent Economic Review (NPIER) identified Advanced Manufacturing, with a particular emphasis on materials and processes as one of four prime capabilities in the North of England. This recognition was originally part of the 2016 NPIER report and reiterated in the 2023 update, emphasising that materials have become a distinct strength that has increased in significance.

Advanced materials also strongly features within local priorities and strategy within the North. Figure 8 maps a provisional review of the degree of policy emphasis given to advanced materials across all 11 LEPS in the North. Policy emphasis is categorised in one of four ways:

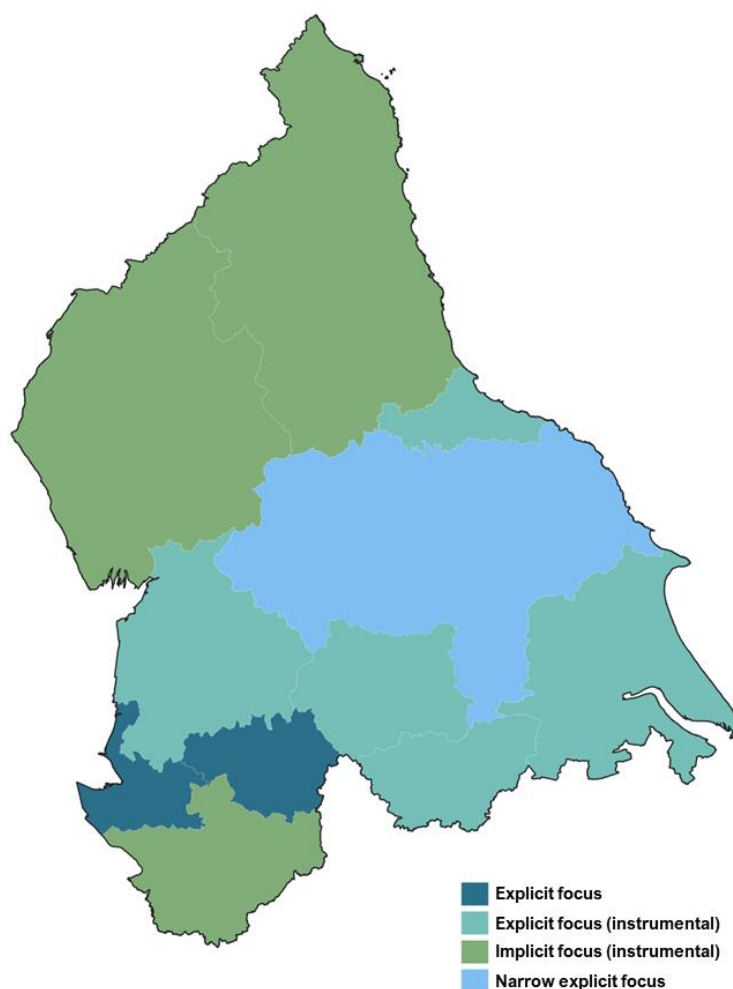
- **Explicit Focus:** in these places advanced materials is an explicit priority area for growth in its own right
- **Explicit Focus (instrumental):** in these areas growth of the advanced materials sector is targeted in order to support the development of other priority sectors
- **Implicit Focus (instrumental):** in these areas advanced materials are not mentioned explicitly but successful growth of the priority sectors will require they play an important role.
- **Narrow explicit focus:** a subset of advanced materials are part of the wider sector focus.

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<sup>21</sup> [Advanced Materials in the North West Understanding Cluster Growth Potential Case Study](#). Innovation Caucus, 2023.

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Figure 8. Policy Emphasis on Advanced Materials in the North



In the most densely populated areas of the North, there's a clear emphasis on advanced materials, whether it's through direct prioritisation or indirectly through sectors like Advanced Manufacturing where materials play an instrumental role. Although the map implies a lesser focus in the North East, this must be caveated as at the time of writing the NECA had not been formally established. With the emphasis on clean energy and green manufacturing within the North East Investment Zone, it's anticipated that policy emphasis could change.

### Assets

Alongside an industrial heritage and a direct focus within policy, the North contains significant assets in advanced materials research and manufacturing<sup>22</sup>. It is home to major private sector organisations such as Jaguar Land Rover, BAE Systems, Unilever, Tata Steel, Siemens, Pilkington, Croda, IBM Research and Victrex. Additionally, the region is home to a

<sup>22</sup> [Advanced Materials in the North West Understanding Cluster Growth Potential Case Study](#). Innovation Caucus, 2023.

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diverse range of established partnerships and institutions, including the UKRI-STFC Daresbury Laboratory located at Sci-Tech Daresbury (also home to national facilities including the Hartree Centre, SuperSTEM and Cockcroft), the Knowledge Centre for Materials Chemistry (KCMC), and the North East Advanced Materials Electronic (NEAME).

The materials industry is also well supported by research assets, with institutes and courses across the Northern Universities, including within the University of Manchester, University of Liverpool, Newcastle University, University of Central Lancashire, University of Chester, University of Salford, Manchester Metropolitan University, University of York, University of Sheffield, Lancaster University, University of Leeds, Liverpool John Moores University, University of Huddersfield, Durham University and Teesside University. For such, across the University of Manchester there are 10 separate institutes dedicated to various aspects of material science, and within the University of Liverpool, there is a dedicated materials innovation factory and a Digital Innovation Facility, purposely developed to foster collaboration between academic and industry researchers and to drive advanced materials innovation.

Examples of large, funded projects led by Northern universities include:

- £12.25m to continue funding the National Epitaxy Facility, led by the University of Sheffield
- £7.7m to develop a new approach to delivering material functionalisation based on Nanoscale Advanced Materials Engineering (NAME) led by the University of Manchester
- £8.7m for the digital navigation of chemical space for function, using computer science to boost the ability to navigate the space of possible materials, led by the University of Liverpool
- £6.6m for Combining Advanced Materials for Interface Engineering, a project aiming to design materials to enable less energy intensive information processing and Storage, led by the University of Leeds.
- £5 million from EPSRC to develop the Industrial Biotechnology Catalyst, led by the University of Manchester together with the Universities of Liverpool, Salford, Bolton and Manchester Metropolitan, to accelerate knowledge exchange, skills development, and innovation in the industrial biotechnology community.

### Spatial clusters

According to research by Data City, 89.5% of advanced materials business premises are located outside of London<sup>23</sup>. Using the text on a company website Data City's machine learning algorithm identifies where a company appears to belong to an emerging economy sector, termed a Real Time Industrial Classification (RTIC).

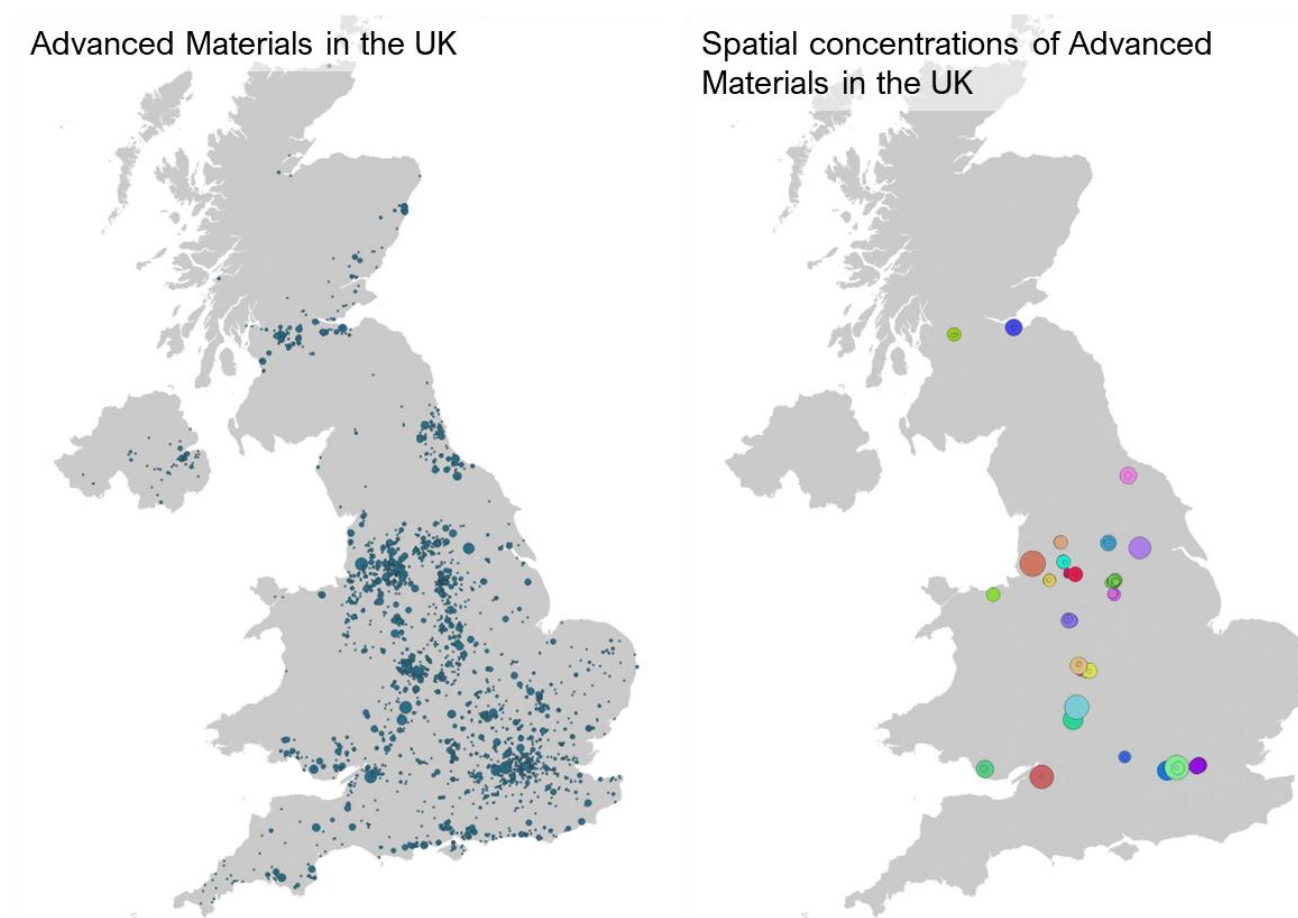
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<sup>23</sup> [UK Advanced Materials Industry](#), Data City.

## Metro—Dynamics

Figure 9 maps all trading locations of businesses assigned the advanced materials RTIC, showing the economic geography of these businesses across the country. To understand where there are concentrations, we have used a spatial clustering algorithm (DBSCAN), which identifies where there are dense concentrations. We have set a distance parameter of 1km and a size threshold of  $\sqrt[3]{\text{total count of advanced materials businesses}}$ . The right hand side of Figure 9 shows the spatial clusters identified, with a number of this spread across the North. The absence of one on the North East is not due to a lack of businesses, as we can clearly see in the map on the left but because they are less densely located, which could be due to the nature of activity, the economic geography of the area etc.

**Figure 9. Spatial concentration of Advanced materials businesses and clusters**



Source: Metro Dynamics analysis of Data City data

Looking across sub-sectors, the type of materials activity areas across the North are involved in differs. Table 2 breaks down advanced materials by activity, where Advanced materials verticals have been defined through RTICs produced by Data City, and by LEP area within the North. The concentration of activity is measured through Location Quotients (LQs). LQs are a ratio of the local share of businesses and share of businesses in GB. Higher LQs correspond to higher levels of concentration, with an LQ above 1 indicating that the area is more concentrated in that sector than UK. A LQ of 1.25 is often taken as a suggestion that an area has a specialism. Whilst the type of activity differs, measuring concentration through LQs reveals the North has specialisms within most materials sub sectors.

## **Metro—Dynamics**

Within the North West, there is a large concentration of businesses involved within activities related to biomaterials, polymers, and technical textiles. Notably, Cumbria is revealed to be a cold spot of advanced materials activity within the North West, whilst Lancashire notes high levels of concentration within technical ceramics and glass, with fourteen times the concentration compared to the UK.

In the North East, there are concentrations across the majority of advanced materials verticals. There is eight times the concentrations of carbon-based businesses and around 5 times the businesses in composite in Tees Valley compared to the UK. Within the North East LEP area, there is a high level of activity within businesses engaged in emergent materials.

Like the North West, all LEP areas in Yorkshire and the Humber, except Hull and East Yorkshire which emerges as a cold spot of activity, have high levels of concentrations within biomaterials, noting over three times the concentration compared to the UK. South Yorkshire has fifteen times the share of businesses involved within metals.



## Metro—Dynamics

Table 2. Location quotients for LEP areas in the North across Advanced Materials verticals

	North West				North East			Yorkshire and Humber			
	Cheshire and Warrington	Cumbria	Greater Manchester	Lancashire	Liverpool City Region	Tees Valley	North East	Hull and East Yorkshire	Leeds City Region	South Yorkshire	York & North Yorkshire
Biomaterials	7.57	1.66	1.55	3.53	2.32	1.22	0.00	0.00	3.74	3.85	3.06
Carbon-Based	0.94	1.03	1.29	0.55	0.00	8.34	2.32	0.00	1.50	1.71	22.85
Coatings	2.00	0.73	1.90	2.72	1.22	2.95	2.98	2.91	2.53	2.06	0.00
Composites	1.35	0.44	0.97	1.30	0.99	4.90	2.63	0.35	1.15	0.89	1.23
Electrochemical	1.53	2.01	0.73	0.27	0.28	3.69	1.98	0.00	0.65	4.67	0.46
Emergent	0.74	0.81	1.18	0.86	2.04	2.38	3.20	0.00	0.52	1.35	0.37
Metals	1.30	0.00	2.03	0.63	0.53	2.80	0.54	0.76	0.77	15.49	2.20
Optics and Photonics	2.86	0.00	0.58	0.25	0.26	0.00	2.38	0.00	0.45	1.56	0.43
Polymers	2.81	0.00	3.56	4.92	1.82	2.79	2.29	1.30	1.75	0.90	0.50
Technical Ceramics and Glass	0.50	0.00	1.02	14.01	3.22	0.60	2.31	0.00	1.06	3.27	0.00
Technical Textiles	1.49	0.82	4.59	6.10	0.00	1.20	0.46	0.65	3.69	0.00	0.00

Source: Metro Dynamics analysis of Data City data.

# Metro—Dynamics

## Investment

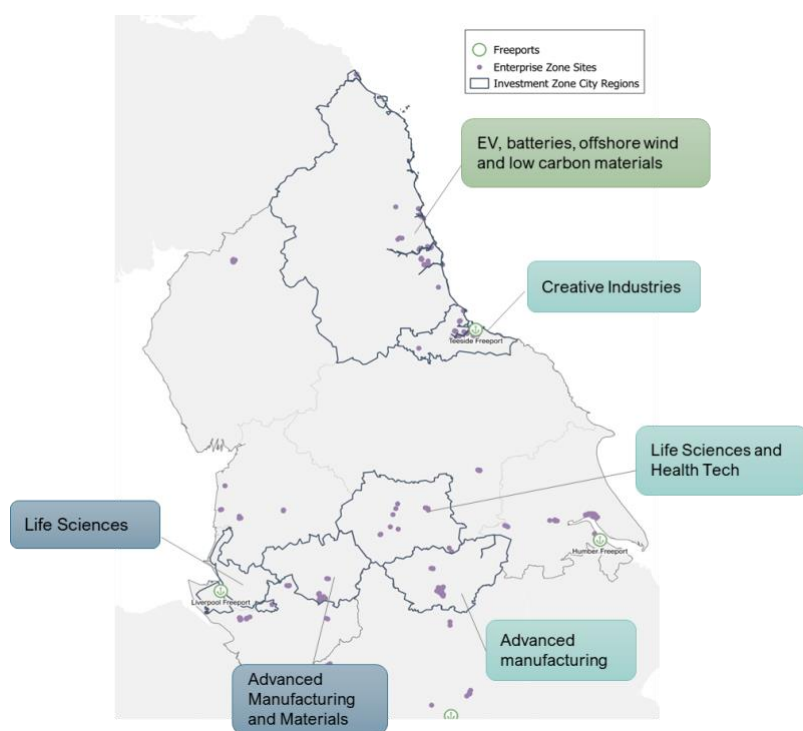
Compared to other countries such as Germany and the USA, R&D investment in the UK is very low.<sup>24</sup> Whilst this can be considered to also be the case in the North, with the scale of current investment lagging against investment needed, advanced materials appears a focus within public sector investment and initiatives and there may be opportunities to leverage Freeports and Investment Zones to attract more investment to the region.

Figure 10 maps the location of current investment initiatives in the North, including:

- **Enterprise Zone sites:** geographically defined areas in which commercial and industrial business can receive incentives (eg tax and planning concessions) to set up or expand
- **Freeports:** similar benefits to investment zones with tax and regulatory incentives but are centred around ports and airports to encourage businesses engaged in international trade.
- **City Region Investment Zones:** offering tax and regulatory incentives, intended to host knowledge intensive growth clusters with funding to support the development.

Focusing on city region investment zones, advanced materials is explicit or instrumental to the sector focus within 5 of the 6 zones, excluding the Tees Valley investment zone whose current focus is digital and creative technology sectors.

**Figure 10. Investment initiatives across the North of England, and sector focus of City region investment zones identified in the pull-out box**



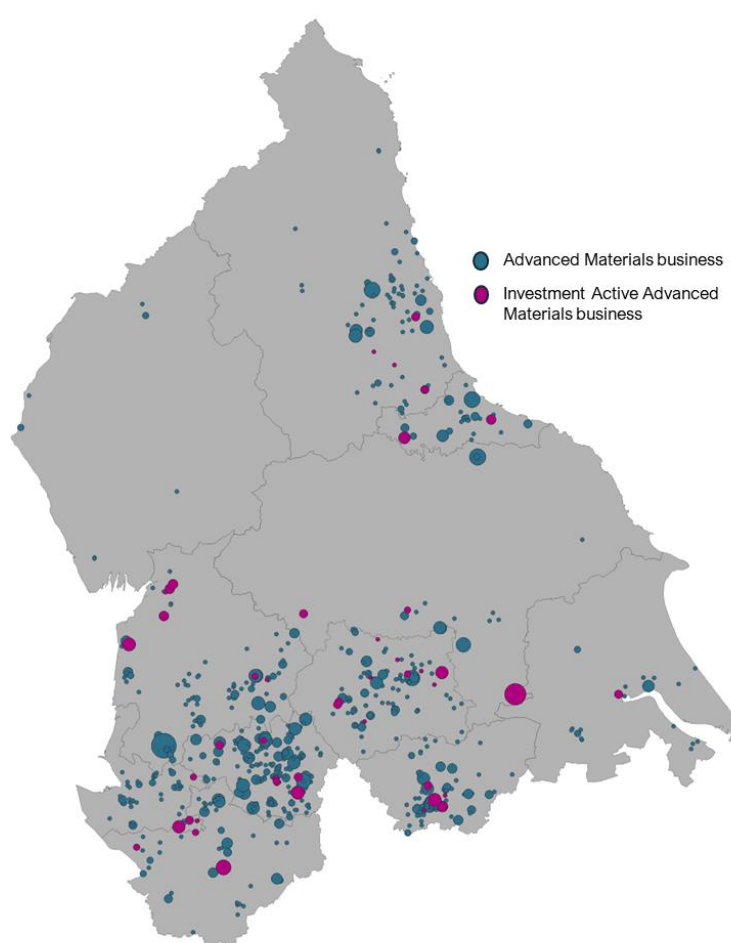
<sup>24</sup> [Advanced Materials in the North West Understanding Cluster Growth Potential Case Study](#). Innovation Caucus, 2023.

## Metro—Dynamics

Looking at private sector investment, Figure 11 uses data collected from Data City on whether businesses have raised funding recorded by Dealroom, a global provider of data on venture capital activity, startups, and tech ecosystems, and maps the location of all advanced materials businesses with a presence in the North who have raised funding in a round recorded by Dealroom. Whilst this cannot be used to identify the location of funding, it provides useful analysis of where the advanced materials businesses identified as being investment active have a presence in the North.

As also shown in Figure 11, investment active businesses are located in all populated areas in the North of England, with advanced materials investment active businesses a key feature among them.

**Figure 11. Location of investment active businesses in the North<sup>25</sup>**



<sup>25</sup> Points are scaled by the number of businesses located at the postcode and given the large range of values, used a natural log transformation so these can be represented in a legible manner. This process shrinks larger numbers to a greater degree meaning that where a point is double the size of another point the number of businesses represented is more than double

## **Metro—Dynamics**

Source: Metro Dynamics analysis of Data City data.

## Annex B: Engagement Findings

### The distinct strengths, challenges, and opportunities of advanced materials in the North

Truly grasping the case for investment demands a nuanced understanding of the North’s unique proposition in advanced materials, and how it differs and can support the national picture. While initial analysis provides a broad overview, this was further explored and tested within a workshop involving more than 20 stakeholders engaged in materials-related activities in the North.

We have categorised the activities that make up advanced materials into three groups, capturing the stages of the materials cycle. These three groups of activity are broadly aligned with technology readiness levels:

- **Discover:** Identification and exploration of new materials or the modification of existing materials. Reflecting TRLs 1-3.
- **Develop:** Continuous process of advancing and improving existing materials, or the optimisation and refinement of discovered materials. Reflecting TRLs 4-6.
- **Deploy:** Practical application and integration of advanced materials into real-world products, systems, or processes. Reflecting TRLs 7-9.

Whilst there exists overlap across categories, this approach provides a clear and engageable framework for understanding the full materials development process, and what can be done at different stages to develop the sector and increase economic growth in the North.

Within the workshop, attendees were asked to identify strengths, opportunities, and challenges in the North across the 3 materials categories, focusing on how the North’s picture differs to the national context. The following tables summarises the distinct strengths, challenges, and opportunities across advanced materials in the North identified within the workshop.

Discover	
Strengths	<ul style="list-style-type: none"> <li>• The North boasts a critical mass of researchers, showcased by strong High Education Institutions (HEI), such as the Materials Innovation Factory and the Henry Royce Institute. Active research hubs feature in cities like Sheffield, Leeds, Liverpool, Manchester, Teesside and Lancaster, and contribute to a vibrant ecosystem.</li> <li>• The North has a rich historical legacy and tradition in advanced materials sectors, rooted in the North’s industrial heritage. Thus, it is the strategic location of major organisations and firms including CPI, Unilever, AstraZeneca, BAE Systems, Croda and Arup.</li> </ul>

## Metro—Dynamics

	<ul style="list-style-type: none"> <li>• The North has expertise in various fields such as chemical analysis, genomics, and proteomics, and is the home of nationally significant materials discoveries, such as Graphene and 2D materials.</li> <li>• Unique pioneering assets including the Energy House 2.0 at the University of Salford, Glass Futures, the Graphene Engineering Innovation Centre etc.</li> </ul>
Challenges	<ul style="list-style-type: none"> <li>• Governmental policy changes and short-term funding disrupts local funding priorities and long-term innovation goals. The recent focus on AI diverts attention and resources away from materials innovation. Regulatory frameworks hinders new materials creation and exploitation.</li> <li>• The North's international offer is often misunderstood and underexploited, whilst international competition adds pressure to regional innovation efforts.</li> <li>• Scale-up challenges, particularly for large-scale materials, such as large-scale composites in Liverpool, hinder innovation.</li> <li>• Fragmentation and difficulties in industry engagement impede collaborative efforts, while talent retention issues risk draining skilled individuals from the region.</li> </ul>
Opportunities	<ul style="list-style-type: none"> <li>• Emerging collaboration across city regions fosters innovation and economic growth.</li> <li>• Challenge-driven initiatives, rather than solely academia or industry-driven, can foster more targeted and impactful innovation.</li> <li>• Tailored talent program within university business schools, driven by policy initiatives or industry demands, can bolster workforce capabilities and drive sustained innovation.</li> <li>• Focusing material discovery within high-value sectors such as Security, Defence, and Nuclear, as well as opportunity to tie in to national investment such as in AI.</li> </ul>

### Develop

Strengths	<ul style="list-style-type: none"> <li>• Strong partnerships and institutes, including EconoMiser led by the Henry Royce Institute, Hynet a decarbonisation cluster in the North West and North Wales, the Hartree National Centre for Digital Innovation led by STFC, and the Centre for Expertise in Advanced Materials and Sustainability (CEAMS).</li> </ul>
Challenges	<ul style="list-style-type: none"> <li>• Lack of prioritisation and understanding of key materials in the North, preventing large scale public and private investment.</li> <li>• Funding end dates limit the time available for thorough development of materials before market entry</li> </ul>

## Metro—Dynamics

	<ul style="list-style-type: none"> <li>• Shortage of capability and access to testing equipment and facilities to enable efficient research and development processes.</li> <li>• Intellectual property (IP) constraints hinder collaboration and innovation within the region.</li> </ul>
Opportunities	<ul style="list-style-type: none"> <li>• Re-industrialisation of the North's sector offers a sustainable opportunity to revive UK industries while ensuring environmental and economic sustainability.</li> <li>• Circular design strategies, particularly within sectors like adhesives, composites, and mining, offers opportunity to re-design materials, leveraging existing technology, and infrastructure.</li> <li>• Developing mobile testing facilities enhances accessibility for on-the-go testing and analysis, crucial for fostering innovation and collaboration across industries.</li> <li>• Continuous funding support throughout the product cycle is essential to sustain innovation efforts, addressing funding gaps for comprehensive innovation. Additionally, facilitating knowledge transfer between RTOs can enhance collaboration and collective progress in materials innovation.</li> </ul>

### Deploy

Strengths	<ul style="list-style-type: none"> <li>• The North possesses abundant existing infrastructure ready to be repurposed for facilitating the deployment of advanced materials.</li> <li>• Several projects are underway across the North, such as Glass Futures in St Helens and The Advanced Machinery Productivity Institute (AMPI) in Rochdale led by NPL, focusing on the deployment of materials.</li> </ul>
Challenges	<ul style="list-style-type: none"> <li>• Scalability issues due to challenges in creating resilient supply chains and achieving end-to-end integration. Limited availability of lab space constrains the commercialisation and adaption of research and development activities.</li> <li>• Shifting government support for advanced materials limits competitiveness and private funding for large scale deployment, slowing down the UK and the North in commercialising materials discovery.</li> <li>• Overemphasis on academic pursuits may overshadow practical applications and industry needs.</li> </ul>
Opportunities	<ul style="list-style-type: none"> <li>• Localising and strengthening supply networks through repatriating supply chains</li> </ul>

## Metro—Dynamics

	<ul style="list-style-type: none"><li>• Developing critical materials and circular economy principles can provide opportunity to decrease reliance on external sources and optimise resource utilisation</li><li>• Freeports present a unique opportunity for investment in the North, with specific focus on advanced materials</li></ul>
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In addition to the workshop, this project also involved conducting a survey, designed to gather input more widely and to fill gaps identified during the desk research process. It was intended as an information gather exercise, not a representative survey of the sector in the North. As a result, the survey was completed by 14 respondents, 11 out of 14 based within the North West of England, majority employed within positions of seniority, e.g. CEO, Director, Senior Lecturer, or Business owner and 11 involved in advanced materials through research. Despite limited scope, the responses provided a number of valuable insights into the advanced materials landscape in the North:

- 10 out of 14 respondents agreed the development of advanced materials is a priority within their region.
- Collaboration is identified as a key aspect of the advanced materials sector in the North, with all respondents identifying that they collaborate with partners outside their organisation. As a result, collaboration between industry and academic was identified as a key strength by 64% of respondents.
- 79% of respondents believed that proximity to partners was important for the commercialisation of advanced materials, compared to 54% for the discovery of advanced materials. This is due to advanced materials having a strong experimental component, and as a result proximity to physical testing space is critical for development of materials discovery and assisting the process to commercialisation.
- Respondents also highlighted the strategic decision behind the location of material activity and the processing of materials, often being due to a geographical market focus or industrial heritage of an area. As a result, proximity to the source of materials discovery is necessary for development and deployment, and a sense of geographical connection can encourage alignment across laboratory fabrication, scale up processes and test-facilities.

To further understand the potential of advanced materials in the North, respondents were also asked what they see as the most important opportunity in advanced materials in their area, and if there are any barriers to realising this opportunity. General findings are displayed in the table below.

Opportunities	Barriers to realising the opportunity
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## Metro—Dynamics

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• Collaboration across the North's centres for excellence and relevant stakeholders to advance materials discovery, development, and deployment.</li><li>• Replicate successful projects/expertise/developments occurred across the regions, capitalising on what has already been done.</li><li>• Investment within infrastructure to enable critical raw material growth and reindustrialisation.</li><li>• Opportunity to develop specific Materials, e.g. advanced and specialist carbon fibres and composites in the North West, battery materials and associated composites in the North East, and base and intermediate chemicals to enable over advanced materials industries and technologies in Tees Valley.</li></ul> | <ul style="list-style-type: none"><li>• Lack of awareness of the North's current state, potential, and the role it can play on a global perspective to drive sustainable material development.</li><li>• Competition for funding between areas of the North, as well as with global competitors</li><li>• Organisational silos and duplication of efforts</li><li>• National recognition of the changing landscape in advanced materials within policy, and regulation including building regulations, and standards for new materials.</li><li>• The scale, scope, and destination of funding, which lack compared internationally.</li><li>• Issues within supply chains, with a lack of funding support across the whole supply chain leading to notorious long commercialisation timelines.</li></ul> |
|--|---|

### Annex D: Review of options for support

This annex presents more detail on the options for support considered. Table 3 sets out the pros and cons of each identified approach while Table 4 assess potential to impact the three identified strategic priorities for pan-Northern intervention.

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**Table 3. Potential Pros and Cons of approaches**

Option	Description	Pros	Cons
<b>Do nothing</b>	No Northern-focused intervention	No investment needed. Status quo	Missed and unrealised opportunity. Lost growth and stagnation compared to other areas, in UK and globally.
<b>Brand</b>	Establish a Northern Materials brand with collateral for stakeholders to use.	Help establish recognition of Advanced Materials North, more investable and funding which can help move and speed up the move of materials from discovery to development and deployment	Ignores the differences across regions in the North. No direct champions, no leadership which might lead to collateral being used in silo across the North or a lack of collaboration. Limited impact without support or infrastructure
<b>Brand and a shared Northern post</b>	Overarching brand and a shared Northern post connecting major leaders in materials (e.g. Institutes, Catapults, Universities etc )	Help establish recognition and centralised point of leadership/control to encourage collaboration and communication. Connect major stakeholders and lobby for north in Advanced Materials	Ignores materials specialism and landscape in different areas of the North. Location issue, where would it be and how do other areas in the North access facilities could be a source of tension
<b>Local network managers</b>	Appoint local network managers to support the ecosystem in their areas	Distributed approach to coordination, recognising the different landscape and specialism across regions in the North. Can provide more tailored support to add commercialisation. Can lobby for specialism and region in Advanced Materials.	Could not solve the issue of fragmentation if network managers are not well connected, may not create a pan Northern brand if networks managers focus on solely promoting their local area and do not come together to also push for a pan northern proposition. Lack of physical infrastructure. Requires strong individuals to drive success
<b>Team of local network managers</b>	Establish pan-northern structure to support the regional ecosystem and appoint local network managers to work to the overarching Northern-focused structure.	Improve co-ordination across the North to achieve shared goals with stronger local knowledge and connections enabling flexibility to respond to local needs (as they align with regional priorities).	Will require balancing of local and regional ecosystem needs and in initial stages success will be reliant on individuals.
<b>Single Northern hub</b>	Create a single physical hub as a central node for materials in the North with a mixture of space, facilities and support.	Concentrated resources and expertise. Help establish a brand through a physical space.	Location would be important, how would it ensure it served the whole north and not just the interest of the region it is located? How does it ensure the whole North feel connected to it. Distance to hub for some areas might mean that facilities are inaccessible to some areas of the North
<b>Northern hubs</b>	Network of hubs offering mix of space, facilities and support in different parts of the North with concentrations of materials activity.	Distributed resources and support which can be tailored to the regions specialism and needs in Advanced Materials. Facilitates regional engagement and collaboration. Increase accessibility in terms of facilities, enabling more commercialisation and deployment of materials	Resource intensive. Might not solve issue of fragmentation across the North. Lack of pan northern proposition or offer, areas still working in silo
<b>Pick a winner' - material led</b>	Identifying a small number of materials to focus on and drive the development and deployment of these materials across the North.	Strategic focus, can ensure higher levels of commercialisation and the North can be better at attracting investment, due to economies of scale. Clear distinct offer to shareholders. Can just focus on high value materials	Risk overlooking opportunities distinct to the North. Overlooks the different specialism across the North. How to decide which material
<b>Pick a winner' -sector led</b>	Choose industries where there are opportunities for growth unlocked by new materials.	Align with industry needs and growth opportunities. Can foster targeted innovation enabling economic growth in the UK through economies of scale , enabling innovation and high levels of commercialisation	Ignores different industrial strengths of areas in the North. Undersells the importance of materials across a range of industries important in the North and the scope for cross-sector collaboration. Limited scope and growth opportunities.
<b>Place leadership</b>	Places within the North taking leadership for materials that are best aligned with their strengths.	Leverages regional strengths and expertise. Stops places competing for the same funding which can allow more development and deployment. Can boost growth in all places through specialisation	Lack of scope for collaboration and communication on pan northern level. Risk of uneven development across the North
<b>Materials networks</b>	Select key materials which are opportunities (where there is research expertise and business/industry demand) and establish pan-northern networks to drive growth.	Requires collaboration and communication across the North.	Requires careful selection, how to pick when materials specialism differs across areas in the North. May overlook emerging opportunities

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**Table 4. Potential impact of approaches across strategic priorities**

Option	Description	Commercialisation	Communication	Co-ordination	Comment
<b>Do nothing</b>	No Northern-focused intervention				National strategy will raise some awareness but not around the North's proposition. Commercial and strategic imperatives may drive some growth but co-ordination will remain challenging and may hamper growth.
<b>Brand</b>	Establish a Northern Materials brand with collateral for stakeholders to use.				Improved awareness of advanced materials in the North.
<b>Brand and a shared Northern post</b>	Overarching brand and a shared Northern post connecting major leaders in materials (e.g. Institutes, Catapults, Universities etc )				Improved awareness and stronger ties between major leaders, less likely to be able to widen the pool of ecosystem participants.
<b>Local network managers</b>	Appoint local network managers to support the ecosystem in their areas				Improved awareness and support for commercialisation locally but risks of duplication of efforts and further fragmentation across different areas.
<b>Team of local network managers</b>	Establish pan-northern structure to support the regional ecosystem and appoint local network managers to work to the overarching Northern-focused structure.				Preferred option with the potential to address the three strategic priority areas at the pan-Northern level while also benefitting local ecosystems and respond quickly to new opportunities.
<b>Single Northern hub</b>	Create a single physical hub as a central node for materials in the North with a mixture of space, facilities and support.				Not clear that this could bring together partners and grow the ecosystem across the North and, while there would be benefits from a physical space it is not clear that infrastructure of space is a major constraint on growth in the North at present, making this a possibly inefficient allocation of resources
<b>Northern hubs</b>	Network of hubs offering mix of space, facilities and support in different parts of the North with concentrations of materials activity.				Potential to duplicate efforts and lead to more fragmentation, with negative consequences for pan-Northern co-ordination.
<b>"Pick a winner" - material led</b>	Identifying a small number of materials to focus on and drive the development and deployment of these materials across the North.				Leadership for a material could raise its profile, convene interested partners and help to drive commercialisation. However, a process to select could be a challenging one while a focus on a few areas will only deliver benefits across parts of the opportunity and may lead to deterioration in other areas of materials through diverted resources. This structure may also be ill suited to accommodate new discoveries and opportunities.
<b>"Pick a winner" -sector led</b>	Choose industries where there are opportunities for growth unlocked by new materials.				Leadership for materials in a sector could raise profile, convene interested partners and help to drive commercialisation and covers a wider scope than a material led approach. However, a process to select sectors could be a challenging one while a focus on a few areas will only deliver benefits across parts of the opportunity and may lead to users in other sectors not looking for materials opportunities or a deterioration in other areas of materials without immediate applications in chosen sectors through diverted resources. This structure may also be ill suited to accommodate changing industrial and sector needs.
<b>Place leadership</b>	Places within the North taking leadership for materials that are best aligned with their strengths.				Leadership for a material could raise its profile, convene interested partners and help to drive commercialisation. However, a process to assign areas of leadership could be a challenging one while a focus on a few areas will only deliver benefits across parts of the opportunity and may lead to deterioration through diverted resources. This structure may also be ill suited to accommodate new discoveries and opportunities.
<b>Materials networks</b>	Select key materials which are opportunities (where there is research expertise and business/industry demand) and establish pan-northern networks to drive growth.				Similar potential issues to above, with the potential to hinder growth in other areas or in new opportunities.

## Supporting the Growth of Advanced Materials in the North

At Metro Dynamics, we **care** about places, our clients, and our colleagues.

We are an **independent** organisation, **curious** about our work, and **collaborative** in our approach. We strive to **make a difference** in all that we do.

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