Sci-Tech DARESBURY

ADVANCING MATERIALS INNOVATION IN THE NORTH

A SCI-TECH DARESBURY ROUNDTABLE

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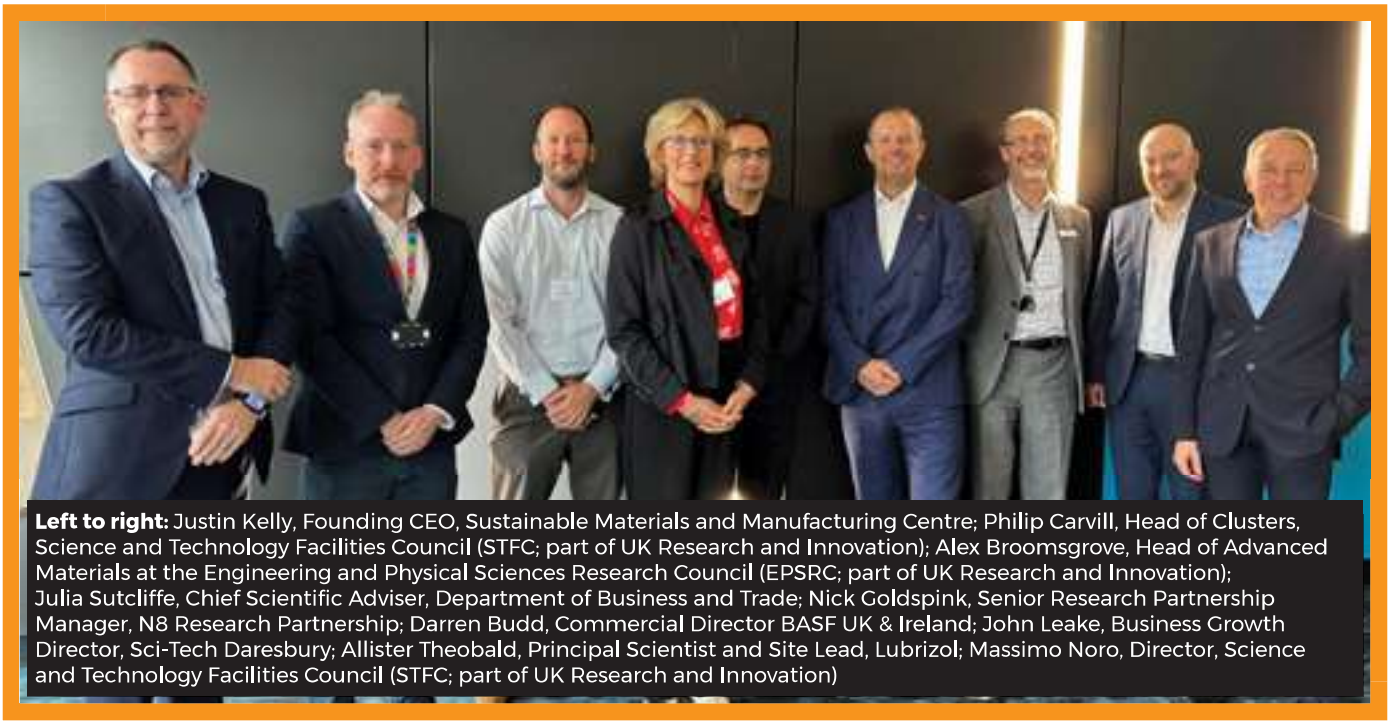


Left to right: Justin Kelly, Founding CEO, Sustainable Materials and Manufacturing Centre; Philip Carvill, Head of Clusters, Science and Technology Facilities Council (STFC; part of UK Research and Innovation); Alex Broomsgrove, Head of Advanced Materials at the Engineering and Physical Sciences Research Council (EPSRC; part of UK Research and Innovation); Julia Sutcliffe, Chief Scientific Adviser, Department of Business and Trade; Nick Goldspink, Senior Research Partnership Manager, N8 Research Partnership; Darren Budd, Commercial Director BASF UK & Ireland; John Leake, Business Growth Director, Sci-Tech Daresbury; Allister Theobald, Principal Scientist and Site Lead, Lubrizol; Massimo Noro, Director, Science and Technology Facilities Council (STFC; part of UK Research and Innovation)

INTRODUCTION

ADVANCED MATERIALS HAVE THE ability to defy expectations and offer tantalising glimpses of the future. Stronger than steel, lighter than air, or perhaps able to mimic nature in some useful way, they challenge our understanding of the physical world, inviting us to rethink what is possible. The cross-sector influence of materials has a profound impact on the global economy and the race to innovate continues to shape new possibilities.

By nation, the United States, China and Japan all have leadership positions. Each contributes to the global advancement of materials science in ways shaped by their industrial strengths, R&D investments, and strategic priorities. China leads in terms of sheer production capacity and control over critical materials like rare earth elements. The United States excels in pioneering innovation and high-tech applications. Japan is a leader in precision and high-performance materials, particularly in carbon fibres and electronics. The UK also features strongly as the demand for new solutions from industries as varied as electronics, aerospace, defence, renewable energy, and biotechnology becomes ever stronger.

The North of England is already home to an extensive research and innovation community that is helping to shape the UK's approach to materials innovation. The region's materials heritage includes a diverse range of industrial assets and expertise in chemicals, detergents, textiles, steel, and glass. The materials ecosystem also includes some of the UK's leading research-intensive universities.

The Science and Technology Facilities Council (STFC), part of UK Research and Innovation, is presently exploring how this cluster of related academic and industrial assets can become more connected with itself. The objective is to make the sum of the parts add up to a greater whole in terms of delivering economic growth.

STFC commissioned an independent report (Supporting the Growth of Advanced Materials in the North, 2024) which considered the rational for a place-based approach. The objective is to better align knowledge, assets and opportunities. As the report's authors, the Metro Dynamics consultancy point out, the North's advanced materials starting position is a strong one. There is already a critical mass of researchers and research assets in the North, along with a demonstrated ability to bring forward new initiatives and infrastructure, and concentrations of businesses directly involved in the development and use of advanced materials.

As one of the key science and technology locations in the North of England and host to one of UK Research and Innovation's (UKRI) National Science and Innovation Campuses, Sci-Tech Daresbury is a convenor within the world of materials innovation and has close links with the manufacturing ecosystem. The campus gathered a group of industry leaders to consider the issues. These are their key insights.

EXECUTIVE SUMMARY

1. **Building up the opportunity narrative:** Big challenges exist around communicating the potential of advanced materials, a broad and multidisciplinary technology, to policymakers and other stakeholders. Although critical to most economic sectors, their diverse applications make it hard to explain their impact and benefits.

2. **Breaking down barriers:** Collaboration between multinationals with either academia and/or SMEs is essential. However, finding the right partners, managing cultural differences, and overcoming trust issues tends to beset the process. Universities seek to balance competing priorities of teaching, research, and technology transfer. SMEs are time poor and can struggle to invest the necessary resources to make partnerships with other organisations work. Large multinationals, meanwhile, are often complex to navigate for outsiders. Collaboration between SMEs and multinationals can take years due to lengthy qualification protocols and supply chain integration.

3. **A home for life:** A place-based approach has a long track record of success in the UK and elsewhere, and physical infrastructure is key to helping any ecosystem, including through mechanism like clusters to form and grow. Innovation hubs such as the Sci-Tech Daresbury campus provide scalable laboratory space and other critical hardware capabilities that can act as key anchors for regional clusters, acting also as focal points for both talent and long-term collaboration between disparate groups.

4. **Funding the big challenges:** The road to commercial viability can be especially long in advanced materials, particularly for SMEs. The difficulty of aligning various needs - technology readiness, skills, finance, and infrastructure – means that only the strongest survive. Collaboration and strategic funding are essential for staying the course.

5. **Manufacturing tomorrow:** Development of novel materials often creates unique production issues. The machinery required may not yet exist and developers sometimes have to become manufacturers to progress, which brings its own upskilling and financial challenges.

6. **The hero for zero solution:** Reducing the carbon impact of how we live and work is an enormous and pressing concern across the UK economy. This reality can be leveraged by the materials and chemicals industry as they have the potential to provide innovative solutions. Advanced materials are of themselves key to achieving Net Zero while the world waits for developments such as the first fully recyclable automotive.

BUILDING UP THE OPPORTUNITY NARRATIVE

Advanced materials represent an area of technology with very broad potential applications. The canvas is so large that it can be difficult to communicate the benefits of investment in materials science to policymakers. The challenge starts with definitions. Businesses interact with advanced materials in different ways - as producers, users, or some combination of the two. The sheer breadth of potential applications makes it difficult to define what activities and businesses are (or indeed are not) part of it. The multi-disciplinary nature of materials also poses challenges when it comes to a joined-up approach to making the sum of the parts add up to a greater whole.

Julia Sutcliffe, Chief Scientific Adviser, Department of Business and Trade, commented that: "The scope of advanced materials is vast," she said. "When you think about core sectors of the economy it's got a role in many, which is both an opportunity and a challenge. Highlighting where there are strong demand signals now and where there are opportunities for the future is important and whilst the field is diverse, the mission-led government and industrial strategy approaches should create anchor points."

Alex Broomsgrove, Head of Advanced Materials at the Engineering and Physical Sciences Research Council, said: "We fully recognise that as a platform technology, materials feed into many potential opportunities, inherently making the case to government for investment in materials actually very difficult. If you are investing in a specific area, a hot topic, it's a lot easier to say this is why – and explain what you're going to get back. If you are investing in core materials, which may feed into lots and lots of different aspects of the economy, it's harder to land that because you can't say with the same conviction there's going to be the payback here."

Darren Budd, Commercial Director BASF UK + Ireland, agreed: "Advanced materials cut across sectors such as health care, automotive or aerospace. But it's really hard to put a case for government or even a local MP. Because if you talk about aerospace, they can sit on a plane and touch it. You talk about automotive or health care and it's a similar experience. We can't have any of those advances without innovation in materials or chemicals. But when you talk about them, it's much less tangible than, say, a passenger jet that is more efficient as parts of it are made from composite materials."

Nick Goldspink of The N8 Research Partnership also concurred: "I don't think anyone has a full appreciation of the breadth of the materials being developed. There are some advanced materials that have high name recognition, but there's much less knowledge about other advanced materials that are being developed. Communication is key, but it's quite a diverse landscape as well."

Nevertheless, the top-level ambition is there, said **Massimo Noro of the Science and Technology Facilities Council.** "Growth is the agenda. It has been, it will be. We just have to address that in terms of advanced materials. There's so much that we can do, and we can all coalesce together. But this is not just a purely technological challenge. It's also a 'how do we help companies grow' challenge."

BREAKING DOWN BARRIERS

The need for industry and academia to work well together goes well beyond the desire for economic growth. As Darren Budd of BASF put it, given the need to achieve Net Zero Carbon targets and perform well against Environmental, Social and Governance (ESG) metrics, collaboration is the only way forward. "Even with the size of companies like ours, we can't do it alone anymore. In the past, if you go back to 1930s and 40s in terms of new polymers coming through, new chemicals, yes, we could. But now, as it becomes more complicated, you have to work together."

Nick Goldspink asked, "What's the real barrier to progress? It's clearly not one of discovery because it's there [in universities]." The panel explored the issues around collaboration. Darren Budd talked about the difficulty of finding the right entry point, whether academic or within businesses. Citing BASF, which has 112,000 employees worldwide, he said: "For us in the UK, trying to find the right person is a challenge. We see this also with other companies, including start-ups, as well as academic institutions. It's that understanding of what both sides want – so the communication is key."

The complexity of the sector is not for the faint hearted, he added. "Where do we go to engage? If you are working with one university, how do you then bring another university into the same project? That is a really difficult process. So, you only focus on one university at a time. You may be doing two different projects at two different universities because you can't bring them together."

He also spoke of cultural differences between companies of different size. "We started working with a UK startup about a year ago. It's taken almost a year to get to an agreement, not just an NDA but a material transfer agreement. Just to get samples [to start the project]." He talked of the need to establish trust within a relationship based on novel IP. "I fear the expectation within a startup company is that the bigger organisation is going to steal their IP. Actually, we just need to do some work in-house to look at the process and to understand if the materials are potentially scalable."

Justin Kelly of Sustainable Materials and Manufacturing Centre shared feedback from research that his organisation had commissioned. It reported on the challenges universities face engaging with SMEs. "They say the same thing – the SMEs are typically time poor. They can't make the meeting at short notice because they suddenly have another priority. They become difficult to work with. The amount of cost to support them is disproportionately high. So, there is a barrier. Some of it is about acceptance and a tolerance."

John Leake of Sci-Tech Daresbury stressed the reality that collaboration needs to be mutually beneficial. "When you are engaging with early-stage companies, it can be a long road to commercial viability. Things can go wrong on that journey. And that's not only just about the materials development process, but also the move into scaling up."

Alex Broomsgrove pointed out that public sector investment already supports and enables collaboration. "A large proportion of that [support] is flexible enough to allow work across the materials community with industry. So, it would be good for us to understand what is missing and how we might do more with what we've already invested."

Nick Goldspink talked about how universities try to balance priorities. "There's a challenge between the different missions, the teaching, the research, and then the reality of being an anchor institution that is part of the regional economy. For many academics, business as usual is the cycle of grant funding. At the N8 Research Partnership we've run programmes over the years that have supported multi-university, multi-industry collaborations. They worked. If you look at the university sector in the UK more broadly, you've got certain universities that do technology transfer really well, and some that are catching up. Universities realise that economic impact is important, but it's a challenge for some institutions when compared with their core missions of teaching and research."

He noted that the universities of Manchester, Sheffield, and Leeds have come together to establish the Northern Gritstone fund to invest in spinouts from the Universities. "There's a similar desire in the North East. Our mission at the N8 is to drive collaboration and move some of these things forward but business as usual is focused on the research and teaching aspects. So, there are competing priorities."

When asked about national differences, Darren Budd remarked that it was easier to work with multiple universities at one time in the United States because they see the value, the process and IP is easier to manage. "It's very much about, okay, let's commercialise this together. What do we want? And let's build this into the structure. Trying to get an IP agreement in a UK university might take years."

A HOME FOR LIFE

Attractive and appropriate places of work are also fundamental to the growth of the sector. In the first instance, where to go when start-ups outgrow university lab facilities is a long-standing issue. John Leake cited an industry consultation the Royal Society of Chemistry is carrying out to explore the issue and identify what is constraining the process to create more grow-on lab space.

The panel acknowledged the importance of infrastructure in the scale-up equation and the benefit of sites like Sci-Tech Daresbury with a range of skills and facilities on offer to help entrepreneurs move quickly.

John Leake picked up the point and talked about the 'home for life' concept that is a draw at Sci-Tech Daresbury. "We work with a number of companies on the site here who are scaling up from incubator lab to grow-on lab to pilot plant."

Building on strengths was also emphasised by Massimo Noro. "We do have hot spots. We need to work around those points. We cannot just create something in the middle of nowhere. No companies will go there due to the lack of available skills, and the difficulty in attracting people to work there."

Infrastructure also has value as a focal point for disparate organisations. "We recognise this is a very fragmented world," said Massimo Noro. "For some people, it means chemicals. For others, it means enzymes, hard materials or graphene. But the common denominator is to build on the infrastructure."

He gave the example of the advanced computing capability at The Hartree Centre, part of STFC, which is used by multiple industry organisations both at Sci-Tech Daresbury and across the UK. He also referenced the cryogenic plant on the campus. “Do you need low temperatures to work on superconducting magnets? Where else would you go? The geographical access to infrastructure that no one else has is a great attractor, both for academics and for companies, small, medium, and large.”

Experience has shown STFC that clusters need to be proactively managed. “The ecosystem doesn’t just work by itself,” said Massimo Noro. “You need to have someone in there whose job it is to convene the ecosystem day-in and day-out, to organise meetings, to run events, to make those connections. The ability to connect relevant people and then use that as a starting point for applying for a grant. We need someone whose job it is to drive it, but that post needs to be paid for. So, we need to find the money for it.”

Phil Carvil, Head of Clusters for the Science and Technology Facilities Council, stressed the importance of a programmatic approach for any cluster. What’s required, he said, is an umbrella approach – “but not one over the ecosystem but an umbrella under it. It means connecting the various elements together and then deploying specific mechanisms at each point that support research and innovation across the system. It is vital that both academia and industry are part of this process, including codeveloping activities. That might involve utilising specific funding to access key capabilities, support knowledge transfer or foster collaborations. When you start exploring collaborations this is when flexibility and funding is key, it gives [innovators] breathing space.”

UKRI has explored how it can better align where its grants go with early-stage venture capital investment. As John Leake commented, material innovation is "a long journey, it's going to cost a lot of money, so grant funding can work well in terms of getting things moving. It can also help establish relationships and collaborations with other organisations like universities. But often, it's not enough on its own. And it's about how you get some early-stage investment into those companies."

Phil Carvill went further. "We need to be supporting the investment community with understanding the opportunity with these advances with materials innovation. This includes working with corporate VCs, investment funds, and grant funders, given the breadth of application materials can have in industrial sectors."

Clusters are also an important dynamic in terms of job opportunities. "What I have seen is that ecosystems can bring skills development in a specific sector, be that health, materials, or space," said Massimo Noro. "Having a pool of talent means that people can go from job to job. The beauty of it is that it is tied to a certain place and geography."

Darren Budd stressed the importance of developing a talent pool within clusters that can adapt to technological advances. "In the UK, we have now set up the British Alliance for Research and Innovation (BARI) working with Imperial and a number of other universities. BARI is one of BASF's eight Academic Research Alliances across the globe enabling us to work with world class academic partners. Despite this, we are in a constant race to get the best people, across all areas. Digital science is a core skill we are looking to upskill our chemists, into. It is still a challenge to make the case for investing a share of the 2 billion euros that BASF invests globally into R&D if we are not able to demonstrate we have the right people on the ground."

Allister Theobald reflected on Lubrizol's experience of moving into the North West. "We're a global business with labs with 34 labs across the world. We relocated the UK location that I was working from two years ago and change from our connectivity point of view, it's a different world, a step up in the North West."

FUNDING THE BIG CHALLENGES

The time and energy demanded of fund raising in all its forms was raised by Nick Goldspink. "Part of [the solution], is you have people that create an environment, create relationships and then people look to apply for grants. But it slows down from that point on because it might take months to write a grant and to get the IP agreements in place. Then you apply, and maybe you're not successful or it's got a long turnaround. And by that point, businesses have moved on."

Julia Sutcliffe spoke of the differences between generic challenges and issues that are specific to materials. "We know from our own experiences that taking technology and turning it into commercially competitive products is difficult because it requires many different factors to be lined up with technology readiness. For example, you need skills, laboratory infrastructure, finance, access to markets, a regulatory environment conducive to innovation etc.

And it's challenging to navigate that space for big businesses and SMEs, for whom it's even more difficult because of the time and resource it takes. But innovation will drive growth, so working across academia, industry and government to create that alignment is important, to enable advanced materials to address some of the big challenges ahead.

MANUFACTURING TOMORROW

Research conducted by the Sustainable Materials and Manufacturing Centre points to the link between materials science and manufacturing and machinery as a deficit area. "No one's really talking about that end of the spectrum," said Justin Kelly. "You've got this underpinning piece about skills and the finance to scale your plant, to build a new factory."

Developers becoming manufacturers along the way was in turn highlighted by John Leake. He spoke about Evove, which set up lab facilities at Sci-Tech Daresbury. The company is focused on Direct Lithium Extraction as one of its core applications. It has created a lithium-selective membrane which reduces the energy, water and chemical requirements compared to conventional lithium extraction methods. Its symbiotic process uses a proprietary lithium membrane and ion exchange technologies. The end solution is said to reduce footprints and engineers design them for easy commissioning and operation.

"They've moved into manufacturing," explain John Leake. "If you look at their journey and what they've got to tackle, they're producing a novel material. For that to happen they've had to develop a process to produce that novel material, and then 3D print it into the membrane configuration they require. There was no off the shelf 3D printer that enabled them to do it. So, they had to develop that technology themselves. So, they've faced multiple challenges not just material development. It is about development of the processing equipment and a whole load of different skill sets to support this. They have secured significant grant funding over the years, as well as VC funding through the Northern Powerhouse Investment Fund. They are now about to go out for a further significant funding round. To scale up as they have done along with securing the funding they need is a huge challenge."

Beyond generic challenges, he felt that there are some hurdles to get over which are specific to the sector. "It isn't just about the material. It's about how you make the material. It might be how the material is used in a particular process. You don't necessarily find this challenge in other types of businesses, the time it takes, the investment that is required, and the skills that you're going to have to bring in. So often we're seeing companies move from a very R&D focused team to having quite a strong operations team at an early stage in that journey."

Darren Budd picked up the point in terms of machinery. "If you have got a novel, advanced material where is the engineering required to do that? You need to be able to design the next generation engineering equipment because current models won't work for you."

He was asked about the ability of smaller companies to join the supply chain of a large multinational. "It's not just a case of having a great product. We've got to look down the line. Who's going to use that product? What is the qualification time? It's got to be cost competitive against what else is in the market. Who else is developing materials? It's not just our customers. It's got to be cost competitive against what else is in the market. Who else is developing materials? So, we could be three parts of the value chain away from this innovation. We love to work with SMEs because our history for over 150 years is a company that is built on innovation and working with startup companies and universities, but it does take a long time. I would say 20 years in terms for a new technology, while existing technology is quicker because you can iterate."

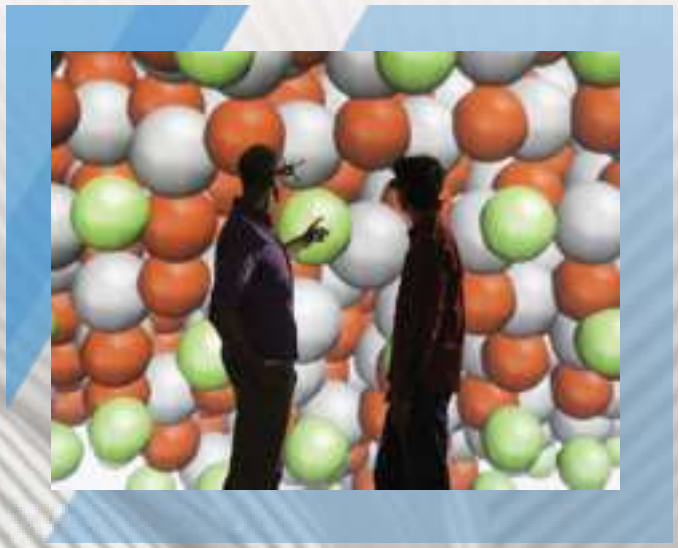
THE HERO FOR ZERO SOLUTION

Materials producers and chemical companies face big challenges when it comes to meeting sustainability targets, but they also need to be part of the solution. Darren Budd talked about the issue from a BASF perspective. "If we go back to 2018 where our benchmark is, we were producing around 22,000,000 tons of CO2 a year. That's got to be Net Zero by 2050, significantly reduced by 2030 in total and that's still with bringing on our new production sites globally. Our investors demand that we perform against the targets. So, we must find new solutions. Digital is a means to that end. How do we use AI or digital technologies in our R&D process? We're looking how we can upskill people in the labs to use these technologies."

He also talked about the need for circularity. "We're constantly being challenged by the automotive industry, for instance, to produce materials that can be recycled at the end of life. What happens to cars? If you look at electric vehicles, can you take the battery out, decommission it, shred it, take the constituent parts, and reconstitute it into its raw materials, to make the batteries again? What happens to the plastic materials that go around the batteries and metals that are inside?"

Being part of the Net Zero solution can be part of a persuasive investment case, acknowledged Alex Broomsgrove. "It's about telling the story of why we should be investing in these areas and the benefits that may be realised that otherwise may just not be possible."

Allister Theobald felt the rapid progress of digital technologies and demand for sustainable solutions was all part of the story of the pace picking up. "Materials science is changing all the time and the demand for innovation and new collaborations is there for all to see." He and everyone else on the panel agreed with the main contention of the independent report, commissioned by STFC, that the case for building on this momentum in the north is strong.



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