# PHYSICS INNOVATION: THE ENGINE ROOM OF THE ECONOMY

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**The UK Government has committed to increasing the share of GDP devoted to R&D. This is a vital goal if the country is to achieve its ambitions to compete internationally as a 'science superpower'.**

Businesses are by far the biggest investors in R&D in the UK, though government has an important role to play. This article draws on research commissioned by the Institute of Physics (IOP) which shows the innovation performance and potential of physics-based businesses, and the impact of physics-based industries on the economy. The research shows the huge opportunity that exists to fuel economic growth and the development of industries built on cutting-edge innovation. It also points to some of the barriers to innovation that businesses are facing.

The IOP is committed to transforming the physics R&D ecosystem so that it can better contribute to innovation, discovery, research, growth and debate.

We believe it is vital to improve the conditions that foster business innovation and grow levels of business R&D and innovation investment. The societal and environmental benefits of physics innovation are vast: in simple terms, physics innovation is essential to developing industries that can decarbonise the economy and will underpin developments from healthcare to defence to food security. It will also provide jobs and prosperity: innovative businesses are the engine room of the economy.

## RESEARCH INTO PHYSICS-BASED BUSINESSES

In 2021 the IOP commissioned CBI Economics to survey the innovation activity of 304 physics-based businesses across the UK and Republic of Ireland. We wanted to gain a better understanding of the amount and type of physics-related innovation taking place, the challenges experienced by businesses, and where the

opportunities lie to increase innovation activity and investment.

The research focused [1] on businesses that were actively engaged with physics technologies or research areas, and which had undertaken research & development (R&D), product/service innovation or activities to directly improve production process within the previous five years. (Other forms of innovation, such as new business practices, were not considered.)

The research found that physics-based firms are by nature innovative and are active investors in scientific discovery and technology. For the vast majority of these companies (91%) R&D and innovation is a strategic priority. Furthermore, 63% of UK physics innovators expected their R&D/innovation spending to increase over the next five years compared with the previous five years.

What does this mean in economic terms? We know from research measuring the impact of physics-intensive industries on the UK economy [2] that around a third (34%) of all business-conducted R&D is done by physics-intensive industries (those industries where physics research is most concentrated). This amounted to £8.9 billion in 2019.

Not only do physics-based businesses contribute a disproportionately large share of R&D investment today, but they also expect to grow that investment in the coming years. Physics-based businesses are pivotal to the Government's ambition to boost private sector innovation.

## A MISSED OPPORTUNITY

Business-led physics innovation therefore represents a big opportunity for the UK. The right support from Government can help unlock this additional investment and ensure that physics-based firms play their part in building economic growth and an innovation economy.

However, the report also lays bare some major challenges facing physics innovators. With development times often stretching to many years, physics innovators face a complex mixture of challenges related to funding, project risks and access to resource. Perhaps the most striking finding is that a shortage of skills has already put a brake on the innovation activities of physics-based businesses. 66% of UK survey respondents said that skills shortages had caused innovation activity to be suspended or delayed in the past five years. Indeed, only 11% of UK innovators said they faced no difficulties recruiting.

This represents a missed opportunity. How much greater could the contribution of physics-based businesses have been, were it not for the inability to fill critical skills gaps?

Another IOP report on workforce skills tells us that the demand for physics skills is growing quickly, which will cause the skills gap to widen even further, stalling plans to increase R&D activity and scientific output.

So, to fully seize the opportunities offered by increased investment in R&D and build a more innovative economy, we need an increase in the scale and diversity of the R&D workforce to fuel scientific progress.

## FUNDING CHALLENGES

Other issues identified in the survey are more inherent to investment, with direct costs and the risky nature of physics-based R&D being cited as challenges by 50% and 48% of respondents, respectively.

Given the high costs and typically long timeframes associated with physics-based R&D, it is perhaps unsurprising that 67% of physics innovators in the UK said greater access to direct funding for early-stage R&D could encourage more R&D/innovation activity.

Funding pressures were most acute at later stages in the innovation pipeline, notably production, scaling up, and commercialisation.

In view of these challenges, it is especially important to note the high value placed on government support for physics-based R&D/innovation activity. Well over half (59%) of the physics-based businesses in the survey reported financing R&D/innovation activity using some form of public funding over the past five years.

In fact, the report makes clear that public funding is not just important, but essential:

- 70% of survey respondents that had received public funding for R&D/innovation within the last five years said that it filled a financing gap without which the activity would not have taken place.
- 55% that had received public funding within the last five years said that it supported the development of products/services that otherwise may not have been produced.

This report adds to the growing body of evidence that public funding for R&D helps attract private investment by accelerating the innovation process and providing a mark of quality for potential investors. Public funding acts as multiplier for private sector investment in R&D.

Public funding is also seen as delivering significant, long-term spill-over benefits too, such as increased collaboration, the development of skills, and improvements to equipment and infrastructure that benefit future products.

## WHAT FORM SHOULD GOVERNMENT SUPPORT TAKE?

We asked firms which policy enhancements would encourage and support them to undertake more R&D and innovation activity in the coming five years.

Two thirds of UK respondents (67%) said that direct funding for early-stage research and later-stage development could help unlock additional spending by their companies. Long-term funding schemes were cited by 61% of UK respondents.

This finding - along with the fact that publicly funded innovators are also more likely to be concerned about future funding - indicates that, currently, support is not being offered with enough certainty to allow innovators the confidence to continue with long-term projects.

Policy also has a role to play in supporting innovation in ways that go beyond addressing funding pressures. Almost a third of respondents said that improved government procurement would support greater R&D/innovation activity, while better digital infrastructure and an improved regulatory environment were also highlighted as changes that would allow physics innovators to undertake more R&D/innovation activity.

## PHYSICS' HISTORIC ROLE

The research we have commissioned gives us great cause for optimism. There is much to celebrate in what we have learned about physics and its contribution to innovation in the UK.

Historically, physics has played a vital role in driving forward technological change. Each of the industrial revolutions we have been through – steam power, electrification, the nuclear age – has been built on the application of discoveries made by physics. We only need to look at today's emerging technologies to see that physics is continuing to play its historic role in innovation. Developments in quantum technology, photonics, advanced semiconductors, satellite technology, and many of the green technologies that promise to help decarbonise our economy, are all heavily reliant on physics-led innovation.

We can see from the report that activities built on physics skills and expertise are associated with high levels of innovation. Of those companies that are doing physics, most are innovating, and those that are doing the most high-intensity physics, tend to be innovating more. Crucially, we can also see that this is driving significant investment in the economy.

The right support can help it to deliver even more.

**This article is adapted from a presentation given to the Parliamentary and Scientific Committee as part of its session on 'The Deep Tech SME Ecosystem – Supporting research-intensive SMEs to maximise their contribution to economic recovery', on 22 May 2023.**


References

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