

Written evidence submitted by The Henry Royce Institute (PEG0106)

Operating with its Hub at The University of Manchester, the Henry Royce Institute for advanced materials research and innovation is a partnership of nine leading institutions – the universities of Cambridge, Imperial College London, Liverpool, Leeds, Oxford, Sheffield, the National Nuclear Laboratory, and UKAEA. Royce aims to support and grow world-recognised excellence in UK materials research, accelerating commercial exploitation and delivering positive economic and societal impact for the UK. Royce is funded by the Engineering & Physical Sciences Research Council.

Summary

This submission focuses on:

- The importance of national research Institutes in accelerating innovation and closer research academic/industry collaborations which will deliver the technology and innovation required to drive sustainable post-pandemic growth.
- How national Institutes such as Royce, Crick, Turing, Faraday and Rosalind Franklin are innovation hubs, representing significant Government investment; they should be fully mobilised to support industry, enabling the technology required for the UK to stimulate post-pandemic economic growth and achieve its societal goals.
- Why advanced materials are a key underpinning technology which are essential in “building back better” in order to establish a resilient economy that is sustainable and fit for society’s needs.

1. What core/guiding principles should the Government adopt/prioritise in its recovery package, and why?

- **Ensure agile mechanisms to enable businesses to work in partnership with strategic National Institutes to accelerate innovation and technology transfer**
- **Develop “sprint projects” to accelerate innovation and closer research academic/industry collaborations which will deliver the technology and innovation required to drive sustainable post-pandemic growth**
- **Ensure continued support for pioneering cross-cutting materials research which supports a number of strategic UK sectors including aerospace, life sciences, chemicals, automotive, next generation nuclear and renewable energy**

1.1 In these challenging times, it is essential that national research Institutes such as The Henry Royce Institute support and maintain innovation momentum when it has become a second order priority for many companies. With the need to move to a healthier nation, existing in a zero-pollution society, this is an opportunity to “build back better” - to establish a resilient economy that is sustainable and fit for society’s needs.

1.2 Advanced materials are a key underpinning technology which are essential to deliver this change. A step change in accelerating developments in production, use and recycling, should be placed at the heart of a recovery package. Such research is ultimately linked to both national and global initiatives, not least Transition to Zero Carbon, Sustainable Manufacture, Digital & Communications, Circular Economy as well as Health & Wellbeing.

1.3 To achieve this requires enduring support for cutting-edge materials research across a number of strategic UK sectors including aerospace, life sciences, chemicals, automotive, next generation nuclear and renewable energy. This type of research includes development and manufacture of high-value sustainable products, from energy harvesting devices through lightweight transportation, to new medicines and bioelectronics.

1.4 Importantly, Institutes such as Royce, which has in excess of £200 million of state-of-the-art facilities, are also placed uniquely to move quickly through the value chain toward commercialisation of research. To deliver in the necessary time frame, the National Institutes need resource to accelerate innovation, identifying opportunities with industry and developing “sprint projects”, driving closer research collaborations which will deliver the technology required to realise the necessary changes within the required timescales.

2. How can the Government borrow and/or invest to help the UK deliver on these principles?

- **Support industry to maintain fundamental research that feeds the substantial innovation required to achieve Net Zero, primarily through existing infrastructure such as our National Research Institutes**
- **Provide industry incentives using a similar model to those which have underpinned the deployment of, for example, renewable energy technologies**

2.1 We are in danger of losing investment and expertise in fundamental, early TRL research – this is critical as it will feed the next stages of innovation necessary for us to achieve Net Zero.

2.2 In current conditions, business will need additional support, both financially and in terms of infrastructure, to innovate and see ideas to market - continued Government investment is therefore vital. The retention of high value R&D activity and people will become more critical in the coming decades, as will the attraction of highly skilled people from overseas. Institutes like Royce can support the UK in achieving this through becoming international beacons of research excellence.

2.3 The Government’s R&D roadmap and continued commitment to an increase in public investment in R&D to £22 billion a year by 2024/25 is a good start. In particular, the proposed ARPA style funding body is also an important initiative. Within any ambitious research portfolio it is imperative to support the “moon-shot” type of research that could lead to development of transformational technologies. The applications of these ambitious ideas need to be embraced for innovation to be exploited. Here, Institutes such as Royce, which oversees the application of materials against national imperatives, must play a key role in efforts to translate this exploration into real opportunities.

3. What measures and support will businesses need to rebuild consumer confidence and stimulate growth that is sustainable, both economically and environmentally?

- **Support businesses with public engagement campaigns on material re-use**
- **Develop innovative anti-microbial materials and systems**

3.1 In the specific area of plastics, we should support businesses to grow consumer confidence in the principle “if you can clean it you can re-use it”. Investment in anti-microbial coatings combined with circular economy systems would be game-changing. Public engagement is essential, and importantly the Royce, through its Sustainable Materials Innovation Hub (SMI Hub), can play an important role.

3.2 Our ability to detect and control the harmful microorganisms which contaminate our environment will continue to be a long-term public concern, as we enter a Post-COVID world. Innovative materials have the potential to detect and control the spread and growth of such harmful microorganisms, and hold one of the keys to protecting our health and well-being. The ability to control the interactions of microorganisms with material surfaces holds real opportunity to enhance and re-design materials and systems. This would see anti-microbial systems that are self-monitoring, self-cleaning and self-controlling, reducing the likelihood of surface contamination and extending product lifetimes.

4. Whether the government should give a higher priority to environmental goals in future support?

- **Focus support on companies committed to a green recovery; there should be a careful evaluation – is it green, is it circular, is it sustainable? The focus should be on zero pollution**
- **Invest in infrastructure that makes our all our futures more sustainable – for example plastic recycling facilities/energy from waste**

- 4.1 We can use the current disruptive climate to accelerate technological change required for our Grand Challenges in a truly sustainable fashion; this will also accelerate economic recovery and resilience of our research and manufacturing base.
- 4.2 Investment in Circular Economies is urgently needed, but we must ensure investment in technology avoids unintended consequences due to incomplete understanding of the system. Consideration must be given to the connection between wider aspects such as human behaviour, socio-economic drivers, the available/required infrastructure. In this regard, a connected supply chain would be a clear output.
- 4.3 Government must invest in infrastructure that makes our all our futures more sustainable – we already lag behind other nations in many aspects common across mainland Europe. Investment in areas such as home insulation or fixing our roads, remains important; but we need nationwide investment in big infrastructure to circularise our resources. This creates a new kind of society and of course jobs. Government has committed to Net Zero and reflecting this through acting on it will provide confidence to companies and markets.

5. Whether the Government should prioritise certain sectors within its recovery package, and if so, what criteria should it use when making such decisions? What conditions, if any, should it attach to future support?

- **Prioritise companies that offer us a more sustainable future and help them to repurpose their operations to help deliver the infrastructure and capability required to deliver Net Zero**
- **Post-COVID we need to re-focus on manufacturing and on building robust supply chains in order to build a stronger industrial base and to become more self-sufficient and resilient**

- 5.1 COVID-19 is, of course, taking its toll on several industrial sectors, with many having to curtail research activity and reduce staff. Royce works closely with a number of leading companies in such industries who recognise they must continue innovation to thrive.
- 5.2 Companies such as Rolls-Royce are urgently addressing the development of truly green transportation, BP continues the transformation from being an oil and gas organisation to a carbon-neutral energy company and Unilever is committed to delivering real sustainable change. Successful transition for these companies will secure many thousands of jobs and fuel the UK economy. Similarly, many small companies are looking to adapt their products and seek support to accelerate the necessary transformation which must be undertaken at pace, but with little to no resource.
- 5.3 It is recognised that the public is wary of the bailout of certain companies, but we must prioritise companies that offer us a more sustainable future. Such companies are at a watershed where they could go out of business or repurpose their operation to deliver the infrastructure and capability required to deliver against our environmental and health imperatives. Repurposing their experience away from their historic carbon-heavy footprints, while remaining focussed in areas such as energy and transport, should be seen as an opportunity for the UK.
- 5.4 The current crisis has demonstrated how important it is for the UK to maintain sovereign capability in research and manufacturing; this also extends to our reliance on precious commodities. As an example, we import metals we need from Russia in the form of billets – but around 70% of such materials go to waste. We also have an over-reliance on exotic alloy

additions (e.g. rare earth metals) from China. We should look to re-purpose materials from aerospace into automotive use and materials research is key. Research Institutes must work with industry to develop both the technology and the necessary infrastructure

6. How can the Government best retain key skills and reskill and upskill the UK workforce to support the recovery and sustainable growth?

- **Utilise National Institutes to draw the necessary capability together to interface with the major national challenges**
- **Institutes working with industry and acting as beacons of research excellence to retain and attract the world's best researchers.**

6.1 There is a real opportunity for Government to use and repurpose the skill sets in our strategically important companies to build a greener society. Royce represents an example of how National Institutes which are co-funded by Government and Industry, acting as beacons of international excellence in research, can play a role in skills and capability development and retention.

6.2 We can provide the necessary facilities for researchers from both industry and academia to undertake work, network and deliver impact to new projects. These Institutes can also offer secondment opportunities to undertake research and learn new concepts.

6.3 This is also the opportunity to reconfigure our education towards interdisciplinary skills, embedding data science/artificial intelligence into physical and life sciences. Centres for Doctoral Training (learner cohorts around themes) are an excellent vehicle for developing such skills, producing future leaders of industry who are well-rounded and display the kind of behaviours needed in our world today.

7. Is the Industrial Strategy still a relevant and appropriate vehicle through which to deliver post pandemic growth?

- **Utilise Technology Roadmapping to provide clarity on current research and where there are gaps or disruptive opportunities which remain overlooked**

7.1 The Industrial Strategy remains an important vehicle for Government-Industry collaboration but we need to make expediting such strategy more agile and achievable, allowing response to changing drivers. Institutes such as Royce, which span industrial sectors, can play a key role in joint Industry-Government collaboration; Royce convenes the UK materials research community to work with a wide range of industries to better understand the future and develop strategic projects through Technology Roadmaps.

7.2 We are one of a number of Institutes establishing a new model for accelerating the translation of innovative research from universities and start-ups into wider industry. This goes beyond bringing together materials experts, to embracing wider considerations such as social impact and human behaviour. The aim of the roadmaps is to provide clarity on current research and where there are gaps or disruptive opportunities which remain overlooked. The maps are therefore a vehicle to develop, define and justify programmes of agreed research.

7.3 An example of such activity is last month's publication of the Executive Summary of the interim result of an important roadmapping exercise for Materials for Energy Transition, in collaboration with the Institute of Physics (IOP). The Summary can be found here <https://www.royce.ac.uk/materials-for-the-energy-transition/>

8. How should regional and local government in England, (including the role of powerhouses, LEPs and growth hubs, mayoralities, and councils) be reformed and better equipped to deliver growth locally?

- **Utilise National Institutes such as Royce to support local companies to spread innovative capability out into the regions**

- **More R&D Investment out outside the “Golden Triangle” of Cambridge, London and Oxford would also support the levelling up agenda**

- 8.1 Local Industrial Strategy means empowering decision makers, once an investment is agreed and governance in place, to be able to get on with project delivery. National Institutes have a central role in supporting local government. Critically a number of the Institutes, such as Royce, and a number of the Catapults are established away from the Golden Triangle, developing expertise in research and innovation throughout the regions.
- 8.2 These Institutes must also play a key role in supporting regional innovation and research into sustainable manufacturing. This will be achieved through a process of developing national capability, but deploying this through the regions. A recent example of this is Royce focusing nationally on development of materials for low (energy) loss electronics, which will be deployed into pilot studies in areas such as the [South Wales Compound Semiconductor Cluster](#).
- 8.3 Royce itself is already delivering regional impact; ERDF funding to support a [Sustainable Materials Innovation Hub \(SMI Hub\)](#) in the Greater Manchester region around innovative design, reuse and recycling of plastics and packaging being a recent example. Further, we are working with partners to connect Royce’s national expertise and assets with plans to create two new manufacturing innovation parks. These will provide translational research facilities in ‘left behind’ parts of the city region to attract inward investment and raise productivity in the local SME base.
- 8.4 These models are examples of how Institutes can work with local companies to spread our innovative capability into the regions, creating new opportunities, particularly evident in areas such as the nuclear industry, chemical materials and healthcare.
- 8.5 The UK’s R&D spending, both public and private, is still regionally imbalanced. Additional investment is essential, but decisions on how and where this is spent must be made differently. The recent Nesta report’s (<https://www.nesta.org.uk/report/the-missing-4-billion/>) analysis is striking. It demonstrates that while some places are doing well others have lost out. The report estimates that many parts of the UK have missed out government R&D spending, to the tune of £4 billion each year, and this money could have leveraged a further £8 billion from the private sector. The UK’s nations, cities and regions, need resources and capacity to build and develop their own innovation priorities. As the UK recovers from the COVID-19 pandemic, there is a rare moment to redress this imbalance.
- 8.6 A de-centralised approach to delivery gives local authorities the power and authority to make decisions and therefore progress. More devolution also gives decision making to the people who are closer to the issues felt by SMEs – from skills development to innovation. An example of this is how we develop both the infrastructure and innovation to address plastic waste, with clear targets. The ability for adapting this locally through pilots are central to these aims, and will support us to take a systems approach.

9. What opportunities exist for the UK economy post Brexit and the pandemic for export growth?

- **Well supported National Institutes will ensure science remains an international venture, with all the opportunities this brings, including the opportunity to attract world leading scientists attracted by a country with an expanding R&D investment strategy and healthy innovation ecosystem**
- **Establishing sovereign ownership of a sustainable manufacturing base which is resilient in a rapidly changing global economy, supported by a network of agile Institutes to underpin the necessary innovation**

- 9.1 The UK research base is still seen as world leading, attracting skills, talent and investment. Our National Institutes will continue to ensure science remains an international venture, with all the opportunities this brings, including the retention and attraction of world leading scientists.

Exports are a goal of regional industrial strategy, and fostering regional hi-tech companies who can export services and expertise, will support a positive balance of payments.

9.2 The UK must recognise that sovereign ownership of sustainable manufacturing with associated R&D is critical to us being able to remain resilient in a rapidly changing global economy. Institutes are ideally placed to support these aims and ensure that UK companies are world leaders in new technologies and sustainable manufacture of high value products.

10. What role might Government play as a shareholder or investor in businesses post-pandemic and how this should be governed, actioned and held to account?

- **Government is ideally placed to be the customer Post-COVID, securing new markets and ensuring they are sustainable by being the purchaser in the early phase**
- **Utilise UK Institute Scientists as a source of independent advice**

10.1 Government is ideally placed to be the customer Post-COVID, securing new markets and ensuring they are sustainable by being the purchaser in the early phase. This is the only way to achieve security of new markets in areas such as energy, with Government creating the market through legislation and regulation. It is clear that some larger businesses are systemically important and their failure could wreak damage on the innovation capacity of our nation or our infrastructure.

10.2 Government therefore needs to have an equity stake in such companies, as long as they can adapt and support our evolving economy. Experts across National Institutes can be drawn upon to provide a considered review to programmes – Royce scientists stand ready to be a trusted source of independent advice and provide the necessary scientific enquiry. This is a tough time, when Government should look to make strategic investments and use Institutes to conduct the necessary due diligence. Having more scientists at the heart of Government, particularly those understand the concept of roadmapping and the risks/opportunities associated with technology, would allow Government to get ahead of technological change.

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