

AMBER



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For what's next

# Advancing — — Materials for Impact

# *Pre-Budget Submission 2025*

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## Executive Summary

The Advanced Materials and Bioengineering Research centre (AMBER) is one of the World's leading multidisciplinary research centres in the area of advanced materials for economic and societal impact. Established in 2012, the centre has an outstanding reputation for excellence in scientific research and industry engagement. Advanced materials are a multidisciplinary field encompassing physics, chemistry, engineering, and other disciplines focused on understanding and exploiting the relationship between the atomic and molecular structure of materials and their macroscopic properties and function. Materials are a primary driver of economic growth and competitiveness forming the basis of all modern and manufacturing technologies and of great significance in Ireland as a small export-led economy with a large high value manufacturing sector. Emerging economic, geopolitical, and societal factors such as population growth, convergence of living standards and the mass adoption of digital and green technologies are driving an unprecedented demand for advanced materials and informing international innovation policies. In this submission to Budget 2025, we set out the need for investment in maintaining and growing our national competency in materials science research that will drive new opportunities for domestic industry as well as continue foreign direct investment. Research funding is an imperative if Ireland is to remain competitive across our current and new industry sectors. Increased funding is critical so as to drive innovation in the areas of sustainability, circularity and substitution technologies required to build resilience for future supply chains and manufacturing industries and enable Ireland to compete and thrive in competitive international markets whilst meeting our environmental and climate commitments. A continued lack of Government investment is becoming a significant barrier to Ireland meeting minimum research and innovation standards needed in maintaining Ireland as an internationally recognised Hi-tech industry hub.

Our recommended actions are as follows.

**Action:** Developing a committed plan for national Research and Innovation funding which aligns with ambitions regarding IMPACT 2030 and increasing Government Budget Allocations for R&D (GBARD) from the current rate of 0.35% GNI\* to 1.0% or at least .71% (EU 27 Average). This funding can address roadblocks and uncertainties that are unintended consequences of the SFI and IRC merger currently impeding the operation of the wider research ecosystem.

**Action:** Increased budget allocation for DFHERIS and Taighde Éireann-Research Ireland to meet the minimum EU agreed funding requirements for an Irish research ecosystem.

**Action:** Commit to a national standardisation of PhD stipends across all funding bodies and awards that aligns with minimum standards of living, initially €25,000 per annum.

**Action:** An immediate and dedicated report by SOLAS and the SLMRU to map the current and future needs of STEM careers now and on a continual 5-year basis to support IMPACT 2030 targets and beyond.

**Action:** Equip primary and secondary level education system to meet current and future standards as well as skill gaps in the delivery of fundamental STEM education via the curriculum and CPD of educators.

**Action:** A dedicated plan (based on a detailed survey of needs) for the maintenance and development of research infrastructure including a national materials characterisation centre with input from all relevant stakeholders and users of that infrastructure.

**Action:** Inclusion of two education representatives on the National Training Fund Advisory Board.

**Action:** Commitment of allocation of current and future NTF surplus to maintaining research infrastructure.

**Action:** Establish a National Science Forum chaired by DFHERIS with inter-departmental attendees and science stakeholders.

**Action:** Maintain and expand the Oireachtas Friends of Science & Technology Group to bridge gap between research, science, and policy makers.

**Action:** Establishment of a Government led and funded independent National Science Centre for public information and education.

**Action:** Prioritise membership and participation in European Technology Council for Advanced Materials supported by a clearly defined **national strategy** which is aligned to our strategic priorities

**Action:** Identify the needs of the tertiary education sector and plan appropriate funding investments, including areas such as, addressing national skill shortages and expertise gaps, staffing and infrastructure.

## Background

Established in 2013, AMBER is the Science Foundation Ireland (SFI) Research Centre for Advanced Materials and BioEngineering Research hosted by Trinity College, University of Dublin, with researchers in 8 additional partner institution around Ireland: RCSI, UCC, Tyndall, DCU, University of Galway, University of Limerick, TUS and UCD.

The AMBER mission is to drive excellence in materials science research for the benefit of people, planet and prosperity enabling a sustainable future through innovating materials technologies that support a healthy planet.

The Centre's strategy reflects the three main pillars:

- I. World-class materials innovation resulting from the excellence of our research which underpins everything we do,
- II. Partnership and engagement with industry not only on collaborative research, but also to contribute to the ethos of the centre in terms of governance & strategy, emerging research challenges and researcher development, and
- III. Impact with a focus on ensuring efficient translation of our research for economic, environmental, health and societal impacts.

In executing this strategy AMBER delivers a unique, integrated capability for materials research to accelerate innovation:

- Brings together Irelands leading researchers across nine higher education institutions.
- Provides access to advanced facilities.
- Provides a gateway to significant European funding.
- Has a team of professional supports to scope, build, and ensure completion of projects to the highest standards, with IP and knowledge transfer capability.

In a global context advanced materials are a primary driver of economic growth and competitiveness forming the basis of all modern technologies. From renewable energy to generative AI to advanced therapeutics, it is difficult to identify an emerging technology which does not have a critical dependency on innovation and adoption of advanced materials. Economic, geopolitical, and societal factors such as population growth, convergence of living standards and the mass adoption of digital and green technologies are driving an unprecedented demand for materials with the OECD forecasting an approximate twofold increase in the global demand for raw materials from 89 Giga Tonnes in 2017 to 167 Giga Tonnes in 2060, it is estimated that 70% of the innovations associated with the green and digital transitions will depend on materials research.

The importance of materials science to Ireland as a small export-led economy is significant and the need to nurture the sector is a pre-requisite for economic resilience and success. As one of the most globalised world economies heavily dependent on trade and foreign direct investment the Irish manufacturing sector is vulnerable to emerging developments in global value chains and protectionism policies. Irish enterprise, innovation and environmental policies place a high priority on transitioning the industry and research base to a low carbon, sustainable and innovation-driven model with increased international reputation and global competitiveness. A strong, internationally competitive materials

science research, innovation, and education capacity, as embodied in the AMBER vision and mission, is pivotal to drive innovation in the areas of sustainability, circularity, and substitution technologies. These technologies will underpin future supply chains of our manufacturing industries and are an absolute necessity in delivering on our national priorities with respect to innovation, competitiveness, advancing our value proposition to FDI, strengthening our indigenous exporting sector, addressing climate change, and delivering an innovative healthcare system.

Materials science is an inherently interdisciplinary field, this is reflected in our pre budget submission which is focussed on the actions required to deliver on the objectives of the IMPACT 2030 strategy to support our national capacity for internationally leading Science and Engineering research specifically addressing the need to increase our R&D intensity rate to 2.5% GNI\*, the acknowledged deficits in PhD stipends, replacement of ageing and obsolete research infrastructure, sustaining the research centres as a national asset for industry-academic engagement and implementing plans for the scientific advisory structures outlined in the strategy.

## National Investment in Research and Development

AMBER is in support of The League of European Research Universities (LERU)<sup>1</sup> call for greater funding of Research and Innovation within Europe. AMBER echoes LERU's calls for:

- Push funding for research and innovation in Europe through the achievement of over 3% of the GDP within the European Union and all European countries.
- Double the budget for the EU's next research & innovation programme (FP10) to reach 200 billion EUR.
- Protect the latter by ring-fencing the budget.

It is important to stress that the Irish research funding landscape has worsened considerably since 2005 and Ireland performs relative poorly compared to other EU countries in terms of R&D investment. This weaker performance is evident when measuring as a percentage of GDP for other European countries and GNI\* for Ireland which brings with it the associated risks and challenges to our aspirations as an innovation led economy.

- Failing to keep pace with other small, advanced economies in terms of investment in R&D represents a significant risk to Ireland's competitiveness and labour market productivity.
- The Impact 2030 strategy has committed to a target 'research intensity' rate of 2.5% of GNI\* by 2030. This will require a significant increase with current reported levels of 1.78% of GNI\* in 2022 and against recent annual figures which have decreased not increased.
- The National Competitiveness and Productivity Council (NCPC) notes that even if the 2030 target is achieved, it is modest relative to international standards and is below that of the OECD

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<sup>1</sup> <https://www.leru.org/news/a-call-to-strengthen-research-and-innovation-in-europe>

average of 2.7% in 2021 and significantly behind other small, advanced economies, such as Sweden (3.3%), Finland (3%) and Denmark (2.8%).

It should also be recognised that Irish Government funding for research is disproportionately low relative to international benchmarks. Currently, Ireland has the highest ratio of Business Expenditure on R&D to Government Budget Allocations for R&D (BERD:GBARD) in Europe with 80.5% of the total national investment in Research and Innovation coming from the Business sector. This means our funding for research and innovation makes us one of Europe's and the OECD lowest performing nations and well behind leading innovation countries such as Belgium, the Netherlands, Sweden, and Denmark.

Our Government Budget Allocation for R&D (GBARD) at 0.35% GNI\* (estimated at €1,075m in 2023) significantly lags behind the EU 27 and OECD average of 0.71% and 0.6% respectively. Countries classified as innovation leaders are at least 2x the Irish investment with Denmark 0.92%, Finland 0.87, Sweden 0.76%, Netherlands 0.77%, and Belgium 0.7% GDP respectively. This level of investment in R&D is simply not consistent with Ireland remaining a major leader in innovation in the future.

In their 'Ireland's Competitiveness Challenge 2023 report'<sup>2</sup>, the NCPC while acknowledging Ireland's above the EU average performance in both the Global Innovation Index and European Index have highlighted the deterioration over a 5-year average with respect to its closest competitors. While still categorised a 'Strong Innovator' in the European Innovation Scoreboard 2023, our lead over countries ranked below us has narrowed, while the higher ranking "Innovation Leaders" have increased their lead. Business and Public investment in R&D are not mutually exclusive but the delivery of new and disruptive innovations for business genesis and growth (particularly in the SME sector) requires Government investment. Achieving the IMPACT 2030 goals for 2.5% GNI\* investment and in the doubling of BERD will not be possible without an accompanying increase in Government budget allocation to research carried out within the academia and other publicly funded institutions.

In the absence of investment in research excellence, talent and infrastructure which makes future industry deployment possible, Ireland risks becoming less attractive for company investment in the emerging areas of advanced manufacturing, decarbonisation, the circular economy, quantum computing and advanced therapeutics. In recent months alone Intel indicated a hesitance for expansion in Ireland, through the sale of a stake in its Irish plant with commentators highlighting "how much of the money is invested here will be an indication of whether Ireland's appeal is waning"<sup>3</sup>. In supporting high value research mandates within local entities of FDI companies it is vital to maintain an appropriately balanced portfolio between individual academic led discovery driven research and centre led targeted programmes of scale which address societal and industry challenges, both of which are mutually dependant. The SFI research centres are a national asset which provide both the mechanism and scale required to act as an interface between academia, industry and public sector and a track record in delivery of an international profile and investment in scientific research and innovation. They are a driver of industry – academic collaboration and private sector investment in university research.

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<sup>2</sup> The National Competitiveness and Productivity Council (NCPC). (2023a, September 28). Ireland's Competitiveness Challenge 2023. <https://enterprise.gov.ie/en/publications/publication-files/irelands-competitiveness-challenge-2023.pdf> Accessed 21 Feb 2024.

<sup>3</sup> <https://www.irishtimes.com/opinion/2024/05/19/cliff-taylor-pay-close-attention-to-what-intel-does-next-its-a-test-case-for-ireland/>

Current uncertainties and delays with respect to the implementation of the research and innovation bill and the establishment of Taighe Éireann has had a destabilising effect of the centres and putting business continuity and their future existence at significant risk. While recognising that some optimisation of the system is required, measures to address the risk of losing a competency and the associated investment that has been build up over 20 years needs to be prioritised as a matter of urgency in consultation with stakeholders from Industry and Academia.

The imminent establishment of Taighde Éireann-Research Ireland will see an amalgamation of SFI and IRC to provide for a combined national approach is welcome however indications that there will be no increase to the existing budget for the new agency is concerning. For example, based on figures available SFI's capital allocation for 2021 was €208.3 million. This funding was broken down as follows: €167.9M allocation for grants awarded in previous years (81%) and €40.4M available for in-year expenditure on new awards (19%) in 2021. The 2023 capital allocation for DFHERIS was €588 million and for 2024 was €620 million. The Department which will now be responsible for the vast majority of research projects within the country will need a significant increase in Budget for 2025 and subsequent years and in turn Taighde Éireann-Research Ireland will need a larger budget allocation to ensure Ireland has a competitive research ecosystem and to improve upon current GNI\* and GBARD goals.

**Action:** Developing a committed plan for national Research and Innovation funding which aligns with ambitions regarding IMPACT 2030 and increasing Government Budget Allocations for R&D (GBARD) from the current rate of 0.35% GNI\* to 1.0% or at least .71% (EU 27 Average). This funding can address roadblocks and uncertainties that are unintended consequences of the SFI and IRC merger currently impeding the operation of the wider research ecosystem.

**Action:** Increased budget allocation for DFHERIS and Taighde Éireann-Research Ireland to meet the minimum EU agreed funding requirements for an Irish research ecosystem.

## Recruitment and Retention of Research Skills and Scientific Talent

### PhD Supports

PhD students form the backbone of academic research in Ireland in addition to performing many teaching and learning support functions within universities and remuneration for this varies not only between institutions but also within individual institutions and faculties. They are our future industry leaders and the vital element in maintaining and developing Ireland's technological economy. Identifying, harnessing and supporting this talent source now can only seek to future proof Ireland in its ambitions to continue to be a world class leader in research, development and innovation and be an attractive location and talent pool for companies seeking to engage in such industries. However, without adequate supports and funding, this vital supply of talent into the future is at imminent risk of drying up.

As AMBER and many other parties have identified in recent PhD support consultations there is a barrier to entry into STEM at third level currently. Barriers exist in the form of Economic viability and affordability. The current stipends do not provide a liveable income for students with the current cost of living. This is particularly true for students studying away from home including non-Irish students and



students coming from disadvantaged backgrounds. This limits numbers applying for studentships particularly affecting our ability to attract good students from abroad.

Some concerns that AMBER has regarding current PhD structures and supports include:

- There is an urgent need to increase PhD stipends to a value of €25,000 to €30,000 (tax free) in line with our high cost of living. This should be implemented across all funding agencies, to ensure pay equality within and across organisations. This also needs to be monitored year on year for necessary adjustments to track with inflation growth to ensure that this issue is not repeated. The current varied stipend amounts do not provide a sustainable income for students with the current cost of living. This is particularly true for students studying away from home including non-Irish students and students coming from disadvantaged backgrounds. This limits the numbers applying for studentships, particularly affecting our ability to attract good students from abroad. Student stipends are not competitive against other countries. By way of comparison, in Germany, the average stipend is €24,500, in France €27,000 and in the Netherlands €38,400.
- The lack of both stipend and research funding makes Ireland uncompetitive internationally. Bringing in the best of the world raises standards in Irish research providers. Whilst the number of people enquiring about positions available has increased, the numbers taking positions has halved in the last 3 years. This has reduced competition and poorer quality students are being recruited.
- PhDs provide some teaching (for undergraduates) in schools and departments. This is vital to the universities and is valuable experience and learning for the PhD students. The classic role of laboratory demonstrator is well known to most PhD students. A decrease in the number of PhD students has ramifications for the organisation and effectiveness of teaching, increasing the ratio of PhD student: undergraduate student will result in a poorer experience for all concerned.
- Advanced industry sectors such as MedTech, semiconductor, pharmaceutical and other sectors, rely on PhD recruitment to develop the industry leaders of the future. Decreasing numbers and quality has a cumulative effect. In the semiconductor industry, about 1/3 of all PhD recruits are from foreign countries. While incoming talent is to be welcomed, it leaves industry with recruitment shortages. If Ireland is to be seen as a centre of excellence with a mobile talent pool, both the number and quality of students needs to be increased.
- In the most recent 'Difficult to Fill Vacancies Survey' by SOLAS in November 2023, Science, Engineering and Technology is reported as the highest difficult to fill sector at 41%, higher than Health and Construction combined.<sup>4</sup> Despite this and the STEM sectors' contribution to the economy with the talent attracting FDI, recent SOLAS reports prioritised were, 'Hospitality Skills in Ireland: Supply and demand in the aftermath of COVID-19'<sup>5</sup> and 'Report on future skills needs for the International Financial Services sector'<sup>6</sup>

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<sup>4</sup> <https://www.solas.ie/f/70398/x/837c65f80c/solas-difficult-to-fill-vacancies-survey.pdf>

<sup>5</sup> <https://www.solas.ie/f/70398/x/2e26383ae0/hospitality-skills.pdf>

<sup>6</sup> <https://www.gov.ie/en/press-release/d47f5-minister-burke-and-minister-richmond-welcome-report-on-future-skills-needs-for-the-international-financial-services-sector/>

Major investment in both the numbers and quality of PhD research is urgently required. Per capita we educate less PhD students than our competitors such as the UK, US, Germany, Netherlands, Asian nations etc. and numbers of PhD registrations have dropped considerably in the last 10 years. The Independent report on supports for the PhD researchers in Ireland was published by Minister Simon Harris in late June 2023. In the report, the Co-Chairs recommend an increased stipend level, with an optimum target of €25,000<sup>7</sup>. This recommendation is far off the necessary increase required to facilitate a basic standard of living for PhD researchers.

The current National Minimum Wage as of January 2024 as recommended by the Low Pay Commission (LPC) to Government saw a 12% increase in the minimum wage in Budget 2024 which brought the minimum wage to €12.70 an hour which is equivalent to €25,095 based on a 38-hour working week, so the recommendation of increasing stipends to €25,000 will see PhD researchers fall below the minimum wage once again. The recommendation by the LPC for Budget 2025 (as has been widely reported) is to abolish sub-minimum wage rates for all young workers<sup>8</sup> which will see any eligible workers entitled to a minimum hourly rate of €12.70 further highlighting the disadvantage of the current PhD stipend rate.

In contrast the minimum wage in Latvia is €620 per month<sup>9</sup> with proposed legislation due this Autumn PhD students will be given state salaries of €1,000 per month in addition to an obligation on Universities in Latvia to match based on involvement in research projects<sup>10</sup>. The aim of this legislation and increase in salary is to increase conditions for PhD students and also to ensure that they are engaged with Research and Development from the beginning of their studies.

The inconsistency of stipends being offered across various funding and awarding bodies is becoming an issue, as colleagues working across different projects in the same fields can see a disparity in income. Science Foundation Ireland (SFI) & Irish Research Council (IRC) both offer €22,000 a year stipend for doctoral researchers as of January 2024. Teagasc offer stipends of €25,000 per annum and Department of Agriculture, Food and the Marine funded projects see PhDs in receipt of €25,000. AMBER is not unique in that PhDs from the four funding bodies mentioned can be working in the same offices and labs at the same time whilst receiving different stipends for the same quality of work and expertise. There needs to be consistency at a national level and a stipend that aligns with the living wage.

## Industry & Workplace Engagement

Continuing and ongoing engagement with industries and workplaces within the STEM sector is needed whilst developing and monitoring STEM education and resourcing. It must be acknowledged that whilst reviews of PhD funding are ongoing, research centres such as AMBER are essentially employers (and a significant one) of the STEM workforce, be they post-doctoral researchers, PhDs, investigators or other. The opportunity to contribute to this roundtable should be a first step for ongoing engagement between research centres such as AMBER and the Oireachtas. As a research Centre AMBER is uniquely positioned at the coal face of third level STEM education and the intersection of industry. It is the aim of AMBER

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<sup>7</sup> <https://www.gov.ie/pdf/?file=https://assets.gov.ie/261655/13774a0b-e8c9-4956-bb62-336250ad6038.pdf#page=null>

<sup>8</sup> <https://www.ictu.ie/news/trade-union-movement-welcomes-lpc-recommendation-abolish-lower-minimum-wage-rules-younger>

<sup>9</sup> [https://www.lm.gov.lv/en/minimum-monthly-wage?utm\\_source=https%3A%2F%2Fwww.google.com%2F](https://www.lm.gov.lv/en/minimum-monthly-wage?utm_source=https%3A%2F%2Fwww.google.com%2F)

<sup>10</sup> <https://sciencebusiness.net/news/universities/latvia-overhaul-phds-and-academic-careers>

and research centres who are dealing in real time with the deficit in personnel qualified in STEM nationally, to contribute to solutions to futureproof Ireland's STEM education.

Steps must be taken to safeguard the future of STEM as a significant industry in Ireland, employer, and contributor to the national exchequer. Education requirements need to be addressed to meet demands for highly qualified school and college leavers and the evolving needs of students to meet expectations in areas such as sustainability. Mapping exercises of teaching resources and future workforce are greatly needed and should be conducted regularly in line with IMPACT 2030 and to reflect the ever-changing technology and science landscape. With adequate data from mapping and forecasting the focus should be investment to ensure a resilient workforce, which can adapt to changing market needs. Materials Science alone is estimated to contribute to 70% of Green and Digital Transitions meaning investment in that fundamental STEM Education, and research career progress is vital for the benefit of all areas of society.

**Action:** Commit to a national standardisation of PhD stipends across all funding bodies and awards that aligns with minimum standards of living, initially €25,000 per annum

**Action:** An immediate and dedicated report by SOLAS and the SLMRU to map the current and future needs of STEM careers now and on a continual 5-year basis to support IMPACT 2030 targets and beyond.

## STEM Education

AMBER as a world class scientific research centre relies on STEM educated individuals to conduct the highest quality materials science and engineering research. We believe that excellent, relevant, and up to date Primary & Secondary level STEM education is a vital foundation for the development of current and future materials scientists, engineers, and researchers. Ireland has had success in developing a highly educated populace through policy and its delivery of education at primary, secondary and tertiary levels. However there remains shortages of highly educated STEM school leavers for industry and academia. There also remains a lack of gender diversity, with engineering subjects in particular remaining male dominated. Gender balance is manifest in senior industry and university positions.

Ireland has a technology-based manufacturing economy with materials science and engineering at its heart. To maintain our international success and our economy we must improve STEM education, its uptake, its quality, and its diversity. It is also imperative to adapt our STEM education to ensure our preparedness as a society for future developments. As the world enters an era where the elements of society and industry must be sustainable, our education must reflect a need for all its citizens to embrace change and to provide STEM trained school leavers and graduates the expertise to drive our economy forward whilst protecting the planet.

AMBER supports the asks of the Irish University Association (IUA) in their Pre-Budget Submission regarding funding of Higher Education, a vital component of STEM. Namely the asks regarding the Funding the Future. "That initiative brought to an end the long-awaited analysis of the funding needs of higher education when it identified a €307m per annum core funding gap and made a commitment to close that gap over successive Budgets. In the two following Budgets, €100m in gross funding was provided. However, as it currently stands, €92m of this has been eroded by unfunded pay awards arising from national pay agreements. This means that, as of June 2024, the net gain in core funding for the

sector is just €8m. This autumn's Budget is the last opportunity for the current government to deliver on its Funding the Future commitments.

This requires a 4-part funding programme as follows:

1. At least €120m Funding the Future allocation, exclusive of provisions for pay awards and extra places. This will go directly to addressing the student-staff ratio, which at 19.6:1 is well out line with other key competitor countries (the EU norm is 17.1:1).
2. €92m by way of a Supplementary Budget to pay for unfunded pay awards in the 2024 funding allocation. This will enable universities pay for existing staff.
3. €171m in the 2025 core funding allocation to fully provide for pay awards to existing staff under both Building Momentum and the National Pay Agreement 202426. A further €35m is required to cover the costs of medical consultant contract costs and additional students arising from demographic growth.
4. Legislative and policy measures to unlock spending for skills development from the growing National Training Fund surplus in line with government commitments."<sup>11</sup>

### Resourcing of STEM Education

Industry and Education have engaged in mapping out requirements for future literacy in STEM subject areas including availability of teachers within subject areas, but this is being done on a piecemeal basis. For example, the recent University of Galway Report 'Capacity for, access to, and participation in computer science education in Ireland'<sup>12</sup> commissioned with the support of Google found that in the area of computer science only 16% of schools are offering the subject to senior cycle pupils and the majority of teachers are giving classes, without Teaching Council accreditation to do so. Lead Author of this report Dr Cornelia Connolly, said the findings showed a significant volume of work was needed to ensure that all students had the opportunity to develop essential computer and coding skills, subjects that needed to be viewed as a "foundational competence for all" and that computing education be introduced at an earlier age so that students' technical use and understanding correspond with their high level of access to phones and smart technology. The findings of this Report are an example of the primary and secondary level education system being ill equipped to meet current and future standards in the delivery of fundamental STEM education.

SOLAS' Skills and Labour Market Research Unit (SLMRU) as part of its remit to 'provide a data gathering, analytical and research resource to identify skills needs and support the work of the National Skills Council' should be tasked with reporting on STEM, mapping future input needs as regards workforce and education and reviewing on a 5-year basis and in conjunction with IMPACT 2030 targets.

### Provision of STEM Education

There currently exists a plethora of optional and additional CPD courses for educators in primary and secondary level education including some of which the AMBER Centre itself has devised and engaged with. This includes a suite of 6 dedicated lesson plans and resources for teachers for ages 4 through to

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<sup>11</sup> <https://www.iaa.ie/publications/iaa-pre-budget-submission/>

<sup>12</sup> Connolly, Cornelia, & Kirwan, Colette. (2023). Capacity for, access to, and participation in computer science education in Ireland. Galway, Ireland: University of Galway, <https://doi.org/10.13025/bccm-2c38>

transition year. This resource<sup>13</sup> was developed by AMBER with the aim of improving teachers and their students' content knowledge of material science, understanding of materials science and society relationships, build awareness of materials science and STEM careers and develop students' sense of science identity (being a scientist) facilitating the teaching of science with other subject areas in an integrated manner.

The programmes integrate other value learning pillars focusing on integration of science lessons with literacy, drama, and design and make, developing children's skills in working scientifically, while also meeting literacy and drama objectives. The modules provide teachers with a framework to build a narrative with young learners, with the express objective of developing oral language skills, cooperation, art, design, and STEM learning. Our resources are developed with and for teachers and teacher educators, to ensure they are age appropriate, based on sound pedagogical practice.

Examples of AMBER's engagement and outreach to Primary level school children and educators:

- Primary resources developed including Materials Now and NanoWOW2!<sup>14</sup>
  - The NanoWOW! Programme launched in 2014 and was developed for children between ages 10-12 years old, but it is also suitable for older and younger children.
  - NanoWOW! includes short educational videos hosted by AMBER scientists to introduce the properties of materials, the concepts of scale and surface area, exploration of graphene one of the first nanomaterials to be found (and one that is inside a pencil!), discussion of where nanoscience could take us in the future, and how we are using nature to inspire new nanomaterials to solve common problems.
  - Each lesson has a combination of downloadable resources which include background information for parents and teachers, and details of experiments and learning activities for children.
- AMBER collaborated with Education Support Centres across the country and STEAM in Junior Cycle throughout February and March 2022 to deliver 18 professional development workshops for over 200 primary and post primary teachers. These workshops were based on the content from our AMBER spiral learning programme. AMBER again participated in 2023 with the STEAM project.<sup>15</sup> A focus for us has been sustainability with materials developed on the circular economy and plastics and helping students and teachers meet the needs of the 'Education for Sustainability Programme'.
- Primary online hands-on materials science workshops were delivered to over 750 primary school students in May and June of 2022. Materials for experiments were posted out to schools in advance of the workshops. DEIS and rural schools were given priority for places on this programme.
- AMBER's Training and Outreach Manager presented a paper titled 'Leadership in STEM,' at the International Academy of Management Conference Presentation, Seattle, August 2022. This paper

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<sup>13</sup> <https://ambercentre.ie/engage/schools/overview/>

<sup>14</sup> <https://www.youtube.com/watch?v=CGn1mFwXXvo>

<sup>15</sup> 'The vision of STE(A)M in Junior Cycle is to "Provide Junior Cycle teachers with rich STE(A)M professional learning experiences in keeping with national and international best standards, which will allow for interdisciplinary responses to societal challenges in subject specific and cross curricular contexts".'

<https://www.jct.ie/steAm/steAm>

explores the perceptions of Irish primary school principals on leadership in STEM, and highlights the importance of specialist teacher instruction, i.e., school-scientist collaborations.

The above initiatives have served to engage greater and more diverse and disadvantaged primary and secondary level students and educators. However, this piecemeal basis of STEM engagement and CPD for educators should be prioritized by the Department of Education in Curriculum. Teachers engaging in STEM education should be adequately resourced, prepared, certified and targets for teacher recruitment should include the prioritization of STEM qualifications.

The Department of Education should as a first step ensure STEM has a structured place in both primary and secondary level curriculum and that subjects such as sustainability are properly treated within STEM programme. STEM programmes should be delivered with consistent quality across the school network. Secondly engagement with Boards of Management to ensure that schools are resourcing teaching staff and infrastructure to facilitate STEM teaching and that where feasible local schools are sharing resources and infrastructure to offer subjects to all students in a catchment area. Historically it was not uncommon for schools in Local Authority Areas to link up to provide a physics or chemistry class for example to students from various schools within one school that has labs and accredited staff to teach.

**Action:** Equip primary and secondary level education system to meet current and future standards as well as skill gaps in the delivery of fundamental STEM education via the curriculum and CPD of educators.

### Research Infrastructure

Provision of funds for basic, essential infrastructure is a high priority if Ireland is to achieve the ambition of IMPACT 2030 and to remain internationally competitive as a location for research talent and investment. As highlighted in 2022's Indecon Report, 'National Research Infrastructure Evaluation'<sup>16</sup> significant proportions of essential research infrastructure are no longer viable due to obsolescence and an inability to fund maintenance contracts and support. An IUA led audit of research infrastructure indicated that half of the equipment across the national university campuses was more than 10 years old and almost a third is more than 15 years old (pre-2007). This obsolescence profile has been raised as a concern by a number of AMBER's FDI Industry partners as the capability of our materials research and characterization equipment is no longer relevant to their emerging research needs or the technical skills they require for graduates, this puts future investment in collaborative programmes at risk the urgent need for a dedicated and comprehensive funding programme to upgrade the depreciated and obsolete research infrastructure which is heavily relied on across the research ecosystem.

We welcome the plan for the Higher Education Authority to develop an infrastructure investment framework to develop projects compatible for the re-allocation of National Development Plan (NDP) underspends. However current classification of infrastructure by our funding agencies based on size and cost (i.e. small-scale equipment, larger equipment that is shared and national-level infrastructures.) which does not accurately reflect the needs of researchers on the ground and has created a

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<sup>16</sup> <https://www.sfi.ie/research-news/publications/SFI-Research-Infrastructure-Indecon-Report-Final-Version-22.pdf>

geographical separation between the critical mass of academic expertise and researchers and the availability of infrastructure which is impractical.

Our recommendation is that when considering infrastructure the emphasis for classification need and use rather than size and cost, this recognises the need to have **local** access to certain pieces of “large” equipment such as electron microscopes and spectrometers is essential for all researchers in materials science, expecting researchers to rely on availability of equipment in another institution and travel across the country on a weekly/monthly basis to access the equipment they need to carry out their work is a false economy and not conducive with carrying out world leading research. Our view is that funding for renewal of basic research equipment and provision of technical supports should be part of a stable core grant that comes to the institutions annually. Resolving this issue requires cross agency and institutional cooperation to build a compelling case for allocation of the significant funding required in the national budget. We would welcome the opportunity to engage with this process though we feel that it should be coordinated at a Department level. We would welcome the opportunity to engage with the HEA on the development of a future strategy for the sustainable management of infrastructure which balances both responsible management of resources with the needs of an internationally competitive research environment.

**Action:** A dedicated plan (based on a detailed survey of needs) for the maintenance and development of research infrastructure including a national materials characterisation centre with input from all relevant stakeholders and users of that infrastructure.

### National Training Fund

The National Training Fund Act 2000 states the levy on employers is for the purpose of funding the development of and raising of skills amongst those in, or seeking, employment. There is currently a significant surplus in the National Training Fund (NTF) that by 2025 is projected to rise to between €1.4 billion and €1.9 billion. Whilst the current exchequer surplus has not yet been earmarked and debates continue regarding reserving that surplus for a rainy-day fund, in contrast as per the 2000 Act, the National Training Fund has a clearly defined purpose to support development and raising of skills. The 1% employers contribute from their payroll (increased several times via the Budget between 2018 – 2020) which has led to the surplus should be strategically allocated with a focus on upskilling through research infrastructure investment. Immediate and ongoing/ annual allocation of NTF surplus to this area should be committed to in Budget 2025.

We echo Ibec’s calls regarding the NTF in their Pre-Budget Submission ‘Sharpening our Edge’ which highlights “The Government will have a surplus nearing €2 billion in the National Training Fund (NTF) in 2025. It is critical this investment is used to deliver on its intended promise to upskill Ireland’s workforce if the country is to successfully navigate the twin digital and green transition. The unique nature of the NTF, where a revenue stream has a direct match to expenditures and a managed surplus, should be recognised. This could best be achieved by giving spending from the NTF the same treatment as other similar specific purpose funds – such as the Brexit Adjustment Reserve, the Recovery and Resilience Fund - as non-core expenditure, outside of the cap of the domestic expenditure rule. This would adequately recognise the nature of NTF spending as being a net addition to economic capacity, rather

than a drain on it.”<sup>17</sup> The commitment in the Summer Economic Statement 2024 to “accommodate new measures in line with Government priorities including in relation to measures funded from the National Training Fund”<sup>18</sup> is welcome and it is hoped that any decision in this regard will be inclusive of all stakeholders particularly those training the next generation of researchers in all areas of STEM.

The National Training Fund Advisory Group (NTFAG) was established in 2019 following the Indecon Independent Review. However, the current membership (listed below) of the group lacks an education and research representative to give perspective outside of DFHERIS or a similar semi-state. Two educational representatives must be added, one from the Irish Universities Association (IUA) and an additional member from the wider educational or research sphere appointed via by open competition.

### **NTFAG Membership**

- ISME
- IBEC
- Chambers Ireland
- Construction Industry Federation
- Irish Exporters Association
- Irish Hotels Federation
- American Chamber of Commerce Ireland
- SOLAS
- Skillnet Ireland
- The Wheel
- Higher Education Authority
- Department of Business, Enterprise, and Innovation
- Department of Social Protection
- Department of Further and Higher Education, Research, Innovation and Science

**Action:** Inclusion of two education representatives on the National Training Fund Advisory Board

**Action:** Commitment of allocation of current and future NTF surplus to maintaining research infrastructure

### Science Forum

Whilst the establishment of a National Science Advice Forum and Government Science Advisor are welcome initiatives there still exists an opportunity for the Science and Research community to engage with legislators in a broader way. Looking at existing forums such as the Hospitality and Tourism

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<sup>17</sup> <https://www.ibec.ie/influencing-for-business/ibec-campaigns/budget2025>

<sup>18</sup> <https://www.gov.ie/en/publication/ee21b-summer-economic-statement-2024/>



Forum<sup>19</sup>, the Retail Forum<sup>20</sup> and the Responsible Business Forum<sup>21</sup> a similar Science and Innovation forum should be established with an inter-departmental membership at Government level due to the place of science and research within all aspects of societal challenges, including health, construction, business and enterprise, education, environment and more. The proposed makeup of the remaining members to include Deans of Research in Universities and TUs, Directors of SFI Research Centres, with a number of positions open for academics of various disciplines within Science and Research. The aim of the group being to discuss and plan for challenges facing the country that can be facilitated by the Science and Research community, how best to support the sector to ensure a stable economy inclusive of FDI and wider European and Global challenges.

The second Trade Horizons Conference hosted by the Department of Enterprise Trade and Employment took place in July 2024<sup>22</sup> highlighting Ireland's deepening global connections with international trade exceeding €1 trillion in 2023 and also Ireland's commitment to halving our greenhouse gas emissions by 2030, and the EU is targeting climate neutrality by 2050. Whilst such a Conference engaging policy makers and trade and business representatives is welcome consideration should be given for next years' conference to having a session the following day co-chaired by Department of Further and Higher Education, Research, Innovation and Science & Department of Enterprise, Trade and Employment bringing together researchers, academics and various Science & Research stakeholders to discuss with businesses within Trade and Policy Makers how we can all work together to achieve a Sustainable Future using science research and innovation. For example Materials Science will be involved with 70% of Green Transition and Digital Transition.

**Action:** Establish a National Science Forum chaired by DFHERIS with inter-departmental attendees and science stakeholders

## Oireachtas Friends of Science & Technology Group

As outlined above, announcements by Minister Harris of the establishment of various Science Fora in the coming months such as Government Science Advisor and the National Science Advice Forum and the Research and Innovation Policy Advisory Forum are welcome. The structure of the Fora are however prescriptive in both their purposes and objectives as outlined below and rightfully so.

### National Science Advice Forum

- “to provide cross-sectoral and multi-disciplinary science advice to the government”.
- “will assist in informing responses to complex and challenging policy issues like climate change, food sustainability, artificial intelligence, cybersecurity and emerging technologies and to needs identified by ministers and government departments”.<sup>23</sup>

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<sup>19</sup> <https://www.gov.ie/en/news/43de4-hospitality-and-tourism-forum/>

<sup>20</sup> <https://enterprise.gov.ie/en/publications/retail-forum-membership.html>

<sup>21</sup> <https://www.gov.ie/en/press-release/5a343-minister-calleary-hosts-inaugural-meeting-of-the-responsible-business-forum/>

<sup>22</sup> <https://enterprise.gov.ie/en/news-and-events/department-events/trade-horizons-conference-2024.html>

<sup>23</sup> <https://www.gov.ie/en/press-release/f343c-national-science-advice-forum-and-government-science-advisor/>

## Research and Innovation Policy Advisory Forum

- “objective is to inform and support national research and innovation policy”<sup>24</sup>

Consideration should be given to maintaining the Oireachtas Friends of Science & Technology Group which should exist alongside the proposed Fora and provide for more informal engagement between all legislators, both Government parties, Opposition, Seanad and indeed support staff and advisors of Leinster House. The Group which has an informal standing in the Oireachtas was established by Mary Harney in 2002 as the ‘Friends of Science’ cross party Oireachtas Group and is now the Oireachtas Friends of Science & Technology with Deputy Denis Naughten TD as convenor.

Understandably due to COVID briefings and meeting of the group and those from the Science and Technology sector were sporadic<sup>25</sup> and it is notable that the current convenor Deputy Naughten will not contest the next General Election putting the Group at risk of falling by the wayside. This Group can provide a vital information exchange between industry, research and politicians and should be maintained.

**Action:** Maintain and expand the Oireachtas Friends of Science & Technology Group to bridge gap between research, science, and policy makers

## National Science Centre

Whilst news of the upcoming National Children’s Science Centre coming in 2025<sup>26</sup> is welcome consideration should also be given to exploring a National Science Centre. Initiatives such as Science Week which is inclusive of all levels of understanding, ages and backgrounds are a fantastic way to engage the public in the everyday science that we utilise and helps our society to function, however a couple of weeks in the year is not sufficient.

The closing of the Science Gallery in Dublin should not be the end of engagement of the wider public in Science and Science Communication. The Science Gallery provided an invaluable opportunity for research and science to be accessible and inclusive and was a great success from that perspective. Mismanagement of the business end of the gallery should not lead to a reluctance by Government Departments to establish a new national centre for the public to engage in science.

The National Children’s Science Museum originally planned in early 2000s and falling by the wayside as a result of financial crash is another example of a lack of centralised Government led planning and for a National Science space. A 2018 article reported that “A group of private individuals have been seeking state funding for the proposed National Children’s Science Centre for more than a decade.”<sup>27</sup>

Planning permission for the Centre was received for the project from An Bord Pleanála in September 2016 and it would be housed in the existing unused north wing of the National Concert Hall complex and

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<sup>24</sup> <https://www.gov.ie/en/press-release/c6f16-minister-harris-establishes-new-research-and-innovation-policy-advisory-forum-and-issues-call-for-members/>

<sup>25</sup> <https://www.oireachtas.ie/en/search/?searchType=newsArticles&q=friends+of+science>

<sup>26</sup> <https://www.nationalchildrenssciencecentre.ie/>

<sup>27</sup> <https://www.businesspost.ie/news-focus/e40-million-kids-science-centre-may-prove-to-be-too-pricey/>

an adjoining new building with the state would fund the construction of the museum at a conservative cost estimate of €50 million. However, a charity was set up to oversee the project with a board of trustees drawn from the public, private and academic sectors, including Ali Hewson, Professor Luke O’Neill, and Professor Brian Ó Gallachóir.

We cannot and should not default to private led initiatives for such important resources as galleries, museums, and science centres for the public, local and National Government should come up with a 5-year plan for Science Galleries and Museums. The rise of misinformation particularly in the area of the health sciences following COVID should spur on greater and more transparent engagement in science with the public and a science gallery or museum for all ages is a first step for this. A vacuum of reliable information or will only be filled by misinformation.

**Action:** Establishment of a Government led and funded independent National Science Centre for public information and education.

## Europe

### Horizon Europe

It was a welcome announcement regarding the UK’s re-entrance to the Horizon Europe programme allowing researchers to participate as of January 2024 on par with their counterparts in EU member states.<sup>28</sup> It is imperative that for the future of programmes such as the All-Island research projects and the co-centres for research and innovation announced in October 2022<sup>29</sup> that there is consistent and cohesive engagement of UK researchers with European research and innovation funding and calls so that wider European challenges such as health, security, climate, energy and environment have focus and engagement for the benefit of the entire continent.

We would also echo many European colleagues concerns regarding Horizon Europe’s primary focus on higher technology readiness levels at the expense of funding for basic research. Whilst it is acknowledged that The European Research Council (ERC) and Marie Skłodowska-Curie Actions (MSCA) are the main sources of funding for basic research, it is hoped that the as yet to be announced incoming Commissioner for Research and Innovation will continue the charge of Commissioner Iliana Ivanova MEP and follow through with the promise to further develop appropriate research infrastructures within Horizon Europe.

Regarding the initial Budget shortfall of approx. €34 Billion in the first two years we welcome the current Commissioner’s promise to seek out additional funding so as to ensure in the months that follow a larger percentage than 30% of high-quality proposals are funded.<sup>30</sup>

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<sup>28</sup> [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_23\\_4374](https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4374)

<sup>29</sup> <https://www.gov.ie/en/press-release/cefe0-ministers-harris-ghani-and-poots-announce-joint-investment-in-co-centres-for-research-and-innovation/>

<sup>30</sup> <https://sciencebusiness.net/sites/default/files/inline-files/en-ivanova-written-questions-and-answers.pdf> , Pg 6

## Advance Materials for Industrial Leadership

In February 2024, the European Commission launched the Strategy for Advanced Materials for Industrial Leadership<sup>31</sup> which intends to harness Europe's strengths in disruptive research and enhance the capacity for translation and commercial exploitation by creating an advanced materials ecosystem coordinated across all of the member states so as to align on EU, national and regional research and innovation priorities for advanced materials.

The preliminary priority areas of renewable energies, transport, construction home and electronic appliances have been identified as the primary targets of this communication. Specific use cases of high priority for Ireland and its industry base include the following:

- *Advanced materials for renewable energy production technologies*; By 2050 90% of electricity generation in Europe will come from renewable sources, with wind and solar together accounting for nearly 70%, this will include Ireland's target of 80% of renewables and a wind generation capacity of 8GW onshore and 5GW offshore by 2030. It is estimated that materials related sectors will represent between 50-70% of the energy market turnover<sup>13</sup>.
- *Advanced materials for improved energy storage* (at lower costs and using more sustainable technologies to facilitate integration of renewables into the grid and the deployment of electric vehicles. These include post lithium-ion battery technologies, electrode and membranes for hydrogen production and novel cathode/anode materials for energy storage devices, essential elements of our Climate Action Plan (2021).
- *Materials for energy efficient, low carbon footprint buildings* including low carbon and renewable construction materials, integrated photovoltaics, advanced insulation, smart lighting, and advanced glazing. Demand will be driven by emerging policies and regulation including our national target of 10% decrease in embodied carbon in construction materials by 2030.
- *Materials for sustainable packaging*, which is fit for purpose, designed for circularity and recycling, compliant with European regulations for the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH standards) and suitable for use in multiple sectors including agriculture, food, MedTech, pharma and consumer goods. This will be essential for Irish industry to achieve the Climate Action Plan target of ensuring all plastic packaging is reusable or recyclable by 2030.
- *Materials for low power, high performance information and communications technologies*, including semiconductor chips, which will be critical for the European electronics industry to meet European Chips Act Goal of doubling current market share to 20% by 2030. This is of particular significance to Ireland with a sector providing over 20,000 high skilled jobs and contributing €13.5bn in export revenue and €450m of R&D spend annually.
- *Materials for health* including engineered biomedical materials and implants to restore function following disease or injury and improved diagnosis and treatment of patients with both acute and chronic conditions including those associated with ageing. Ongoing research in Ireland is informing the next generation of medical technologies including the development of digitally

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<sup>31</sup> COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Advanced Materials for Industrial Leadership (2024). Retrieved March 4, 2024, from [https://research-and-innovation.ec.europa.eu/document/download/0fcf06ea-c242-44a6-b2cb-daed39584996\\_en](https://research-and-innovation.ec.europa.eu/document/download/0fcf06ea-c242-44a6-b2cb-daed39584996_en)

enabled medical implants, systems and platforms and advanced therapy medicinal products which combines cells, genes, and materials for drug delivery. The medical technology sector is one where Ireland has an established global leadership position, with 450 companies employing 42,000 people and contributing over €12 billion in export revenue<sup>15</sup>. Ireland is home to 14 of the top 15 global MedTech companies – spanning multiple sites across the country and ever-increasing R&D by the MNC sector is now driving the formation of numerous new indigenous start-ups and SMEs.

- *Materials for new disruptive and unconventional technologies*, such as novel superconductors and superconductor heterostructures for quantum computing, semiconductor/metal high integration for cryogenic electronics, semiconductor/optical stacks for coherent quantum communication.

This will involve a coordinated approach across the members states with the formation of a Technology Council for Advanced Materials to align on EU, national and regional priorities on research and innovation with the provision of digital and physical infrastructure with financing provided through a number of Horizon Europe Instruments. As a small member state, it is important that Ireland has active representation and participation on the proposed Technology Council for Advanced Materials supported by a clearly defined **national strategy** which is aligned to our strategic priorities. This will ensure that we continue to influence to the emerging policies that will govern European innovation, industry and trade policies relating to advanced materials

### Investing in Education

The new Commission report "Investing in Education 2024" released in June 2024 highlights Ireland's performance in funding of education. "Public expenditure on education in the EU amounted to 9.5% of total public expenditure and 4.7% of GDP in 2022. At country level, the former varies from 14.6% in Estonia to 7.2% in Italy; the latter ranges from 6.3% in Belgium and Sweden to 2.7% in Ireland."<sup>32</sup> Whilst this can be attributed to Ireland to GDP being larger than GNP because of negative net factor income: income outflows are much larger than income inflows due to the presence of many foreign-owned multinational firms, which pay their profits back to their owners abroad, this stark ranking should not be overlooked.

**Action:** Prioritise membership and participation in European Technology Council for Advanced Materials supported by a clearly defined **national strategy** which is aligned to our strategic priorities

**Action:** Need for greater investment in education, including areas such as staffing and infrastructure.

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<sup>32</sup> <https://op.europa.eu/en/publication-detail/-/publication/b172797d-3752-11ef-b441-01aa75ed71a1/language-en>

## Recommendations / Actions

**Action:** Developing a committed plan for national Research and Innovation funding which aligns with ambitions regarding IMPACT 2030 and increasing Government Budget Allocations for R&D (GBARD) from the current rate of 0.35% GNI\* to 1.0% or at least .71% (EU 27 Average). This funding can address roadblocks and uncertainties that are unintended consequences of the SFI and IRC merger currently impeding the operation of the wider research ecosystem.

**Action:** Increased budget allocation for DFHERIS and Taighde Éireann-Research Ireland to meet the minimum EU agreed funding requirements for an Irish research ecosystem.

**Action:** Commit to a national standardisation of PhD stipends across all funding bodies and awards that aligns with minimum standards of living, initially €25,000 per annum.

**Action:** An immediate and dedicated report by SOLAS and the SLMRU to map the current and future needs of STEM careers now and on a continual 5-year basis to support IMPACT 2030 targets and beyond.

**Action:** Equip primary and secondary level education system to meet current and future standards as well as skill gaps in the delivery of fundamental STEM education via the curriculum and CPD of educators.

**Action:** A dedicated plan (based on a detailed survey of needs) for the maintenance and development of research infrastructure including a national materials characterisation centre with input from all relevant stakeholders and users of that infrastructure.

**Action:** Inclusion of two education representatives on the National Training Fund Advisory Board.

**Action:** Commitment of allocation of current and future NTF surplus to maintaining research infrastructure.

**Action:** Establish a National Science Forum chaired by DFHERIS with inter-departmental attendees and science stakeholders.

**Action:** Maintain and expand the Oireachtas Friends of Science & Technology Group to bridge gap between research, science, and policy makers.

**Action:** Establishment of a Government led and funded independent National Science Centre for public information and education.

**Action:** Prioritise membership and participation in European Technology Council for Advanced Materials supported by a clearly defined **national strategy** which is aligned to our strategic priorities

**Action:** Identify the needs of the tertiary education sector and plan appropriate funding investments, including areas such as, addressing national skill shortages and expertise gaps, staffing and infrastructure.