



Llywodraeth Cymru
Welsh Government



Review of Government Funded Research and Innovation in Wales

Professor Graeme Reid
For and on behalf of the Welsh Government



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Foreword

Research and innovation make vital contributions to the economy and society of Wales. They are underpinned by judicious investment from the Welsh Government. With continuing pressure on public finances, reforms to higher and further education in Wales and the approach of major changes in UK and EU funding, it was timely for the Welsh Government to commission a review of Government-funded research and innovation. I was delighted to have this opportunity to lead the work.

I agreed with the Welsh Government that my work should proceed quickly and that I should report around the end of 2017, before UK Research and Innovation (UKRI) is created formally, while Brexit negotiations are still underway and before education and research reforms in Wales are finalised.

I aimed to pursue a transparent process. Broadly speaking, I spent the first half of the review receiving evidence and meeting people from many parts of Wales and from UK-wide bodies with interests in Wales. During the second half of the review I shared emerging findings with stakeholders from business, local authorities, Government, further and higher education and refined my views in response to their feedback. Throughout the work I benefitted from advice from a distinguished panel of advisors and from Welsh Government officials, however, the conclusions and recommendations are mine alone.

I found enormous enthusiasm for the Welsh Government's ambition to use research and innovation to raise levels of productivity, build a stronger and more resilient economy, protect the environment and ensure the well-being of future generations. I have seen countless examples of talented, energetic people in business, universities, further education and local authorities already

working together towards these goals. I have come across wonderful ambitions and achievements in research and innovation from Anglesey to Newport and from Port Talbot to Deeside.

Research and innovation also contribute more widely to the image, culture and national identity of Wales and these vital contributions have been made clear to me throughout my review. Indeed, I see opportunities to give more prominence to research and innovation in the national narrative of Wales.

I have been guided by Cabinet Secretary for Education, Kirsty Williams, who said at the start of my review:

“Our aim is to make sure that every penny we invest in this area delivers the maximum benefit to the people and economy of Wales. I am looking forward to the education sector, business, learners and others getting involved.”

and by the Minister for Skills and Science at that time, Julie James AM, who said:

“The aim of this review is to look at all the investment the Welsh Government makes into research and innovation and how it is making a difference and what we can do to change things for the future as this area is vital to Wales' prosperity.”

This led me to follow three principles. I have recommended that Welsh Government resources are concentrated on cost-effective investments, in areas of high potential, where:

- only the Welsh Government can provide financial support – other sources of funding are not readily accessible in the public or private sector.
- Welsh Government funding not only provides a direct impact but also creates

incentives to deliver wider Welsh Government objectives.

- the historic dependence on EU funding can be replaced not only with Welsh Government money but also by even more success in UK-wide funding competitions and by attracting higher levels of business investment.

At a time of great pressure on public spending, these principles help align my findings with the wider agenda set out in the Welsh Government's strategy '[Prosperity for All](#)' in September 2017.

Describing that strategy, Cabinet Secretary for Economy and Transport, Ken Skates AM, said:

"Our new overarching strategy 'Prosperity for All', which the First Minister launched today, sets out a whole Government approach for a competitive and fairer economy that can help us increase health, wealth and well-being in all parts of Wales."

Throughout my review, I have been standing on the shoulders of Professor Sir Ian Diamond, whose perceptive examination of higher education funding and student finance arrangements was my starting point. I endorse all of Sir Ian's recommendations relating to research and innovation. I expand on them to take account of events that he could not have foreseen at the time of his report, including the £2bn yearly increase in the budget of UK Research and Innovation, the UK-wide industrial strategy and the consequences of BrExit for research and innovation.

When publishing the response to Sir Ian Diamond's review, Cabinet Secretary Kirsty Williams AM told the National Assembly Plenary in the Senedd, in November 2016:

"... I can therefore confirm that we are implementing, with only minor modifications, the full Diamond package, whilst also delivering a future dividend for further and higher education. This,

of course, would be subject to normal Government budget negotiations and process.

...Similarly, given the current economic climate, there are a number of recommendations with financial implications that will need to be considered as part of future budgeting rounds. These include recommendations on quality research funding, knowledge transfer, the Learned Society of Wales and the unhypothecated amount allocated to the Higher Education Funding Council for Wales's recurrent budget."

I have no overview of the range of public spending priorities in Wales. Only the Welsh Government can balance the many demands for scarce funding. My review contributes to the budget considerations referred to by the Cabinet Secretary in her Senedd statement.

I encountered long-standing structural weaknesses in the research and innovation ecosystem that put Wales at a disadvantage compared with other parts of the UK in funding competitions. That disadvantage has been masked by the availability of EU structural funds, whose future remains unclear. The growing budget in UKRI now presents major opportunities for businesses and universities in Wales to win sizeable amounts of additional research and innovation funding. There is no limit to the proportion of UKRI funding that can be won in these competitions and the benefits to Wales that would come from that success.

Only the strongest competitors will win. Funding not secured for Wales will go elsewhere in the UK. Against that background, I set out recommendations, building closely on Sir Ian Diamond's proposals, on how to sustain research and innovation competitiveness in Wales and contribute to *Prosperity for All*.



Professor Graeme Reid
University College London
22 December 2017




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Summary and Recommendations

Credit: Cardiff Catalysis Institute, Cardiff University



The contributions of research and innovation to economic productivity, population health and social well-being are widely documented. The research and innovation ecosystem in Wales is strong and includes strikingly successful examples of university-business collaboration and research impact. But the research base does not have the scale needed to deliver its full potential to the people of Wales.

Major changes are already underway in the research funding landscape in Wales and across the whole of the UK. The funding of post-compulsory education and research is being transformed in Wales. BrExit will bring to an end EU structural funds for Wales. Their replacement – the UK Shared Prosperity Fund – is at an early stage of development and its method of allocation remains unclear. Large funding increases in the new funding organisation UK Research and Innovation (UKRI) will open major opportunities to those who can win competitions. These changes will bring threats and opportunities to Wales. My review sets out proposals to grasp the opportunities and mitigate the threats.

I have observed weaknesses that, unless they are addressed, will hamper the Welsh research and innovation community's ability to adapt to the new UK funding environment. I have found great strengths and national assets in Welsh Universities and in research and innovation centres that have been developed in Wales during the last decade but I am not convinced that the potential of these assets is fully exploited for the benefit of Wales.

To respond to external changes and address the Welsh Government's national priorities, I propose that the research and innovation landscape undergoes major changes in the following ways:

1. BrExit will bring a major shift away from EU WEFO funding towards the competitive-awarded funding from UKRI, research charities and industry. The research and innovation community in Wales

will need to work together to become stronger and more influential in pursuing this competitive funding. The Welsh Government has a central role in driving through this change by setting pivotal incentive and reward structures for the whole research and innovation ecosystem. The Welsh Government should introduce a powerful, performance related, incentive and reward system, based on winning competitively awarded research and innovation funding from outside Wales. If Wales does not win this money in competitions, it will go elsewhere in the UK.

2. That initiative can only succeed if the research and innovation ecosystem is fit for competition. To that end, it is essential that Wales has at least parity in the levels of un-hypothecated research and innovation funding compared to the rest of the UK. The low level of this un-hypothecated funding relative to the rest of the UK has been a structural weakness in Wales for around two decades and is reflected in relatively low levels of funding secured in competitions at UK-wide and EU levels and fragile levels of business income in Welsh universities. This funding shortage can only be addressed by the Welsh Government: no other funding source is available. The degree to which this weakness is addressed will have a major influence on Welsh performance in the increasingly competitive UK-wide landscape for funding from UKRI, businesses and research charities. This recommendation has my highest priority.
3. The level of skills and knowledge within the Welsh workforce will need to increase significantly to deliver Welsh Government ambitions for enhanced productivity, competitiveness and prosperity. To drive up skills and employability across all abilities and address the requirements of the Well-being of Future Generations (Wales) Act 2015 (WBFG Act), it will be necessary, over time, to give wider access

to Welsh innovation funding so that Further Education Colleges, Research and Technology Organisations, business incubators and others can work together with Higher Education in new innovation hubs across Wales. These new innovation hubs could build on existing facilities and capabilities in Welsh Universities and research institutes, getting the hubs off to flying starts.

Recommendations:

To create these changes, I make the following recommendations, costings for which are at Annex 1.

Recommendation 1: I recommend that the Welsh Government increases the visibility and influence of Welsh research by creating a new Welsh Research and Innovation London Office (WRILO).

The creation of UKRI, its rising budget and the uncertainties associated with BrExit will shift the balance of opportunities for research and innovation funding from the EU towards the UK. To take advantage of these developments, **I recommend that the Welsh Government creates a new 'Welsh Research and Innovation London Office' (WRILO)**, ideally using existing premises in Victoria Street, Westminster, to increase Welsh contributions to UK-wide decisions and to:

- Act on behalf of the Welsh Government, Welsh Ministers and in the interests of the Welsh research and innovation community.
- **Identify and promote funding opportunities** for universities, businesses and research institutes in Wales arising at UK and international levels;
- **Attract talent and investment** into the Welsh research and innovation community from the rest of the UK and internationally along with the Sêr Cymru initiative and

- **Increase the visibility of Welsh research and innovation** outside Wales.

Recommendation 2: I recommend that the Welsh Government strengthens the Welsh research base and enables Welsh researchers to attract a greater share of UK-wide funding by implementing Diamond's recommendation for QR funding and creating an additional Future of Wales Fund specifically to incentivise Welsh researchers to win funding from outside Wales.

The Welsh Government is rightly enthusiastic about capturing a larger share of research and innovation funding from sources outside Wales. The Welsh Government has also accepted proposals from Sir Ian Diamond's review to protect QR funding at £71m yearly in real terms from 2016 onwards and introduce knowledge exchange funding at £25m yearly¹.

Sir Ian also recommended – and I support – further funding of £1m yearly for the Learned Society of Wales and £3.75m yearly for postgraduate research scholarships.

I endorse entirely Sir Ian's recommendations in research and knowledge exchange. I propose additional incentives to capture a larger proportion of growing budgets in UKRI and mitigate uncertainties arising from the BrExit process, each of which were unknown at the time when Sir Ian published his review.

Reinforcing the Welsh Research Base

Supporting Welsh researchers in an ever more competitive funding environment across the UK and aligning the purpose of such funding with the WBFG Act are high but achievable priorities. Implementing all of the Diamond recommendations, particularly for QR funding, should have the highest priority of all.

¹ <http://gov.wales/docs/dcells/publications/160927-he-review-final-report-en.pdf>

Once QR funding levels reach the level proposed by Diamond, I recommend the creation of a new funding stream, the Future of Wales Fund, which should be allocated to universities in direct proportion to the amount of **additional** funding they secure in competitions outside Wales. I recommend that £30m yearly (some 0.2 per cent of Welsh Government spending) is set aside for the Future of Wales fund.

This will enable the Welsh Government to deliver a system which will:

- **incentivise and reward those who attract further talent and leverage further research investment into Wales from elsewhere;**
- **protect and grow existing strengths in the Welsh research base;**
- **secure greater impact for Wales from that research base, not least on productivity levels.**

I leave the final decision on the operation of the Future of Wales Fund to the proposed 'Tertiary Education and Research Commission Wales' (TERCW) and the Welsh Government but I offer an illustration in the highlighted box 1 on page 23-24 of this document.

Innovation and Engagement support

Sir Ian Diamond recommended that HEFCW's funding for innovation and engagement activity should be re-instated, with funding of £25m yearly. I fully support that recommendation. However, the research and innovation and wider political landscapes have changed significantly in the meantime. I therefore propose that the reinstated Innovation and Engagement Fund should be distributed to universities on the basis of performance metrics, to incentivise universities to attract the highest levels of external income through collaborations with businesses and other partners.

The scope of this innovation and engagement funding should include the vital civic mission of universities.

This will incentivise and reward:

- **further increases to the scale of business collaboration with universities in Wales**
- **further increases in university collaboration with public sector bodies in Wales**
- **the attraction to Wales of collaborators from business, charities and public sector bodies elsewhere.**

Over time, I recommend that Further Education colleges should also be made eligible for the Innovation & Engagement Funding but that will require further work by HEFCW, TERCW and the FE sector to develop criteria for funding and performance metrics.

Diamond envisaged that the reinstated innovation and engagement funding would be used to support a small number of hubs and a competitive scheme for institutions and business. I strongly support Diamond's concept of hubs and competitions and I have recommended that these should form part of the proposed **St David's Investment Fund** set out under recommendation 3 to bring them closer to business.

Recommendation 3: I recommend that the Welsh Government increases the visibility, coherence and impact of research and innovation in Wales by creating a single overarching brand for its innovation activities: the St David's Investment Fund. This should be worth some £35m yearly in the first instance but with the potential to grow to £100m yearly or more, post-Brexit.

The St David's Investment Fund should consolidate the planning and presentation of support for innovation in business and the public sector from across Welsh Government and public bodies in Wales. Coherent planning and presentation should help businesses, science parks and other institutes

integrate Welsh Government support with that from agencies elsewhere in the UK by offering higher levels of visibility and coherence for a wide range of innovation activities in Wales. Coherent presentation will also help to raise awareness in the business community of the scale of opportunities in Wales. Funding and other support may well continue to be managed by a number of different areas of the public sector in Wales but those differences need not be on display. I recommend the St David's Investment Fund should:

- Be underpinned by a **new productivity roadmap and a coherent description of all public sector investment in business innovation in Wales.**
- Create **three industry-led innovation hubs** in the first instance, building on the recommendations by Sir Ian Diamond, each aiming to raise around £5 – £10m yearly together with other partners including City Deals, Sector Deals, Catapult Centres, the UK Research Partnership Investment Fund and Innovate UK to seize specific economic opportunities in Wales. Many sources of funds are available to support business innovation and, while Welsh Government will have a key catalytic role, I see no reason why it should be the largest source of funds for these hubs but the Welsh Government has a unique role in providing predictable, long-term support that provides a foundation for external investment. Experience in Scotland² suggests there would be advantages in recruiting directors and managers from the private sector while anchoring hubs in Welsh Universities or research institutes. These can provide administrative support and access to networks of businesses and researchers, particularly during the early life of each hub.
- **Run pilot competitions for time-limited projects that advance progress towards the goals in the productivity roadmap**, for example by attracting business investment in R&D into Wales and stimulating R&D investment from businesses already operating in Wales. These competitions should be explicitly aligned with the WBFG Act and should **usually** operate as public-private partnerships that respond to specific opportunities such as the proposed nuclear power and aerospace initiatives in north Wales and opportunities in the semiconductor, renewable energy or life sciences sectors in South Wales.
- **A distinctive approach is needed to promote business innovation in rural communities.** The population of Wales includes many geographically dispersed rural communities. By one analysis, around 1 in 3 people in Wales live in rural areas compared to 1 in 5 people in England. UK-wide industrial strategy focuses on cities and established industry sectors. There are already calls for a coherent rural development strategy³ for improving the infrastructure of rural Wales, promoting food, farming and forestry and boosting tourism. I, therefore, propose that the requirements for private sector financial contributions in economic growth hubs and time-limited competitions be relaxed in rural communities such as mid-Wales but that the longer term ambition for higher levels of business investment should remain.

The First Minister has stated clearly his intention to replace EU structural funds with funding provided directly from HM Treasury. Meanwhile the UK Government is developing a Shared Prosperity Fund⁴ to replace EU structural funds. I recommend that the research and innovation component

² <http://www.sfc.ac.uk/innovation/innovation-centres/innovation-centres-review.aspx>

³ <https://www.theplanner.co.uk/news/report-calls-for-city-deal-type-support-for-welsh-rural-areas>

⁴ <http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2017-07-03/2380/%20via>



of that funding – which should amount to some £65m yearly if EU structural funds for innovation are replaced fully – should be managed under the St David’s Investment Fund. It may be several years before the EU funding comes to an end and is replaced by HM Treasury. That will provide time to evaluate smaller, early investments before any larger sums of EU-replacement funding are available for investment.

Health Care Research

I have received little evidence or commentary on Health Care Research Wales (HCRW) compared to the amount of evidence I have received on research and innovation more widely. In any case, health research is handled separately from the generality of research and innovation in both Wales and other parts of the UK. The HCRW budget is lower, relative to the Budget for the English National Institute of Health Research, than I would expect from the size of the Welsh population relative to England but the shortfall in Wales may be explained by policy choices available to the Welsh Government. I hope that the shortfall is kept under review but I make no assessment of its impact on the efficiency and effectiveness of health care in Wales and no recommendation for its future scale.



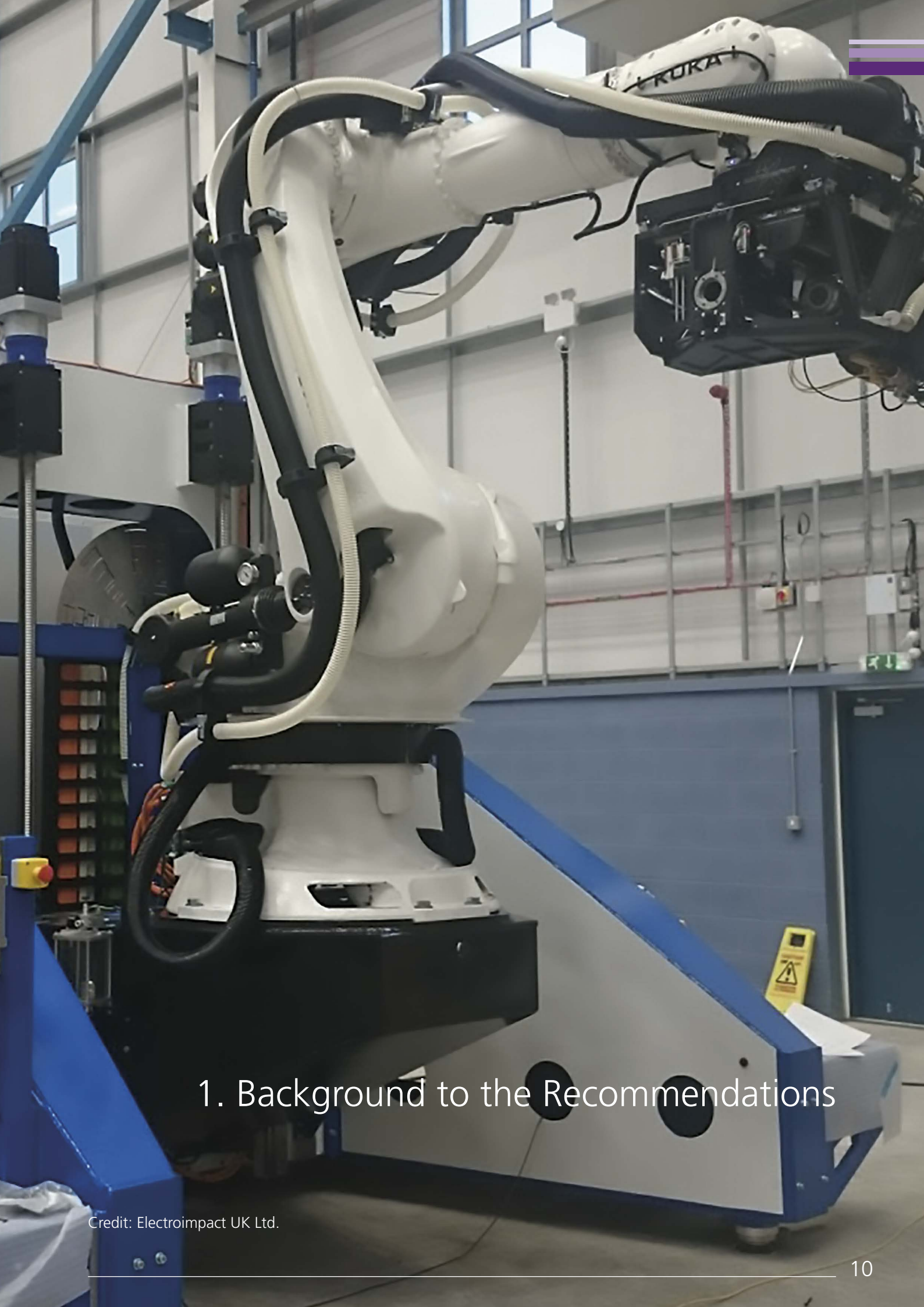
Acknowledgements

This review is largely an assimilation of views, observations and data provided by leaders in business, education, local authorities, government and other organisations. I have been fortunate in receiving so much help and advice, both in written evidence and in meetings during the review. I have had support from Research Councils, Innovate UK, Higher Education Funding Councils, technology transfer experts, medical research charities, membership bodies in the business and academic sectors, National Academies and members of advisory committees. I visited many universities, research institutes and innovation centres in Wales and each time acquired fresh insights and contributions for the review. But the same key messages reached me again and again and I have reflected them in my findings.

Officials gave me several tutorials on the internal workings of Welsh Government. Huw Morris provided wise advice and guidance at many points in the review. Robert Hoyle provided management and secretariat support throughout the process and the review would not have been delivered without his energy, enthusiasm and commitment. I thank each of them for their support.

In particular, I thank the distinguished panel of advisors, who gave so much of their time to the review. They were a wonderful team and a delight to work with. Each of them brought individual expertise and insights that proved invaluable at every stage of the work. Members of the panel are listed elsewhere in this report.





1. Background to the Recommendations

Credit: Electroimpact UK Ltd.

Research and innovation contribute significantly to economic productivity. Widely cited work by Haskel, Hughes et al. sets out theoretical and empirical evidence⁵ while research by Richard Jones⁶ (2016) explores the causes of the UK's stagnant productivity.

Research and Innovation also enrich cultural life and help Governments address societal challenges⁷. A full analysis of the rationale for public spending on research and innovation is beyond the scope of this review. Annex 2 describes examples of business/university collaborations and research impacts already present in Wales while Annex 3 summarises key literature and sources of expertise on research and innovation policy.

There is unequivocal evidence that high quality research and innovation are present across Wales⁸ but in smaller proportions than elsewhere in the UK. Research impact in Wales is higher than the UK average⁹ but Wales has a relatively small research community from which impact can be

delivered and harvesting impact from further afield often brings additional challenges.

Kevin Morgan's work for the National Centre for Universities and Business (NCUB), submitted in evidence to this review¹⁰, highlights the strength of the relationship between businesses and universities in Wales but there are specific opportunities to increase incentives and rewards for academic interactions with business.

The level of R&D investment in Wales, compared to other parts of the UK is shown in Figure 1.

Direct comparison between areas of the UK is not straightforward: each region will have its own distinct characteristics and some will have greater concentrations of research intensive industries than others. For example, London's uniquely strong concentration of financial services industries, company headquarters and major research universities influences the shape of its business R&D. Cambridge has attracted so much R&D

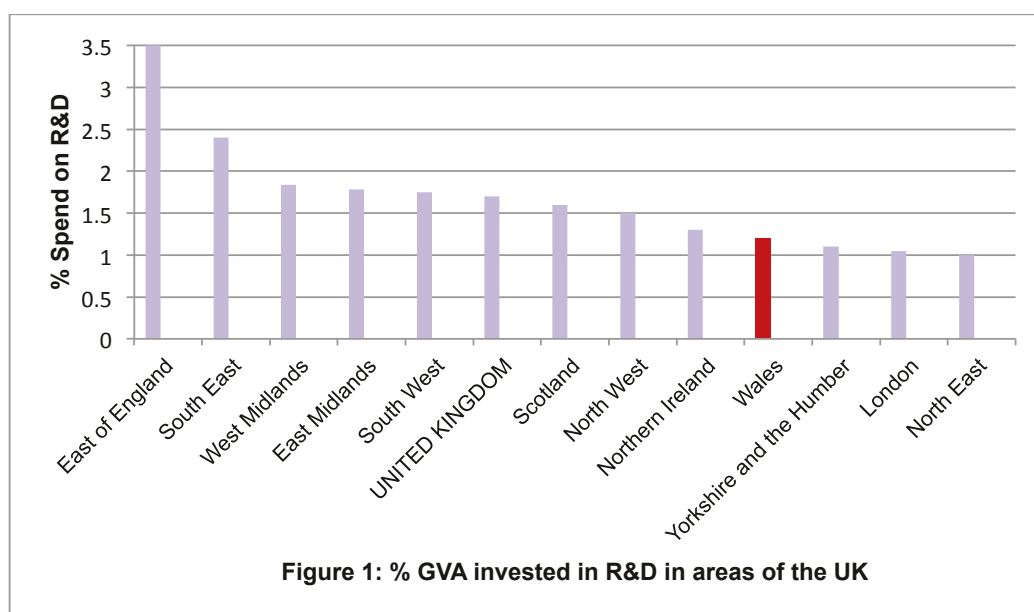


Figure 1: Regional expenditure on research & development performed in UK businesses, 2015 to 2016.

5 <http://www.sciencecampaign.org.uk/resource/UKScienceBase.html>

6 <http://speri.dept.shef.ac.uk/2016/04/14/new-speri-paper-innovation-research-and-the-uks-productivity-crisis/>

7 <http://www.esrc.ac.uk/research/research-and-impact-evaluation/economic-impact-reports/>

8 <https://www.learnedsociety.wales/our-publications/wales-and-the-world/>

9 <https://www.learnedsociety.wales/our-publications/impacts-academic-research-welsh-universities/>

10 <http://www.ncub.co.uk/blog/wales-a-strong-innovator> and Annex 4.

investment from global corporations that it propels the sparsely-populated East of England to one of the most research intensive areas of the UK.

Whatever the explanation, the level of investment in R&D is low in Wales but with a sizeable and encouraging level of growth as shown in Figure 1a. Examples, elsewhere in this report, suggest a close link between universities and business R&D, as is the case across other parts of the UK.

Low levels of R&D investment has been recognised for some time by Welsh Government. Its 2014 publication 'Innovation Wales'¹¹ stated

'Levels of R&D in Wales are nowhere near as high as we would like, and we do not win a large enough share of available competitive funding.'

More recently, Cabinet Secretary Ken Skates AM stated in the Foreword to the Welsh Government's report 'Science for Wales 2017', published in December 2017:

'This shortfall [in research capacity] has resulted in Wales, with some excellent, indeed, world-leading academics, still not winning the proportionate share of competitively-awarded research funding that it should.'

This shortage of research capacity along with other factors, contributes to low levels of productivity in Wales compared to the UK and many other OECD countries. Overall, hard work in Wales generates less wealth than the same level of effort in England and Scotland. That gives people in Wales a raw deal.

	£ million		
	2015	2016	% change
UK	21,038	22,224	5.6
North East	306	302	-1.3
North West	2,116	2,346	10.9
Yorkshire and the Humber	769	750	-2.5
East Midlands	1,531	1,655	8.1
West Midlands	2,159	2,303	6.7
East of England	4,200	4,393	4.6
London	1,892	2,296	21.4
South East	4,765	4,693	-1.5
South West	1,476	1,500	1.6
Wales	368	435	18.2
Scotland	953	1,072	12.5
Northern Ireland	501	481	-4.0

Source: Office for National Statistics. Note: Differences may occur between totals and the sum of their independently rounded components.

Figure 1a: Between 2015 and 2016 Wales had one of the highest growth rates in R&D in the UK, albeit from a low base.

11 <http://gov.wales/topics/science-and-technology/innovation/innovation-wales-strategy/?lang=en>

The Impact of BrExit

BrExit may well bring a reduction in R&D investment from the EU. The UK Government has guaranteed support for EU projects during a transition period¹². The increase of £2bn yearly in UKRI's annual budget is greater than the total annual amount of research and innovation funding the UK receives from the EU (£1.5bn, according to a report from the House of Lords Science and Technology Committee)¹³.

At a UK-wide level, most EU funding for research and innovation is won in competitions under the Horizon 2020 programme. In Wales, however, most EU funding for research and innovation comes through structural funds. That difference means that BrExit has distinctive implications for Wales.

The Welsh Government has set out a clear policy on the replacement of EU structural funds¹⁴:

'During the referendum campaign voters in Wales were assured that leaving the EU would not result in Wales being worse off and it is vital to public faith in political process that this promise is honoured. Replacement funding from UK sources must reflect current EU funding for regional economic development in Wales, agriculture and the countryside.'

The UK Treasury has made no public response so far to this Welsh Government position but the Conservative Party Manifesto for the 2017 General Election stated:

'We will use the structural fund money that comes back to the UK following BrExit to create a United Kingdom Shared Prosperity Fund, specifically designed to reduce inequalities between communities across our four nations.' (My italics).

'The money that is spent will help deliver sustainable, inclusive growth based on our modern industrial strategy.'

On 3 July 2017, Chief Secretary to the Treasury, Elizabeth Truss, told the Westminster Parliament:

"The government's manifesto committed to create a UK Shared Prosperity Fund. Further details will be set out in due course. The government has provided a guarantee for all European Structural and Investment Fund projects signed before the UK leaves the European Union (EU) if they provide good value for money and are in line with domestic strategic priorities. This includes projects that continue beyond the UK's departure from the EU." (My italics).

Plans for BrExit continue to evolve with proposals for a two-year transitional phase being proposed by the Prime Minister in her Florence speech in September 2017. If this transitional model of BrExit is adopted, it remains unclear when within the transition period EU Structural Funding would cease. If structural funds for R&D are replaced by HM Treasury and the Welsh Government maintains that level of funding going to research and innovation in Wales, this would maintain Welsh investment in R&D at 2017 levels. With sizeable increases in the UKRI budget¹⁵, however, that level will continue to lag behind the UK overall. Without Welsh Government intervention, there is a risk that the R&D investment gap between Wales and the UK overall will increase.

There is no realistic prospect of Welsh Government investment alone raising R&D levels in Wales to levels proportionate to the UK overall. Nor should that burden fall on the Welsh Government exclusively,

¹² <https://www.gov.uk/government/news/chancellor-philip-hammond-guarantees-eu-funding-beyond-date-uk-leaves-the-eu>

¹³ <https://publications.parliament.uk/pa/ld201516/ldselect/ldsctech/127/127.pdf>

¹⁴ https://beta.gov.wales/sites/default/files/2017-01/30683%20Securing%20Wales%C2%B9%20Future_ENGLISH_WEB.pdf

¹⁵ <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016>

when increasing levels of UK-wide funds are available to universities, research institutes and businesses in Wales.

Attracting R&D investment to Wales should therefore be a priority step on the path to:

- Contributing to higher levels of productivity in Wales;
- making Wales a more attractive destination for business investment; and
- persuading larger numbers of talented people to pursue a wide range of careers in Wales.

HM Treasury announced in the Autumn Statement last year, 2016, a £2bn yearly increase in UK-wide investment for research and innovation to be administered by UKRI, taking the UKRI Budget to some £6bn yearly and serving the research community across all parts of the UK. Further announcements were made in the November 2017 Budget.

There will be no Welsh quota for that funding: no upper or lower limit to the proportion of UKRI funding that can be won in competition. That could be good news for all parts of Wales – provided Wales can seize the new opportunities on offer. But action will be needed in Wales – in government, universities and business – if Wales is to capture at least its pro-rata share of UKRI budgets.

Wales could take advantage of these opportunities both to mitigate the expected fall in income from the EU and to grow the scale and impact of the Welsh research base to levels comparable with a larger number of OECD countries. Otherwise, money that could have been brought to Wales will go elsewhere in the UK.

Catching up with the competition need not be the limit of Welsh ambition. With judicious use of resources from the Welsh Government, this review sets out a realistic ambition for the research community in Wales to increase the level of research funding won in UK-wide competitions and

leap-frog ahead of some competitors' levels of investment in research and innovation, reaping corresponding levels of economic and social impact. This review also sets out practical steps towards that ambition through proposals for reforms to the incentives and rewards for universities in Wales and higher levels of Welsh input to UK-wide policy and funding processes.

Background to Recommendation 1

I recommend that the Welsh Government increases the visibility and influence of Welsh research by creating a new Welsh Research and Innovation London Office (WRILO).

BrExit and the creation of UKRI will shift the balance of opportunities for research and innovation funding from the EU to the UK. To take advantage of this development, the Welsh Government should create a new research and innovation office in London, perhaps using existing premises, to:

- Act on behalf of the Welsh Government, Welsh Ministers and in the interests of the Welsh research and innovation community.
- **Identify and promote funding opportunities** for universities, businesses and research institutes in Wales arising at UK and international levels.
- **Attract talent and investment** into the Welsh research and innovation community from the rest of the UK and internationally along with the Sêr Cymru initiative.
- **Increase the visibility of Welsh research and innovation** outside Wales.

The new office should not be responsible for significant levels of research and innovation funding, but it will need a budget for, say, 3 or 4 staff and associated costs.

The responsibilities of the Research and Innovation office should include:

- Attracting new candidates for the highly successful Sêr Cymru scheme; building

Welsh participation in the new Rutherford Fund; and expanding Welsh participation in existing international research and scholarship funds at all levels of higher education and research, such as the Newton Fund and the Kennedy, Fulbright and Chevening scholarships.

- Raising the profile of Welsh science and research in the FCO's international science and innovation network to identify more opportunities for Welsh participation in international exchanges and collaboration.
- Working with the Welsh Ministers to encourage leading academics and business people from Wales to seek appointment to governing councils and key committees in UKRI, the UK Government Office for Science (GO-Science), Research Charities and other bodies that influence research and innovation policy at UK and international levels. Ministers and the Chief Scientific Adviser for Wales could meet such office-holders once each year to learn of their experiences and ensure that they are aware of Ministerial priorities.
- The new research and innovation office should convene periodic meetings where experienced Committee and Board members can share their experience with prospective applicants from Wales.
- The research and innovation office should encourage Welsh leadership of initiatives by UK-wide bodies, following the example of Dr Drew Nelson and Professor Colin Riordan who lead the Growing Value Wales project for the National Centre for Universities and Business.
- The research and innovation office and the Learned Society of Wales should encourage UK-wide and international research and innovation bodies to hold more major events in Wales, following

the British Science Association's successful 2016 festival in Swansea.

- The research and innovation office will need a sponsor in the heart of the Welsh Government with which it agrees its business plan (objectives, resources, accountability, etc.) and to which it can report new opportunities for Wales.

Wales and the world

Wales produces 0.2% of the world's scientific knowledge but nearly half of Welsh research papers were internationally co-authored¹⁶. Researchers in Wales have already established networks around the world. The business and academic communities in Wales should use those networks to attract even more business investment, research funding and talented people to Wales.

UK-wide budgets for research and innovation will grow by £2bn yearly – about 30 per cent – following an announcement in the 2016 Autumn Statement. The UKRI budget for research and innovation is due to reach at least £6bn yearly by 2020-21. Research charities and research-intensive businesses have long histories of investing alongside Research Council and Innovate UK funding, taking the total sums dependent on their decisions to £10bn yearly or more¹⁷. The UK Government has re-stated and is now planning to deliver, a Conservative Party 2017 manifesto commitment to raise total UK-wide R&D investment to 2.4 per cent of GDP by 2027.

The distribution of UK-wide funding may change following the formal creation of UKRI and the earlier introduction by UK Government of overarching funding streams for the industrial strategy and global challenges. Meanwhile, EU funding for research and innovation in the UK will enter a period of uncertainty and may well decline following Brexit. Arrangements for the next

¹⁶ LSW's Wales and the World estimates that Wales quotes 2013 research (updated 2016) by Elsevier showing that Wales has 0.14 per cent of the world's researchers yet produces 0.24 per cent of the published papers.

¹⁷ The UKRI Budget is more than £6bn yearly; HEBCIS data shows UK universities external earnings are well over £4bn yearly. Further investment happens outside universities.

Research Excellence Framework assessment in 2021 are now taking shape following a review by Lord Stern¹⁸ and contributions from the then Chief Scientific Adviser for Wales.

It is critically important – and urgent – that perspectives from Wales are included in UK-wide policy formation during these changes. This will require more widespread contributions to research and innovation policy from the business and academic communities in Wales.

The scale and quality of research in Wales, particularly in Cardiff and Swansea Universities but also in Bangor, Aberystwyth and other institutions, is not reflected in the membership of governing boards and key advisory committees of UK-wide and international bodies responsible for policy and funding as shown in Figure 2 (based on October 2017 data). Early appointments to the advisory structure for the 2021 Research Excellence Framework show higher proportions of Welsh-affiliated members but these positions do not advise directly on funding allocations.

A similar distribution is evident if immediate sub-committees to governing boards are taken into the analysis.

The appointment of the UKRI Board reinforces this overall distribution. Members of that Board were never intended to represent geographic regions, business sectors or academic disciplines. That was clear from the outset of the appointments process. Nevertheless, the 12 Board members include one person affiliated in Scotland and 11 with English affiliations.

Background to Recommendation 2

I recommend that the Welsh Government strengthens the Welsh research base and enables Welsh researchers to attract a greater share of UK-wide funding by implementing Diamond's recommendation for QR funding and creating an additional Future of Wales Fund specifically to incentivise Welsh researchers to win funding from outside Wales.

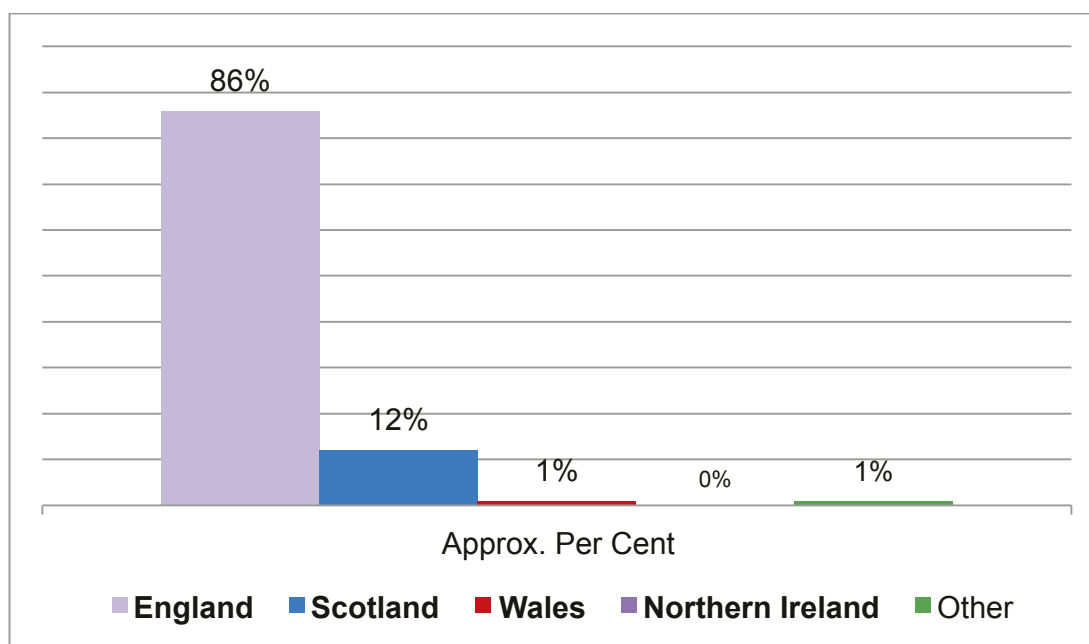


Figure 2: Geographic affiliations of members of Governing Boards of UKRI funding bodies in October 2017. 'Other' refers to a member who had unclear affiliation within the UK.

¹⁸ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541338/ind-16-9-ref-stern-review.pdf

The impact of Welsh research on the economy and society is built on foundations of excellence. That impact is already recognised and documented, most recently by the Learned Society of Wales. The pattern of existing impact demonstrates clearly the benefit to Wales of having clusters of the highest quality research with the freedom, agility and incentives to:

- **create and support major collaborations with business and public services** in all parts of Wales.
- **leverage funding from UK and international sources** into the Welsh research base through funding partnerships and collaborations with business, charities and other universities.
- **explore frontier areas of research** – the fields that subsequently attract business collaborators and develop into funding competitions from bodies such as UKRI and research charities.
- **attract talented research students and researchers** – the ones likely to win funding competitions at UK and international levels – at every stage of their careers by offering high quality infrastructure for research and a degree of stability and resilience that cannot be provided from unpredictable funding competitions.
- **recognise and reward research excellence** through the allocation of research funding in response to the internationally respected, UK-wide, Research Excellence Framework.

The Welsh Government should focus scarce resources for research and innovation on areas that:

- (i) deliver clear benefits to businesses, public bodies, charities and other organisations in Wales.
- (ii) have demonstrable potential to leverage further funding into Wales, thereby increasing the return on Welsh

investment.

- (iii) the Welsh Government alone can support rather than areas for which alternative sources of funding are available.

QR funding should be the highest priority in Welsh funding for science, research and innovation, reflecting the scale of benefit it delivers to Wales, both directly and through the leverage of resources from elsewhere. No other source of funding is available for this underpinning of the research base in Wales.

Research Funding

Without competitive levels of funding to support the underpinning capability, strategic initiatives to address specific economic and societal challenges in Wales would inevitably take longer to launch (as each one would need to wait for researchers to complete existing projects before becoming available) and would take longer to deliver impact (underpinning capabilities would need to be assembled before researchers could focus on the challenge they were set). In a fast-moving world, these delays could undermine the competitiveness of the research and its appeal to business investors.

QR funding mirrors the endowment funds available to major research universities in the USA and beginning to appear in larger research universities in the UK. Many well-informed observers attribute the high performance of UK and US science to the availability of sufficient unconstrained core funding, whether through QR or endowment funds.

Un-hypothecated funding for university research plays a fundamental role in the competitiveness of these institutions by providing the resources to:

- meet the cost of entering financial partnerships (sometimes at short notice) with other organisations.
- accept research grants from funders that do not meet the full economic cost of

research. Such funders include Research Councils, medical research charities and the EU.

- nurture researchers at early stages of their careers who are not yet ready to win research funding competitions.
- provide stable careers (rather than short-term contracts) for leading researchers in an environment where even the strongest teams will encounter gaps between competitively awarded research grants.
- support adventurous explorations at the frontiers of knowledge where exciting discoveries lay the foundations of research funding programmes.

The terms under which QR funding is allocated has a major influence over the incentives it creates. The Welsh Government's decision, following Sir Ian Diamond's review, to protect QR funding levels over the next few years will provide underlying support for the Welsh research base. But more recent decisions by the UK government may well bring an increase in QR funding for English universities, leaving Wales at a disadvantage yet again unless it keeps pace with English QR. As shown in Figure 3, Scottish Universities already receive higher levels of QR funding than their Welsh counterparts and secure correspondingly larger levels of Research Council funding.

Country	QR (%)	Research Councils (%)	Total Research Income (%)	Population (% of UK)
Wales	3.9	3.6	3.5	4.8
England	80.1	80.3	81.4	84.3
Scotland	13.7	14.7	13.4	8.3
Northern Ireland	2.3	1.4	1.6	2.8
UK Total	100	100	100	100

Sources: HESA Resources for Institutions of Higher Education 2015/16 (for all figures, except recurrent research funding). HEFCE, HEFCW and SFC Recurrent Grant Circulars, 2015/16 (for recurrent research funding only)

Figure 3: Percentage Share of UK Research Income by Country – 2015/16.

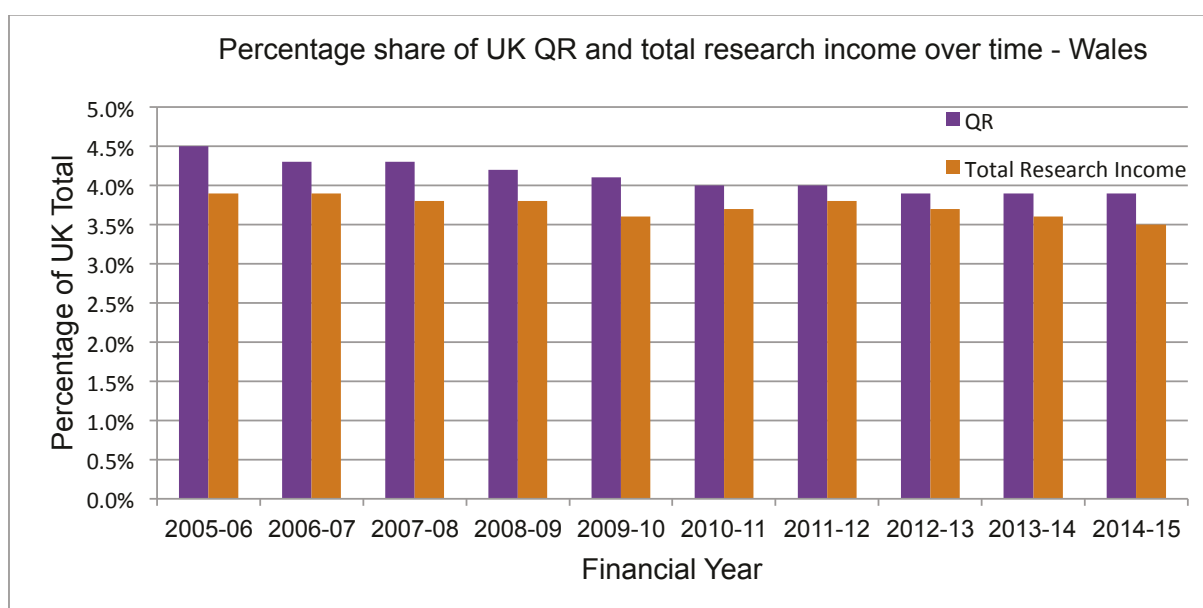


Figure 4: Percentage share of UK QR funding and total research income over time in Wales.

This pattern has persisted over a number of years, as shown in Figure 4.

Welsh universities will therefore continue to be at a disadvantage in competitions for funding and talent unless core funding in Wales keeps pace with the rest of Britain. As the Royal Society said in their evidence to this review:

'The 'Quality-related' funding stream is very important in underpinning research capacity within institutions, enabling them to compete effectively for competitive funding streams.'

The Wellcome Trust, the largest charitable funder of research and innovation in the UK, said:

'...Government money [for research and innovation] should be channelled through effective structures, including the UK's unique dual support system. This balances competitively-awarded grants to individual investigators with QR investment in universities....Wellcome continues to see the dual support system as fundamental to our investment in UK research.'

Figure 5 demonstrates a close correlation between the level of core QR funding and success in winning funding from Research Councils and other sources. It should be noted that this is a snapshot of one year only. A similar picture emerges if Research Council funding alone is considered.

Stagnation or reduction of core QR funding in Wales unavoidably undermines research competitiveness and brings consequent reductions in funding leveraged from UK-wide and international sources. In turn that dilutes the attractiveness of Wales to the most talented researchers, risking a spiral of decline. Only Welsh Government can provide this underpinning resource: no alternative source of core funding for university research is available.

Any portion of the UKRI budget not captured by Wales will instead go to other parts of the UK.

Sir David Grant, Board member at IQE and Renishaw, said:

"From a business perspective, I think you should persuade the Welsh Government

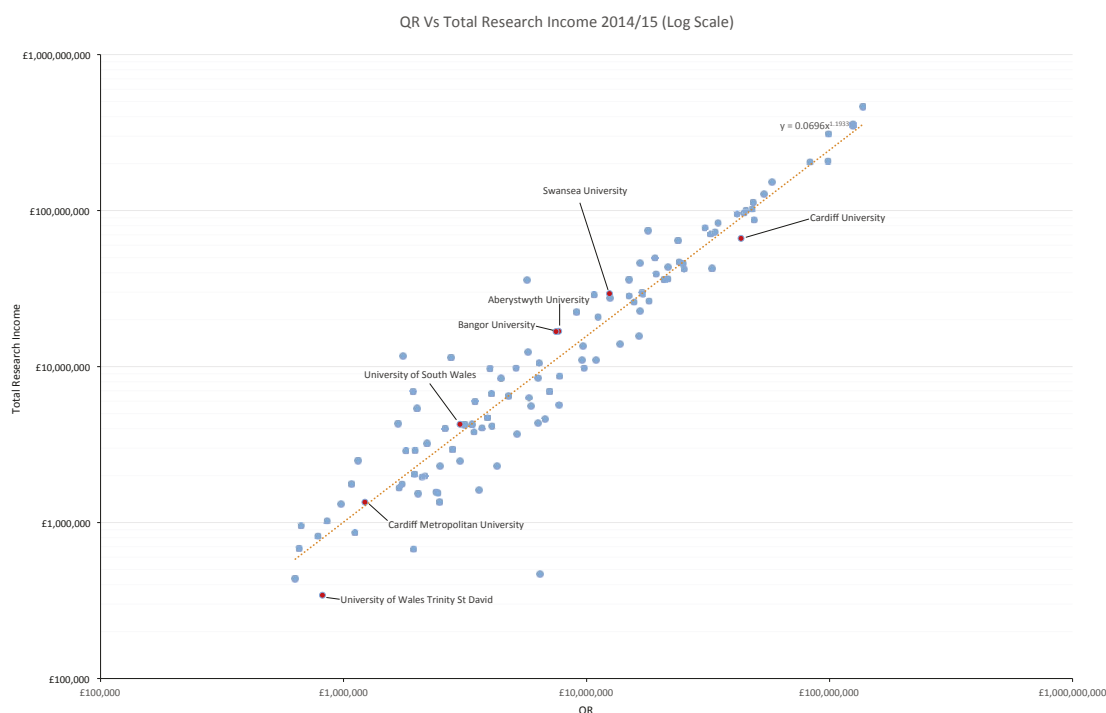


Figure 5: QR funding against total research income in UK universities (note – log scales). Source: HESA Finance Record 2014/15, UK Funding Council Data. For ease of presentation, institutions with zero QR values and the remaining lowest quartile have been excluded.

to invest larger sums in QR but sharpen up the purpose of the additional funding.”

Andrew Evans, Director, Commercial Services at SPTS Technologies, said:

“SPTS Technologies, an Orbotech company, is a leading supplier of etch and deposition process solutions and equipment for the global semiconductor and microelectronic industries. Our business is based upon understanding the needs of manufacturers producing the devices of today and the technologies of tomorrow. SPTS conducts all its global R&D, as well as driving its product and technology innovation, from Newport, Wales. Our key research and innovation is further strengthened by our longstanding relationships with Universities such as Swansea and Cardiff, with whom we have been involved in cutting edge research and pushing the boundaries of technology for over a decade.

This valuable cooperation would not be possible without the core research funding from Welsh Government that underpins universities’ capabilities and the innovation funding from both Welsh and UK governments that supports our engagement with academia.” (My italics).

Increases in the scale of the Future of Wales Fund should enable Welsh Universities to leverage further resources into Wales, exploiting the recent £2bn pa increase in UK-wide funding for research and innovation as well as increasing their share of the underlying £4.7bn yearly budget. Any portion of the UKRI budget not captured by Wales will instead go to other parts of the UK.

I have considered whether the QR funding could deliver greater value to Wales if it was focused on a preferred set of academic disciplines. There may be a superficial appeal

to that approach but the widespread, sometimes counter-intuitive, range of impacts together with the experience of both QR funding in other parts of the UK and large endowment funds in top universities in the United States leads me to the firm view that centralised planning of QR allocations could never foresee the patterns of impact it will generate and is more likely to diminish the value of that funding than enhance it.

An extensive analysis of the impact of academic research in Welsh Universities was carried out by Kings College London for the Learned Society of Wales¹⁹. Data from that work supports the proposition that research impacts occur across a broad spread of academic disciplines and geographic regions – as shown in Figure 6.

I have also considered whether the QR funding should be directed more strongly towards HE Institutions that deliver the greatest impact. Figure 7 uses data from the Research Excellence Framework to plot UK universities in rank order of research power (research excellence x volume) versus impact power (impact excellence x volume). The degree of correlation is so strong that I see every reason to continue allocating QR funding largely on the basis of research excellence. The assessment of research excellence in the UK has been refined over a period of more than 30 years and has won the confidence of businesses and academics around the world. From this and other data, research excellence is a strong predictor or research impact.

The Future of Wales Fund

Unprecedented increases in research and innovation funding at UK levels were first announced in the 2016 Autumn Statement and have been reinforced and expanded in the November 2017 announcement relating to the UK Government’s industrial strategy²⁰.

This time of change creates opportunities

¹⁹ https://www.learnedsociety.wales/?post_type=publication&p=11485/

²⁰ <https://www.gov.uk/government/news/record-boost-to-rd-and-new-transport-fund-to-help-build-economy-fit-for-the-future>

Unit of Assessment	Mid & West Wales	North Wales	South Wales Central	South Wales East	South Wales West	Total case studies
Clinical Medicine						0
Public Health, Health Services and Primary Care						0
Allied Health Professions, Dentistry, Nursing and Pharmacy			2	1	1	4
Psychology, Psychiatry and Neuroscience		2	1	1		4
Biological Sciences			1	1	1	3
Agriculture, Veterinary and Food Science	2	2	1	1		6
Earth Systems and Environmental Sciences	1	1				2
Chemistry	1		1			2
Physics	3	1	2		1	7
Mathematical Sciences	1	1	1	1		4
Computer Science and Informatics	1	1				2
Aeronautical, Mechanical, Chemical and Manufacturing Engineering						0
Electrical and Electronic Engineering, Metallurgy and Materials						0
Civil and Construction Engineering						0
General Engineering	2		1	5	1	9
Architecture, Built Environment and Planning				1		1
Geography, Environmental Studies and Archaeology		1		2		3
Economics and Econometrics						0
Business and Management Studies	1	2	2	2		7
Law	2	1	2	1		6
Politics and International Studies	1		1			2
Social Work and Social Policy		1	1	1		3
Sociology			1	1	1	3
Anthropology and Development Studies						0
Education						0
Sport and Exercise Sciences, Leisure and Tourism	1		1			2

Unit of Assessment	Mid & West Wales	North Wales	South Wales Central	South Wales East	South Wales West	Total case studies
Area Studies						0
Modern Languages and Linguistics	7	4	4	5	1	21
English Language and Literature	4	4	2	2	1	13
History	3	2	4	4		13
Classics						0
Philosophy	1					1
Theology and Religious Studies						0
Art and Design: History, Practice and Theory	1	1				2
Music, Drama, Dance and Performing Arts	5	1	7			13
Communication, Cultural and Media Studies, Library and Information Management		1				1

Figure 6: An illustration of the breadth of research impact: the table shows a sample of the impacts occurring in regions of Wales, categorised by the academic disciplines used in the 2014 Research Excellence Framework.

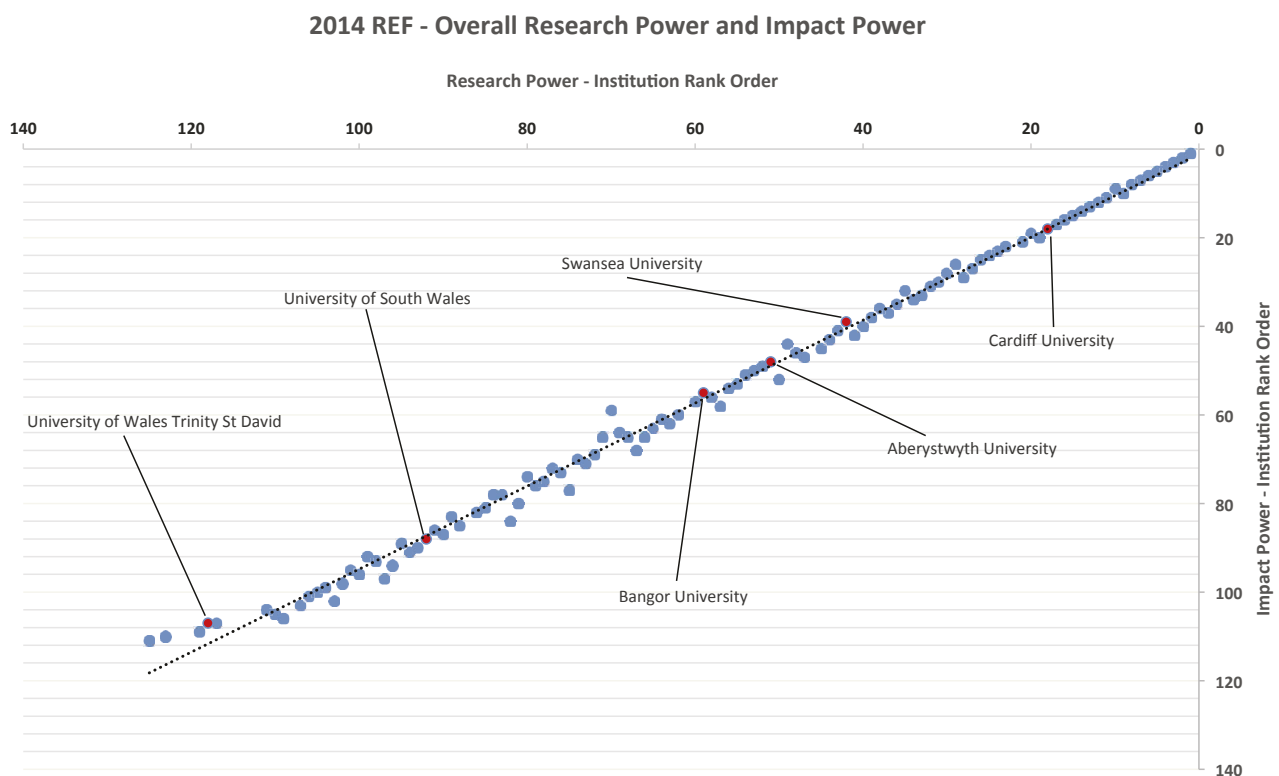


Figure 7: REF 2014 data comparing research power and impact power of universities across the UK.

for the relatively small, agile community in Wales to seize a greater share of UK-wide research and innovation funding. I therefore recommend the creation of a new funding stream – the **Future of Wales Fund** – that would have the specific purpose of increasing the proportion of UK-wide funding captured by Welsh Universities.

The incentive properties of judicious formulaic funding were demonstrated recently when the introduction of research impact to the basis of QR allocation provoked a significant change in culture and behaviour in the academic community, releasing previously untapped potential and demonstrating previously undocumented achievements in the academic community.

I propose a similar approach to stimulate greater levels of competition for UK-wide research and innovation funding, particularly through UKRI but not confined to that source. In the first instance, I suggest that the Future of Wales Fund should be focused on universities in Wales since they have the greatest capacity to capture UKRI funding. But I do not exclude the possibility of wider eligibility if state-aids requirements can be satisfied and robust allocation processes can be established. I leave it for the Welsh Government and HEFCW (or its successor) to design the detailed method of implementation but I offer an illustrative description here:

Box 1 – Illustrative arrangements for The Future of Wales Fund

The benchmark level of income from sources outside Wales could be defined for each university by calculating the average of the last 5 years income. Income from Research Councils, charities, businesses, international sources and elsewhere could be included.

Funding from HEFCW and Welsh Government would be excluded from current and future calculations. Funding from the EU would be excluded from current and future calculations at least until its future is clear.

In future years, funding secured above the current benchmark level from outside Wales would be calculated. For each pound secured above the benchmark, 50 pence from the Future of Wales Fund could be allocated to Universities, up to the maximum value of the Fund. (If the fund is oversubscribed, then the allocation would be scaled back proportionately for all recipients). The Future of Wales Fund therefore creates a guarantee for the Welsh Government that it will only be spent after additional funding is attracted to Wales. On the figures above, a £30m yearly Future of Wales Fund would attract a further £60m yearly to Wales.

The benchmark level should be updated every 5 years but no sooner than that. Otherwise the incentive properties of the Future of Wales Fund would be diluted by increasing levels of research income.

Once the Future of Wales Fund has been established, I would not be surprised if the level of funding

attracted from outside Wales continues to grow. At that stage, after about 5 years, the benchmark level could be recalculated and the level of incentive (50 pence per one pound, in the above example) from the Future of Wales Fund could be revised.

Also, once the Fund is established, funding might be weighted to align the incentives with wider policy objectives. For example, higher levels of incentive could be attached to business investment or investment in a strategic priority (dementia; nuclear technologies; air quality; etc.).

Some academic disciplines (e.g. life sciences and engineering) have more opportunities than others (e.g. humanities and arts) to win sizeable external funding through competitions. There is a case for weighting Future of Wales awards to compensate for that disparity. I leave it for HEFCW and, in due course, TERCW to decide whether to introduce such a weighting.

I have considered whether the Future of Wales Fund could replace a proportion of QR funding, rather than add to it. I advise strongly against replacing any portion of QR with the Future of Wales Fund. Such a replacement would risk encouraging larger numbers of competitive bids, without first supporting a larger number of strong competitors and without having funds available to cover the overhead costs of successful bids. Furthermore, Research Councils operate a so-called Demand Management System that can lead to sanctions against individual researchers who repeatedly submit unsuccessful funding bids.

Innovation and engagement funding

A distinct allocation of funding for business collaborations within the Future of Wales Fund raises the profile of this important activity and provides visible Government endorsement of external collaborations as valued parts of academic life. This endorsement has proved valuable in other parts of the UK and I have no reason to question its value in Wales.

Collaborations between universities and businesses are important features of the research and innovation landscape. The examples given in Annex 2, provided by Universities Wales, reveal part of the rich portfolio of collaborations already underway. The re-introduction of innovation and engagement funding would enable universities and businesses to take their collaborations to even greater heights. The allocation of that funding could be designed by TERCW to give greater incentive for universities to collaborate with SMEs and businesses in specific sectors (e.g. in rural economies).

Universities across the UK have diversified their research and innovation income substantially over the last 15 years or so. This increase is widely attributed to the introduction of financial incentives and rewards for innovation and engagement: the HEIF fund in England being the largest. The scale of that UK-wide increase is illustrated in Figure 8.

No other source of this funding is available. As shown in Figure 9, taken from Kevin Morgan's evidence to this review, equivalent funding in Scotland, Northern Ireland and England has grown in recent years, promoting growing income to universities from business, charities and other external sources. Such growth should return to university-business collaboration in Wales.

The consequence for Wales is illustrated in Figure 10, which compares external income to Welsh Universities with that to UK Universities overall.

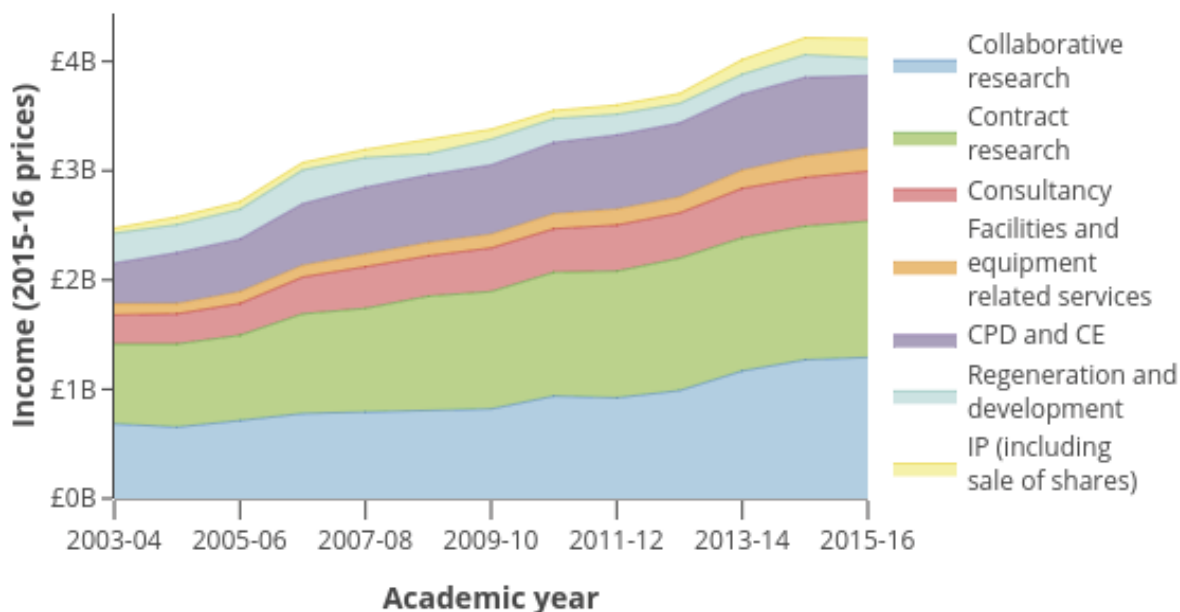


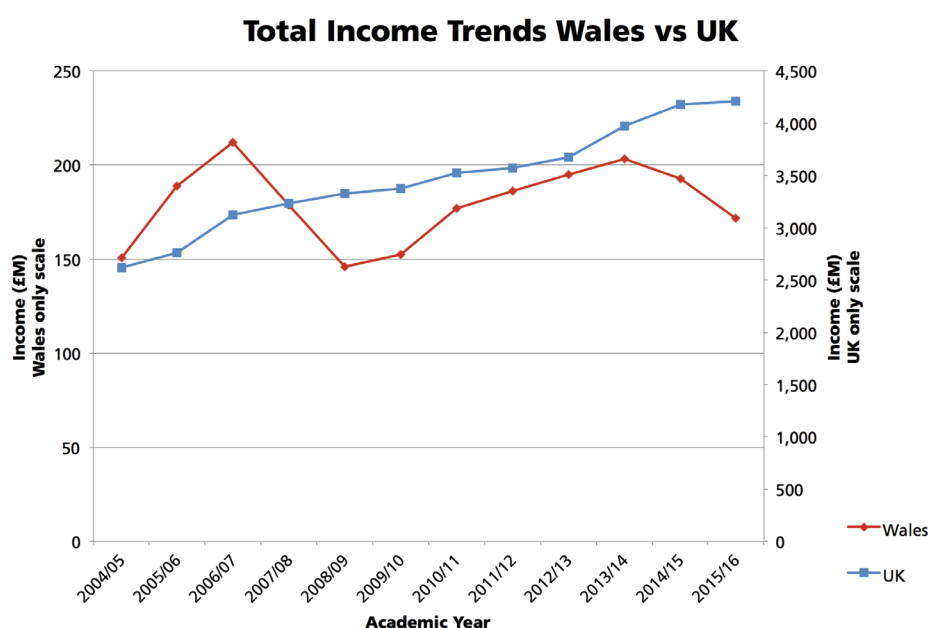
Figure 8: External income to UK-wide universities over the last decade.
Source: Data from the Higher Education Statistics Agency (HESA).

Country	2014/15 I&E budget	2013/14 KE income	2014/15 KE Income	% change In KE income
	£ million	£ million	£ million	
England	150	3200	3400	6
Scotland	17.1	412	453	10
Northern Ireland	3.96	93	121	30
Wales	0	201	193	- 4

Figure 9: Funding to promote university – business collaboration.

Notes:

1. English funding has grown more than 25 per cent in 2016/17, taking its 2016/17 total to almost £200m.
2. I&E = Innovation and engagement funding (from Funding Councils).
3. KE = knowledge exchange income (from business).



Note that Wales and UK totals are shown on different scales so they should be used with interpretation.

Figure 10: Total external income to universities in Wales and across the whole of the UK.

Background to Recommendation 3

I recommend that the Welsh Government increases the visibility, coherence and impact of research and innovation in Wales by creating a single overarching brand for its innovation activities: the St David's Investment Fund. This should be worth some £35m yearly in the first instance but with the potential to grow to £100m yearly or more, post-BrExit.

With a healthy level of QR funding in place to support the research base in universities and a powerful incentive system to encourage universities to win sizeable levels of funding from competitions at UK and international levels, the Welsh Government should create more coherent funding and presentation of innovation support for business, under a single new St David's Investment Fund, to promote the existing scale of this activity and achieve more effective engagement with investors, outside the Welsh government.

Moving innovation funding into TERCW?

The Welsh Government 2017 consultation 'Public Good and a Prosperous Wales'²¹ explores whether the Post Compulsory Education and Training Commission should have responsibility for business innovation as well as research and knowledge exchange. This proposal has not featured prominently in the written and oral evidence I have received but I offer the following personal observations.

Drawing on previous personal experiences of reforms to research and innovation funding, I suspect that the effectiveness of research and innovation support in Wales will depend more on clarity of purpose; definition of success; efficient execution and policy stability, than on the precise organisational structure. In other words, research and innovation support could work effectively whether or not innovation functions are absorbed into the new TERCW.

Whether or not innovation support comes under TERCW, teams of officials with different backgrounds, objectives and responsibilities will need to work together

21 www.consultations.gov.wales/sites/default/files/...

effectively for the benefit of businesses, universities and other organisations in Wales.

That said, if innovation functions are absorbed into the new Commission then:

- over time I would expect to see a healthy fusion of values and working practices across the HE, FE and innovation communities, along the lines experienced in Scotland following the creation of the Scottish Funding Council some years ago;
- there would be a single line of accountability (the Board of the new Commission reporting to Ministers) for the entire agenda; and
- there would be a single, more powerful, voice for research and innovation interests in Wales: but
- there would be a significant risk that higher and further education interests would outweigh those of business innovation and these risks would need to be managed and mitigated at both governance and management levels.

The creation of TERCW would be an opportune time to consolidate innovation programmes with HE and FE. I am therefore working on the assumption that innovation support will be consolidated under TERCW but my recommendations do not depend on it.

A Productivity Roadmap for Wales

The Cabinet Secretaries for Education and for Economy and Transport (responsible for science and research) should ask the TERCW and the new Chief Scientific Adviser for Wales to create a roadmap with milestones, through which HE, FE and business innovation can contribute together to higher economic productivity in Wales.

- That roadmap should integrate existing Welsh strategies for health research, computing, innovation and other relevant topics, ideally including infrastructure, regulation and skills. The roadmap should mark the beginning of a new, more

coordinated mission for research and innovation across the Welsh Government aligned with the WBFG Act.

- FE should be integrated into the productivity agenda, initially by the TERCW and FE Institutions preparing case studies on the impact of FE on the economy and society. Over time FE institutions should be encouraged to participate in projects supported by the St David's Investment Fund that will contribute to productivity gains in Wales.

The development of an implementation plan for the productivity roadmap will provide an opportunity to assess future needs for high level advice. I have been impressed by reports of the work of the Science Advisory Council for Wales (SACW) and the Innovation Advisory Council for Wales. The TERCW, the Chief Scientific Adviser for Wales and the Welsh Government will need to agree on their needs for advice in future.

Whether or not innovation support is moved into TERCW, the creation of a single consolidated Research and Innovation Advisory Council for Wales should be considered.

Innovation Hubs

With core funding for university-business collaborations in place, the Welsh Government should create three new innovation hubs, along the lines recommended by Sir Ian Diamond, supported in part from the St David's Investment Fund, to seize specific opportunities to support economic growth with research and skills.

Hubs will vary in size from sector to sector but experience from Scottish Innovation centres and Innovate UK Catapult Centres suggests that an indicative budget of £10m yearly in total for the three hubs would be sufficient to make a significant impact both regionally and sectorally within Wales, providing that significant further resources are attracted from sources outside the Welsh Government.

Each hub should usually be industry led with directors and managers having significant experience of working in the industries served by the hubs. Hubs could operate successfully under many different operational models but experience in Scotland²² and in several catapult centres suggests that they will deliver results more quickly if they are anchored in a university, research institute, or college that can provide back-office support, access to facilities and existing networks in the business and academic communities.

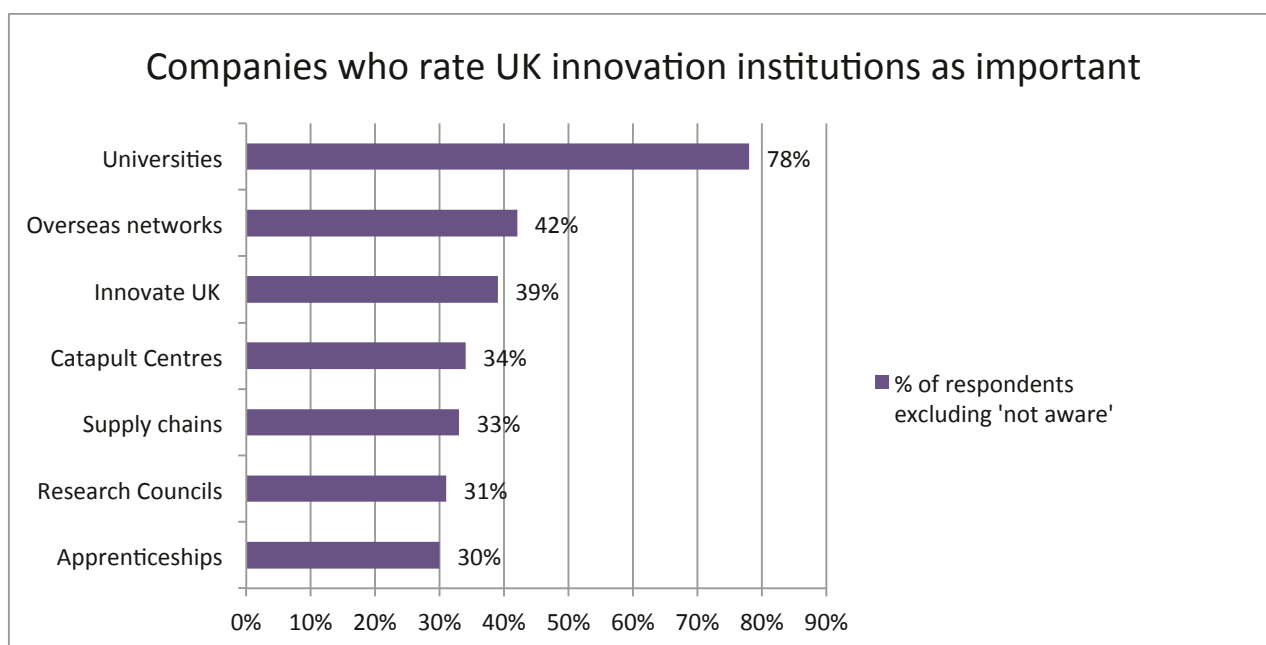
That approach resonates with the preferences of firms who rate innovation institutions as important to their business. CBI Wales submitted in evidence the chart at Figure 11, taken from the 2016 CBI innovation survey.

Of course other technology institutes and clusters, often related to universities, already provide invaluable expertise and capabilities aligned with specific business demand:

- Horizon Nuclear Power (a wholly owned subsidiary of Hitachi Ltd), is currently

looking to invest over £10bn in a new nuclear power station at their Wylfa Newydd site, Northern Anglesey. Bangor University and Horizon have already signed a Memorandum of Understanding which will enable both organizations to collaborate and work more closely together in future years²³. Nuclear power stations need a range of skills including physical sciences, natural sciences, health and behavioural sciences, business, administration and law. So staff and student briefings have been provided by Horizon and other partners such as the National Skills Academy for Nuclear and the Nuclear Graduates Programme to raise awareness of the sector and its opportunities.

- SPECIFIC²⁴ is led by Swansea University, with Strategic Partners Akzo Nobel, NSG Pilkington, Tata Steel and Cardiff University and a wide range of business and academic partners. It enables



Companies who rate UK innovation institutions as important
(% of respondents excluding 'not aware')

Figure 11: Preferences of firms who rate innovation institutions as important to their business.

22 <http://www.sfc.ac.uk/innovation/innovation-centres/innovation-centres-review.aspx>

23 <https://www.bangor.ac.uk/news/latest/bangor-university-students-succeeding-in-nuclear-27498>

24 <http://specific.eu.com/>

buildings to generate, store and release their own energy using only the energy from the sun. It was created in 2011 with a £20m commitment from the public and private sectors. This has allowed Swansea University to generate more than £40m of funding for allied projects. In April 2016, SPECIFIC began phase two of the project with £26m in funding from the Engineering and Physical Sciences Research Council (EPSRC), Innovate UK and the European Regional Development Fund through the Welsh Government, as well as further investment from Swansea University, the industrial partners and match funding from Cardiff University.

- The TWI Technology Centre (Wales)²⁵ is located in Port Talbot and focussed on industrial non-destructive testing. Its research spans the so-called 'valley of death' between academe and industry. It employs 33 people, of whom 23 are PhD and degree qualified. Funded from public sector, industry and competitively-awarded sources, its balance of funding gives it a degree of resilience to market fluctuations. Part of TWI Wales' success is its ability to connect industry with academia, by the use of industrial PhD schemes.
- In May 2017 Cardiff City Region, with Welsh Government, announced an investment of £37.9m to create a state-of-the-art foundry for compound semiconductor applications development and high-volume manufacturing. The Compound Semiconductor Cluster spans academic research and commercial activity and builds upon Cardiff University's strong capabilities in that area²⁶. The Cluster is a collaboration between IQE; Cardiff University; SPTS Technologies; MicroSemi; Infineon and others and is expected to leverage up to £375m of private sector investment over the next five years,

creating 500 high-value jobs. This Cluster has already been recognized by award of £150m funding from Innovate UK²⁷.

- In Aberystwyth University, IBERS²⁸ (the Institute of Biological, Environmental & Rural Sciences) is located in a strong agricultural area. Research at IBERS creates new knowledge that drives innovation through applied research, education and training for the benefit of society, nationally and globally. With partners in government and industry and award-winning innovation programmes, IBERS has a long-term commitment to the transfer of knowledge to help build a Knowledge-Based Economy, creating high-value employment in agri-food, energy, the environment and human and animal health, nutrition and welfare.

Clearly they are among the candidates to host innovation hubs. Many sources of funds for innovation hubs are available and I see no reason why the Welsh Government should be the main source of financial support. Instead, Welsh Government funding should be used as a predictable, long term foundation on which investment from other public and private initiatives can build. Sector Deals, City Deals, Catapult Centres, Innovate UK and various bespoke initiatives around the UK and internationally have already followed this approach.

I therefore recommend that, in most cases, the readiness of other public and private investors to contribute to a Hub is one of the key criteria, when selecting hubs for support.

Rural communities have geographically dispersed populations and fewer opportunities to attract external investment through UK-wide initiatives and private sector investors. It would be unrealistic to apply the same key criteria to the selection of innovation hubs. In rural communities higher

25 <http://www.twi-global.com/about/twi-group/twi-technology-centre-wales/>

26 <http://www.cardiff.ac.uk/institute-compound-semiconductors>

27 <https://www.gov.uk/government/news/compound-semiconductors-new-catapult-centre-in-wales>

28 <https://www.aber.ac.uk/en/ibers/about-us/>



levels of public sector support may well be inevitable in the first instance but the longer term goal of attracting business investment should remain.

Whether or not innovation funding falls within TERCW, the proposed post compulsory body should aim to expand the range of industry sectors collaborating with HE and FE institutions through smaller, pilot projects and experimental initiatives in tourism, food, financial services, agriculture, retailing and other sectors, each located near a cluster of sectoral activity across Wales. These experiments should explore new models for collaboration and may well inform the creation of future Economic Growth Hubs.

Making Wales even more attractive to business and charity investors in research and innovation

From time-to-time, as resources permit, the St David's Investment Fund should also provide time-limited funding for projects that are selected in competition. The competition (for a 'St David's research and innovation award') should invite bids from individual organisations or groups of organisations across Post-compulsory education; public sector, business and charities that:

- contribute to productivity gains or otherwise address economic or social challenges across Wales.
- are clearly aligned with the WBFG Act.
- leverage the largest sums of investment into the project from UKRI, EU (if available), charities and other sources outside Wales. Experience with the UK Research Partnership Investment Fund, which has already supported projects in Wales, suggests that as much as 2 to 1 leverage (i.e. £2 external investment for each £1 of Welsh Government investment) can sometimes be achieved but 1 to 1 leverage is often a more realistic ambition.
- attract new talent investment from businesses, research and technology organisations, charities or other innovation

and economic development bodies to Wales. This should include – but not be confined to – continuation and growth of the highly successful Sêr Cymru initiative.

Building on existing success

Science and research already deliver major benefits to the economy and society of Wales:

- Attracting and retaining business investment in R&D.
- Delivering highly skilled people to the labour market.
- Improving public services in areas such as health and social care.
- Enabling mature businesses to improve their performance.
- Creating new businesses.

Examples of existing collaboration between businesses and universities, provided by Universities Wales, are given in Annex 2. High quality research is often delivered in substantial clusters of activity concentrated into a few locations. This allows expensive facilities to be shared and a broad spread of expertise to be assembled in many different ways to meet research challenges. The intellectual stimulation of a large research community tends to attract the talented researchers that underpin research success.

Regions that host a large cluster of research tend to benefit from research impact, directly and through the enhanced ability to acquire those benefits from research conducted elsewhere in the world. But many regions of Wales benefit from the research conducted in clusters.

For example, Colin Sirett, Chief Executive Officer of the Advanced Manufacturing Research Centre in Sheffield told me that:

"Following proposals from industry and academia, in November 2016, Cabinet Secretary Ken Skates announced the establishment of an Advanced Manufacturing Research Institute in



Deeside. Recognising the compelling case for such an initiative to support the development of future manufacturing technologies in Wales, a £20m budget was assigned. This brings together Welsh industry, Welsh Government, Deeside Enterprise Board, AMRC (Advanced Manufacturing Research Centre), Coleg Cambria, Swansea University, Glyndŵr University and other Welsh Universities for participation in collaborative research projects.

Two open access facilities are planned, one in Broughton, one in the Deeside Industrial Park (final location to be confirmed). The Broughton facility will be operated by AMRC and, as such, will be recognised as part of the UK High Value Manufacturing Catapult. This will provide access for Wales to the HVM network and collaboration across the UK, attracting further funding. Working closely with industry, the £20m Welsh Government investment will be matched through collaborative and directed research projects.”

NCUB’s Growing Value Wales project²⁹ led by Dr Drew Nelson of IQE and Professor Colin Riordan from Cardiff University has received lists of existing and emerging ‘hotspots’, shown in Figure 12.

A new advisory structure, which consolidates the Science Advisory Council for Wales and the Innovation Advisory Council for Wales may well be given responsibility for identifying opportunities for new innovation hubs and time-limited projects under the St David’s Investment Fund. I can make no firm recommendation on the advisory process, until the responsibilities and governance arrangements for TERCW have been finalised but I offer that suggestion for consideration over the longer term.

²⁹ <http://www.ncub.co.uk/what-we-do/growing-value-wales-task-force>

Current 'Hot Spots'	Region	University
Compound semiconductors	SE Wales	Cardiff
Catalysis	SE Wales	Cardiff
Energy technologies	SE Wales	Cardiff
Creative sector	SE Wales	Cardiff/Cardiff Met./S. Wales
Life sciences/drug discovery	SE Wales	Cardiff
Hydrogen technologies	SE Wales	South Wales
Automotive and power systems	SE Wales	South Wales
Aircraft maintenance	SE Wales	South Wales
Design and product research	SE Wales	Cardiff Metropolitan
Plant/crop breeding	West Wales	Aberystwyth
Nuclear power technology	North Wales	Bangor
Advanced materials	SW Wales	Swansea
Energy technologies	SW Wales	Swansea
Non-destructive Testing	SW Wales	UW Trinity Saint David
Emerging 'Hot Spots'	Region	University
Cyber security	SE Wales	Cardiff/South Wales
Environment	SE Wales	South Wales
Digital manufacturing	SE Wales	Cardiff Metropolitan
Food and drink	SE Wales	Cardiff Metropolitan
Data science	SE Wales	Cardiff
Software	SE Wales	Cardiff
Parasitology/infectious diseases	West Wales	Aberystwyth
Food and drink technologies	West Wales	Aberystwyth
Advanced manufacturing	North Wales	Bangor
Energy and environment	North Wales	Bangor
Life sciences	SW Wales	Swansea
Computational science	SW Wales	Swansea
Construction innovation	SW Wales	UW Trinity Saint David

Figure 12: Existing and emerging hotspots of collaboration between business and universities demonstrate the wide geographic spread of opportunities for economic growth.





2. Reason for this Review

For many years in Wales, there has been a perception that the Welsh research and innovation scene has not been delivering the levels of success that it should relative to its population size with respect to the rest of the UK. For at least two decades, the proportion of competitively awarded research funds from the UK Research Councils has been around 3.0 per cent to 3.4 per cent of the UK total, despite the population of Wales being approximately 4.9 per cent of the UK's population. By comparison, Scotland has some 8.3 per cent of the UK population but attracts over 14 per cent of Research Council funding.

It has been argued by many that this shortfall in research income is a direct result of underfunding of the higher education research base over decades in Wales' universities by the Higher Education Funding Council for Wales (HEFCW) and by the Welsh Government (WG). These arguments of a shortfall focussed mainly on the number of researchers in Wales who could pursue those Research Councils who had the largest budgets, i.e. the Engineering and Physical Sciences Research Council (EPSRC) and the Medical Research Council (MRC) and that, with a greater number of researchers in these areas, the 'gap' in competitively awarded Research Council income coming into Wales could be closed. In recognition of this and in an attempt to make a statement of intent, **Science for Wales**³⁰ was produced in 2012 by the then Chief Scientific Adviser for Wales, Professor John Harries, acting on behalf of the Welsh Government. From this was born the Welsh Government's Sêr Cymru programme, which provides funding to recruit research talent from all over the world to increase researcher numbers in Wales.

Professor Peter Halligan and Dr Louise Bright have published, in 2015, more recent analysis of the case for expanding the capacity of the Welsh research base, to address Wales' lack of researcher numbers, available to compete for more research funding³¹.

In March 2016, Professor Ellen Hazelkorn published her review of post compulsory education and training in Wales. Titled **Towards 2030: A framework for building a world-class post-compulsory education system for Wales**³², her report recommended the creation of a new 'at arm's length' body from Government, which would be responsible for overseeing all Post Compulsory Education and Training in Wales (PCET). In order to integrate the full range of post compulsory education and training programmes in Wales, Professor Hazelkorn recommended bringing together and aligning Further Education, Higher Education, Life Long Learning, Adult and Community Education, Apprenticeships and other education activities which included post graduate (taught and research higher degrees) as a logical full extension of the term 'post compulsory education'. As much HE sector research activity involves significant learning and training, even at post-doctoral level (for example, the Welsh CRUCIBLE programme), Professor Hazelkorn recommended that all research and innovation activities and funding be included within this new PCET body. Furthermore, Professor Hazelkorn recommended that an independent review of research and innovation in Wales be conducted.

In September 2016, Professor Ian Diamond published his final report, titled **The Review of Higher Education Funding and Student Financing Arrangements in Wales**³³.

30 <http://gov.wales/docs/det/publications/120306scienceen.pdf>

31 Leadership Foundation for Higher Education report 'The Case for Growing STEMM Research Capacity in Wales' <https://www.lfhe.ac.uk/en/research-resources/research-hub/2015-research/the-case-for-growing-stemm-research-capacity-in-wales.cfm>

32 <http://gov.wales/topics/educationandskills/publications/reports/review-of-the-oversight-and-regulation-of-post-compulsory-education-and-training-in-wales/?lang=en>

33 <http://gov.wales/topics/educationandskills/highereducation/reviews/review-of-he-funding-and-student-finance-arrangements/?lang=en>

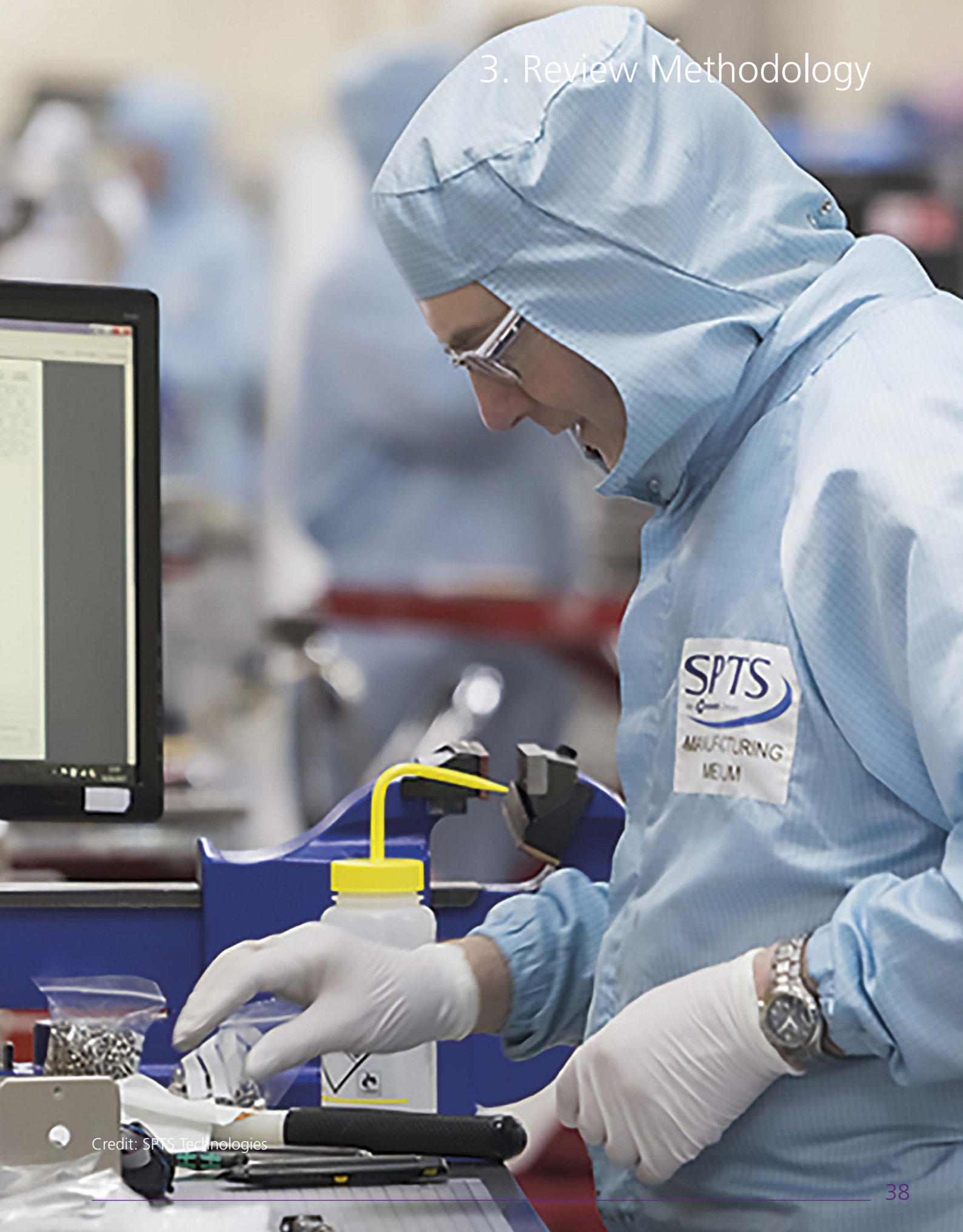


This recommended major changes in the Government funded support arrangements for HE students with a shift from partial funding of tuition fees wherever students study to a means-tested maintenance grant system, thus helping to alleviate much student living expenses hardship while being a student but at a cost of incurring longer-term debt in the form of student tuition fees loans. In making this transfer, the Welsh Government could expect to make considerable savings on student tuition fee financing which could be transferred to the post compulsory education sector as additional government financing. This has been termed the 'Diamond Dividend' and has been referenced expectantly by many stakeholders during the course of this Review.

The Welsh Government has accepted the recommendations made by both Hazelkorn and Diamond and is in the process of consulting on the implementation of both. Furthermore, this Review is the enactment by the Welsh Government of the Hazelkorn recommendation to undertake an independent review of government-funded research and innovation in Wales.



3. Review Methodology



Credit: SPTS Technologies

3.1 Timing

I agreed with the Welsh Government from the outset to do this review quickly, so that the findings and recommendations would be available before UKRI is formally in operation in April 2018 and before BrExit negotiations conclude as soon as 2019. Furthermore, with the publication of the Welsh Government's White Paper on 'Public Good and a Prosperous Wales – Building a reformed PCET system'³⁴ published in June 2017, the recommendations would be available in time to inform the development of the legislative programme in late 2017 or early 2018 for implementing the Hazelkorn reforms. Therefore, compromises on scope and depth of the review have been made but we are not aware of any great sacrifices in the quality of analysis made through these compromises.

3.2 Advisory Panel

I led this Review and the conclusions and recommendations are mine alone. In undertaking this Review, however, I was assisted by an Advisory Panel whose membership is given in Annex 5.

3.3 Call for Written Evidence

On 14 April 2017, invitations were distributed to key stakeholders within Wales inviting them to submit written evidence. An example of the invitation letter is shown in Annex 6, with the Appendix to this letter giving background at Annex 7. Responses were invited by 30 June 2017.

The written evidence was collated by Robert Hoyle from the Chief Scientific Adviser's Division. Dr Hoyle's summary of this evidence is shown in Section 4 and the Written evidence providers listed in Annex 8.

3.4 Oral Evidence Hearings

During April 2017, formal oral evidence hearings were organised with key stakeholders. These included senior figures from the Welsh HE and FE sectors, Welsh

industry, local authorities, the UK Research Councils, Innovate UK, the fledgling UK Research and Innovation, HEFCW and medical research charities. The starting point for these discussions were the questions listed in Annex 7. Many supplementary questions were also discussed.

During these formal oral evidence hearings, a voice recorder was used to record to keep a full account of the proceedings and these recordings will be made available, on request, from the time of the publication of this Review. The oral evidence hearings took place during May and June 2017 and are summarised in Section 5.

3.5 Informal Oral Evidence Hearings

Informal oral evidence hearings were conducted during April to October 2017, without the use of a voice recorder. The complete list of witnesses, for both formal and informal hearings, is shown in Annex 9.

3.6 Visits and other meetings

The schedule of these visits and meetings is in Annex 10.

³⁴ https://consultations.gov.wales/sites/default/files/consultation_doc_files/170620_reformed_pcet_system_final_en.pdf



4. Written Evidence Summary

The written evidence was provided in response to four questions. There were 29 responses to the call for evidence. For this summary, all the responses have been grouped according to the question but with the outliers either included under each question, as appropriate, or summarised separately. Further, within each question summary, the responses have been subdivided into three main groups: 1. HEI sector, 2. industrial and local authority sector and 3. informed body sector (charities, academies and societies).

Unless otherwise indicated, the universities will be referenced by their location name e.g. Cardiff University will be referenced as 'Cardiff'. When this has the potential to cause confusion, a fuller name will be used – e.g. Cardiff Metropolitan.

4.1 Question 1

How can future support for Government-led investment and support for research and innovation in Wales be aligned with the requirements of the Well-being of Future Generations (Wales) Act (2015)? What link should there be between the WBFG Act (2015) requirements and the economic and industrial strategy of the Welsh and UK Governments?

4.1.1 HEI sector responses and closely-related organisations, including HEFCW.

Wales needs to create the conditions in which a greater proportion of the added value is locked into the economy. Cardiff stated that 'both the Wales and UK Government interventions through the industrial strategy should focus on projects that support a number of sectors, anchor existing supply chains in the UK and encourage more to be based in the UK. More locally, Bangor suggested that R&I development strategies need to reflect regional differences in Wales and, where possible, align these to the UK Industrial Strategy.

The role of niche expertise was illustrated by Cardiff Metropolitan who called for 'Welsh

sectors that are not currently represented in the Industrial Strategy' to be subject to Welsh Government promotion as this offers more of a local Welsh flavour to research and innovation activities than would the UK Government's Industrial Strategy. For example, one niche area that were cited was Cardiff Metropolitan's Zero2Five Food Industry Centre, which brings together HE with FE (Coleg Llandrillo Menai), a County Council (Ceredigion) to facilitate pan-Wales innovation delivery through knowledge transfer supported by £11.9m Helix project from the WG Rural Development Fund. This has worked with over 200 food companies and has generated hundreds of manufacturing and technical jobs. Localised exploitation of expertise was highlighted further: HEIs working with the public sector have the potential to address some of the seven principles of the WBFG Act. For example, University of Wales Trinity Saint David (UWTStD) is working with Public Services Boards on crime, policing and safe communities and in doing so is addressing the goal of 'A Wales of Cohesive Communities'. Glyndŵr University noted that 'the UK Government's approach to industrial strategy acknowledges the need for the benefits to be spread more equally, a recognition of the fact that concentration of advantage, either regionally or within communities, does not lead to the maximum benefit in terms of 'healthy, resilient, cohesive, equal, [...and...] culturally vibrant' communities.

The need to align R&I more closely with the WBFG Act was explored further by the South East Wales Academic Health Science Partnership (SEWAHSP) who stated that funding 'could be targeted and will generally support one or more of the 7 well-being goals.' Swansea developed this theme further by suggesting that investment 'fit with the work of' the Future Generations Commissioner and, where appropriate, the National Infrastructure Commission for Wales' and the Future Trends Report.

There was a note of caution expressed by Bangor, who suggested that the seven WBFG Act goals should be as much as 'guiding principles' in funding strategy decisions, which need to be balanced against seeing them as 'specific objectives'. Aberystwyth echoed this by suggesting that, 'if the Welsh Government aims to support excellent science there must be funding/support available that is not tied to economic or well-being priorities but is curiosity driven'.

4.1.2 Business, industrial and local authority

TWI (Philip Wallace) stated that the WBFG Act provides 'a good underpinning' for future Government-led R&I in Wales and, although it does not dictate R&I strategy, it does provide the 'wider aspect' within which all proposed initiatives should be assessed. Rob Rolley of General Dynamics stated alignment could be achieved 'By developing a clear and tangible roadmap... of what interventions could deliver aspects of the vision outlined in the WBFG Act.' These 'interventions would help to define both a short and long-term plan of actions' with KPIs and 'success factors, against which investment can be sought' and these reviewed periodically 'to ensure the investments are delivering value against the agreed success criteria'.

To help align the support for innovation and business development with the WBFG Act, Andy Middleton of Tyf Group suggested that the Welsh Government could use the B Corp Assessment. Andy Middleton quoted Madeleine Albright (former US Secretary of State) '...the B Corp movement shows us that business, the driving force of our economy, can be an agent of change and live up to society's standards' for alleviating poverty, preserving ecosystems and building strong communities and institutions.

Byron Tucker, Tata Steel Europe, gave a clear message that 'A prosperous Wales needs to generate wealth'. He went on to suggest that future generations need to be appropriately trained and skilled, that there

needs to be a focus on STEM in schools and that undergraduate courses and post-doctoral researchers in manufacturing and advanced materials need to be aligned with major foundation industries such as steel and emerging technology companies with the aim of revolutionising manufacturing in the UK.

Business Development Wales suggested that modern R&I 'is often seen as 'out of reach' and only relevant to high tech businesses'. They agreed that 'we need to focus investment on the high value, high returns' market but that we should not exclude SMEs and micro-businesses having access to R&I resources.

4.1.3 Informed body sector (charities, academies and societies)

The Learned Society of Wales argued that the expansion of R&I funding is implicit in the WBFG Act. By stating 'The lack of funding for research and innovation is ensuring that Wales cannot compete with the rest of the UK and funding cuts mean we cannot adequately support the teaching of our doctors, health professionals, scientists and engineers. This lack of investment disadvantages the future for the people of Wales and the policies being followed are the opposite of those needed to support the WBFGA[ct]'.

The British Academy suggested that challenges facing future generations will only be tackled by 'the bringing together of knowledge and expertise from across the full breadth of research disciplines' as highlighted in their 'Crossing Paths' report. This report illustrates the barriers which prevent interdisciplinary research and the Welsh Government 'should recognise the need to facilitate an interdisciplinary approach to tackling these major challenges for future generations'.

4.2 Question 2

What can be done by the Welsh Government, Welsh universities and

the private sector to increase the competitiveness of the research and innovation landscape in Wales, thereby increasing the attractiveness of Wales as a place to undertake research and innovation and attract inward investment and investors from outside Wales, both in academia and in industry?

4.2.1 HEI sector responses and closely related organisations, including HEFCW.

A common, strong theme that emerged from this question was on the issue of innovation and knowledge exchange (KE) funding and its equivalent in England: Higher Education Innovation Funding (HEIF). In Wales, this is non-existent, having been phased out by the Higher Education Funding Council for Wales (HEFCW) in about 2014. Cardiff stated that that the EU Structural funds have taken the place of HEFCW's innovation and KE funding and, with the probable loss of much of this due to BrExit, KE activities were at great risk. Aberystwyth described how R&I in Wales' top universities had benefited enormously from EU structural funds which had helped build state-of-the-art research infrastructure, by bringing large teams of research experts together and by growing long-term collaborations with industrial partners. Most universities agreed and made a specific request for the reintroduction of HEIF given the impending demise of EU structural funds. Bangor called for the restoration of HEIF-type funding in Wales and that it should be based on the HEBCIS metrics and 'be distributed on hypothecated, flexible and sustainable principles' and 'within a strong, regionally relevant strategic framework centred on *place-based innovation*'. South Wales agreed with the HEBCIS suggestion and added that higher TRL-level R&I could be a major determinant in the award of HEIF funding, thus driving the emphasis to industry driven R&I rather than a university driven approach. Trinity Saint David suggested that HEIF 'funding can then be focused on the most effective KE (Knowledge Exchange) activities for the economy and society'. Further, South

Wales argued that HEIF funding should cover interdisciplinary R&I and that a 'sector based approach' be pursued in which, for example, 'psychologists and designers can work together with end users to design products and processes'. HEFCW argued that their equivalent 'Innovation and Engagement Fund (IEF)' should be reinstated and that 'The provision of baseline funding to support innovation and engagement related to activity in FE is long overdue'. The value of HEIF is recognised in the UK Industrial Strategy because it supports 'knowledge transfer infrastructure in English universities' and 'supports the REF Impact agenda' (HEFCW).

Aberystwyth suggested that there is a need to create better opportunities and incentives for higher investment in Welsh R&D partnerships and that 'industry push investments' be promoted by providing funding for both sides of the HE and industry engagement, thus promoting relationship building between them. HEIF would achieve this. Trinity Saint David developed this theme further by suggesting that FE should be part of the mix, i.e. that HE and FE should partner to provide a wide range of skills, training and R&I expertise in a 'back to basics approach with appropriate funding levers' to deliver a new system of technical education system fit for the use and benefit businesses in a modern economy. South Wales suggested that the Strategic Insight Programme (funded by HEFCW but discontinued) would be beneficial for driving short term cross placements between universities and industry or the public sector. This Programme encouraged the development of collaborative partnerships by the transfer both ways of staff on a temporary basis. This was key for development of each partner's understanding of the culture and ways of working of the other.

Swansea stated that 'With the impending loss of EU structural funding in Wales, it is incumbent on all the actors to create an environment where we can increase our market share of these 'hard to get'

investments. Key to achieving this step change is the importance of the HE sector in Wales continuing to produce world class, industry led research and innovation in collaboration with the private sector'. Further, Swansea states 'Regional R&I investment should not be perceived as an accessible alternative to the 'hard to get' funding', although adding that local investments have been a crucial stepping stone that has enabled researchers and the private sector build R&I capacity.

Swansea developed this comment further by suggesting that more work needs to be done by the Welsh Government, industry and the HE sector in Wales to define 'our collective offering', i.e. 'we must have a clear understanding of our proposition (USP)' (Unique Selling Points) and that 'the rich tapestry of research, innovation, high-level skills and infrastructure (in Wales)... needs to be packaged in a more coherent manner that underlines the Team Wales approach'.

The dual support mechanism for funding R&I was mentioned by Universities Wales (UW) and Tamsin Mann of PraxisUnico. One component of this mechanism is the un-hypothecated Quality-related Research funding (QR). UW and Cardiff Metropolitan called for HEIF type funding to be included as un-hypothecated funding. Aberystwyth stated that '...QR must remain un-hypothecated' and that 'great care must be taken not to weaken Wales' participation in the dual funding model of UKRI' and this was echoed similarly by Bangor who stated that 'Dual support is widely recognised as a fundamental strength of the UK's HE research infrastructure, so if Wales is to remain competitive QR funding is essential and must be maintained and grown over time'. HEFCW stated that R&I in Wales needs 'a competitive and sustained source of unhypothecated baseline infrastructure funding' and suggested that it be re-branded, possibly being called 'HERIO ('to challenge' in Welsh), SBARC ('spark' in Welsh) or FFRES ('fresh' in Welsh) funding.

There was comment about businesses, industry, recipients and beneficiaries taking a more active role in the research and innovation undertaken as envisaged in the role of the Catapults. Thus, Cardiff Metropolitan called for coordination with UK-wide R&I initiatives, for example, the Connecting Capabilities Fund and Research Partnerships Investment Fund (RPIF) and suggested that collocation and collaboration between industry, academic research and commercialisation. They gave the example of PDR (Cardiff Metropolitan's Centre for Product Design and Research), which combines leading research and consultancy. The emphasis on focussing on beneficiaries was described well by SEWAHSP who stated that research could be focussed on patient and clinically-led research such as through the 'Efficiency through Technology Fund and Research for Patient Benefit Scheme'. HEFCW suggested that a more targeted fund should be made available 'to support defined priorities ... or priority business sectors', such as that provided by Sêr Cymru Grand Challenges.

One area could be enhanced is the publication and promotion of R&I outcomes by industry and business. Aberystwyth suggested that 'Welsh Government should incentivise private companies to showcase their successful and current collaborations with Welsh HEIs that have or are likely to lead to Economic Impact'. This would illustrate the delivery of R&I services by the academic community in response to the 'pull' from industry.

Glyndŵr University suggested that there should be developed 'a scheme based at the university which is similar to Knowledge Transfer Partnerships but where the idea is at a lower level of maturity. This would entail Masters students being taken on, on an undertaking that their project is on an area, which is a potential development for the company'.

4.2.2 Business, industrial and local authority.

Business Development Wales suggested that we need to 'develop a culture where research and innovation is part of daily life and that in itself will attract inward investment'.

To achieve this, Byron Tucker suggested that new innovation centres such as the proposed National Steel Innovation Centre could create these conditions. Such centres 'will bring SMEs, supply chain partners and foundation industries together to generate new ideas and bridge the technology valley of death, thereby bringing promising ideas to commercialisation'. This was echoed by Dr David Owen who concluded that Wales should 'Initiate funding mechanisms to meet Proof of Concept/Valley of Death challenges'. Colin Sirett of AMRC stated that 'Collaborative R&D between Industry and Academia is based on stability of focus and environment' and suggested that the success of UK Government's 'Automotive Propulsion Council, Aerospace Technology Institute and Catapult Centres' is due to 'funding programmes that extend beyond any one Government Administration period'. Further, Andrew Evans of SPTS Technologies illustrates this point with the Compound Semiconductor Catapult which 'has already brought together both business and academia in the region' and which is 'an excellent example of industry leading academia'.

The issue of whether academia is leading industry or vice versa was explored further by Kellie Beirne from Monmouth Council and Chair of the Innovation Advisory Council for Wales (IACW). With regard to the meaning of innovation, she argued that 'Innovation is not a subject; neither is it a theme or programme – it is mind-set – a way of thinking that can be applied as we come to consider how we might solve some of the wicked issues and problems of today and tomorrow'. She went further by stating 'Innovation, therefore, cannot just be seen as 'belonging to science' and that a continued view of 'Innovation

as being most closely aligned to science and research' will not help productivity: 'Commercialisation, wealth creation and real-terms wage growth are the things that will help solve the productivity problem'.

To increase the competitiveness of R&I in Wales, Philip Wallace of TWI Technology Centre (Wales), argued that a clear map of Wales' R&I stakeholders and world-class excellence and capability is required – a capability map which would need to be realistic and believable. Further and perhaps most importantly, he argued for 'an overall research and innovation strategy with a real vision for the role of Welsh science and innovation in the world'. This world view was developed further by Mr Wallace and Colin Sirett, both of whom suggested that R&I needs to look outside of Wales for strategic collaborations, i.e. 'to gain a foot in the door' (Sirett) and 'world-class resources to support the Welsh strategy, either by collaboration or inward investment of money and people' (Wallace). Andy Wood of Qioptiq commented that 'Whilst the PhD route is relatively cost-effective for the company, the output from the sponsored PhD projects compared to what was promised in the programmes of work has been disappointing overall', adding 'Universities over-promise on what they will deliver and the output is strongly dependent on the capability of the student and the commitment of the supervisor'. Consequently, we need to 'Recognise that Universities and Industry have different agendas and (we need to) develop a new model for the support of industrial focused R&D'. 'There is an opportunity to establish Wales as the UK centre of expertise' in niche areas such as 'for optics'.

4.2.3 Informed body sector (charities, academies and societies).

Cancer Research UK (CRUK) stated that 'The medical research and innovation landscape in Wales would benefit from a strategic approach that is both ambitious and sustainable'. This would 'enable Wales



to carve a unique space for itself in the competitive international research arena'. This strategic approach should 'Ensure (that) the right balance of funding across basic, translational and clinical research is developed and maintained'.

The mapping of parts of the R&I landscape has been undertaken by Nesta in collaboration with the Welsh Government and IACW. Kirsten Bound from Nesta and IACW described the 'Arloesiadur' or 'Innovation Directory' initiative. This is a new way of looking at the innovation system and promises to increase competitiveness of the R&I landscape in Wales in two ways – internally by helping to identify opportunities for collaboration between organisations active in different research topics and disciplines and designing innovation interventions to harness these; and externally by promoting Wales to potential investors and partners.

Strategy and mapping of Wales' R&I assets was a theme explored by the Royal Academy of Engineering (RAEng). The Academy stated 'Wales needs to focus on creating an enabling environment, articulating a clear vision of an innovative, smart nation and promoting its success'. It called for mapping and in order to maximise the value of any mapping exercises, 'the Welsh Government should use the outputs...to enhance the breadth and range of connection opportunities, including links between the research, innovation and industrial communities, building on and promoting existing effective initiatives such as the semiconductor cluster' (RAEng). Further and in response to the opportunities presented by the UK Industrial Strategy Challenge Fund, the Royal Society stated that 'Small amounts of public investment in areas where little funding is available can have a bigger impact than their monetary values might suggest', thus could 'businesses (be) supported to take up emerging technologies (which) could help Wales to compete'.

RAEng discussed funding mechanisms and recommended 'that the Welsh Government gives increased priority to supporting knowledge exchange activities through the creation of a long-term flexible funding stream'. In further detail, the RAEng 'recognises that QR funding provides a valuable funding stream that allows institutions to achieve their own strategic objectives...in a rapid and responsive manner to pursue risky or innovative activities'. They called for 'QR to be maintained in real terms' in line with the Diamond recommendations. CRUK echoed this theme by stating that the 'Welsh Government should continue to recognise the importance of and support for Quality-Related (QR) funding as is reflected in their response to the Diamond review'. The British Academy developed this further, stating 'Maintaining the flow of quality related funding in particular to excellent research wherever it is found within Wales will be crucial for the ongoing competitiveness of its research and innovation landscape'. The Learned Society of Wales (LSW) extended this reasoning to expensive STEM subject undergraduate teaching.

There was considerable comment about R&I infrastructure; the LSW praised the 'very successful Sêr Cymru' programme as a means of building research capacity but this needs to be developed in a holistic manner by considering at the whole issue of expensive STEM undergraduate and postgraduate support as recommended by Diamond. High quality infrastructure was a theme explored further by RAEng and that 'enhancing the digital skills of the Welsh workforce ... will be fundamental to Wales' competitiveness across a range of sectors...'. The British Academy (BA) suggested that the Welsh Government 'should ... work with UKRI to identify potential new areas of growth that are appropriate to Wales' and gave the creative economy as an example which is growing fast in the UK and Wales.

On the business side, both the RAEng and BA suggested that business management skills and business finance are areas that require development: 'Moreover, effective adoption of technology throughout businesses and improvements in management and workforce skills are just as important and depend on the understanding and insight which HSS (Humanities, Social sciences) can bring' (BA). Although equity finance deals in Wales are comparatively low compared to the UK, 'there would be value in stronger promotion of these investments' (RAEng) that exist would 'demonstrate to investors and companies across the UK the opportunities available in Wales'.

4.3 Question 3

What can be done by the Welsh Government, business and universities to increase research and innovation income in Wales in the light of the implications of BrExit and the increased funding announced in the 2016 Autumn Statement and UK Government's 2017 Budget, the Global Challenge Fund and other, opportunistic Government funding opportunities?

4.3.1 Responses from the HEI sector and closely related organisations including HEFCW.

Swansea argued that 'More high level engagement between Wales and the UK Government is crucial in order to influence stakeholders at a UK level' and that 'A greater communication and dissemination of the USP (of Wales) is paramount to ensuring that Wales can secure a growth in research and innovation income'. Swansea went further in that they 'encourage the Welsh Government to explore strategic links with the UK government in attracting inward investment in a way that will strengthen the indigenous research and innovation base'.

Regarding BrExit, Swansea stressed 'the need to continue to welcome and recruit talented European staff, ... students and encourage outward mobility opportunities

for staff and students'. This was echoed by Trinity Saint David who called for 'continued access to Erasmus, MSCA programmes and Horizon 2020'. Further, they suggested that 'The sector could also work with the Inward Investment to explore opportunities in other countries ... and proposed links the UK Government is developing with the US and elsewhere'.

There has been a growing realisation that with the impending loss of EU structural funds and the changes taking place with UKRI, there is no overall guiding policy or strategy in Wales. Bangor developed this theme specifically by stating that Wales should 'Have a clearer national strategy and defined roadmap for delivery'.

The issue of any Barnett Formula consequential, in relation to the Industrial Strategy Challenge Fund, was developed by Cardiff Metropolitan who argued that this should be available to all the Welsh universities and not just the top four (Cardiff, Swansea, Bangor, Aberystwyth) as had been in a recent allocation by HEFCW. The justification for this appeared to be that, in the case of Cardiff Metropolitan, the funds 'could potentially be used to better effect' and, further, 'A competitive model could also be explored in anticipation of a Welsh allocation of Industrial Strategy funding'. HEFCW added that the Welsh Government should 'Commit to securing any consequentials arising from UK Government's ... additional funding for research and innovation' and that the Welsh Government should 'secure this funding for HEFCW to allocate for research and innovation activity in Wales'.

The consequences of BrExit were discussed by HEFCW, who called on the Welsh Government to 'Make the case for regional investment to replace EU (...structural...) funding in Wales' in line for example with the UK Shared Prosperity Fund promised by the Conservative Manifesto'. This is essential because Wales has used structural funds in

place of QR and HEIF funds for R&I capacity building; this is a theme developed by Cardiff who stated that 'Wales (and Cardiff University) has used EU funding to invest in infrastructure to a far more significant extent than universities in England'. The degree to which Welsh universities have become dependent on EU funds for R&I activities and capacity building and the need to have replacement funding was emphasised by Cardiff who stated that 'Cardiff would welcome assurances from Welsh Government that advances are being made to secure a viable future for this type of activity'. Again, but outside of EU or QR and HEIF funds, Cardiff calls for 'the continuation of initiatives such as Sêr Cymru to help retain competitiveness'.

Regarding QR, Cardiff states simply 'that QR funding remain at least at its current level of £71m'. Also, Cardiff states that 'Improved support from Welsh Government for the delivery of major projects, programmes and centre status applications would make applications and proposals from Wales more competitive'. Further, Trinity Saint David stresses that QR 'is vital for meeting the Full Economic Cost of research, helps fund essential organisational infrastructure..., contributes to .. physical infrastructure, (and) enables universities to leverage in additional research investment...'.

Trinity Saint David developed the theme of 'supporting KE activities where universities work with industry to deliver solutions' because these will increase levels of R&I and 'allow companies to grow'. They gave the example of 'non-destructive testing where the University works with the three major global and national NDT companies – TWI, Oceaneering and Silverwing'. As stated during the Reid visit to TWI, TWI values this relationship with Trinity Saint David very highly. The Knowledge Economy Skills Scholarships (KESS) managed by Bangor have played a major role in providing the funding necessary to promote industrial and academic knowledge exchange partnerships.

Bangor states: 'KESS is an excellent exemplar of how a skills focussed programme can deliver measureable benefits to businesses in Wales'. Bangor goes further, suggesting that 'Initiatives to retain highly qualified young people in Wales are required – such as PhD studentships for Welsh students studying in Wales' and extending this to 'MScs etc'. The support for KESS was echoed strongly by the SEWAHSP who 'has been very engaged with ... KESS2'.

The issue of who or what type of organisation is best placed to manage research and innovation funds was addressed by HEFCW, stating 'Funding collaborative research, development and innovation project activity between business and universities should remain a Welsh Government role' and 'Welsh Government has a distinctive role to support research, development and innovation activity in the business sector', but does request that 'mechanisms to ensure that HEFCW (or its replacement body) can provide input to decision making processes need to be hard-wired into our structure'. It is implicit in what HEFCW writes elsewhere that the QR and HEIF funding for universities and, possibly, FEIs should be part of its operation or that of the replacement (Hazelkorn) body, i.e. at arms length from Government. This suggests that HEFCW sees the future funding arrangements as being very close to the current funding landscape.

4.3.2 Business, industrial and local authority.

Kellie Beirne from Monmouth Council and IACW was explicit in suggesting that a post-BrExit state offers the chance to forge different collaborations and seek new opportunities. 'A far more far-sighted approach to unlocking innovation potential would take us beyond the buzzwords and jargon – big data, automation and AI – to demonstrating how such emergent technologies have applicability to Wales' wicked issues and challenges. Operating a 'challenge-driven' approach to defining

problems and developing solutions
..... in order to build solutions that are transformative, truly disruptive and capable of bringing about long lasting benefit to Wales'. Further, she states 'We cannot keep doing the same things and expecting different and better outcomes and relying on the 'usual suspects' to guide and dictate pace. It is time to disrupt the thinking that got us to this point in the first place'. She goes on to describe the creation of 'a National Innovation Body as the best means of creating a distributed system of innovation (which could) ... deliver a number of measureable and distinctive benefits that simply could not be realised through a government-led approach'. This is in contrast to the view held by HEFCW.

The issue of what R&I should be pursued was explored by Business Development Wales who suggested that Wales needs to 'Develop a focus' and asked '– what are we good at? – what are our strengths? – what do we have that is of value to others? – who needs this knowledge, landscape, environment, etc'. These are questions which will help define the 'challenge-driven' approach advocated by Kellie Beirne.

Philip Wallace of TWI suggested that 'Coordination of all resources leads to effective proposals and projects' and that Wales needs to 'Be realistic where partners are needed outside of Wales – partner with the best'. Further, he suggested that 'Strategic use of Welsh money (is used) as seed funding for attracting further funding' and that Wales needs to avoid 'too many ad hoc activities'. This points to his earlier point and similarly to that of others, that Wales needs 'an overall Welsh strategy' for R&I.

Rob Rolley stated that 'There is not a shortage of challenges' but 'the challenge is translating them into a need. Health, education, transport, energy, skills etc. – we need to be visible and active on the global stage and not continue to lick our wounds regarding BrExit'.

4.3.3 Informed body sector (charities, academies and societies).

The Learned Society of Wales responded by stating Wales 'needs to have a vision and a clear strategy. It needs to fight for funding for regional capacity development and it needs to ensure that appropriate people and structures are in place to drive programmes', mentioning Sêr Cymru and Compound Semiconductors as examples of successful models. CRUK stated that 'There should be a long term and sustainable commitment to initiatives to attract scientists to Wales, such as the Sêr Cymru initiative.' They extended this to include 'adequate provision of research nurses and clinical trials support staff in the NHS Health Boards'. Further, LSW requested that an 'agile approach should be applied which enables advantage to be taken of emergent opportunities – so-called 'strategic serendipity'".

The Royal Academy of Engineering stated 'As the UK proceeds ... to leave the EU, it will be essential that measures are put in place to ensure continuity of funding streams to support this type of research and innovation capacity and capability building in Wales in the future', especially 'where EU funding has been particularly catalytic and effective in Wales'. This was echoed by the British Academy who suggested 'The Welsh Government, alongside the UK Government' could seek to advocate for the UK's continued involvement in EU funding programmes'. Cancer Research UK echoed this in more detail stating that the 'Welsh government should prioritise alignment with the new EU Clinical Trials Regulations' because 'The ability for UK researchers to collaborate with European counterparts is key to conducting research for paediatric patients and those with rare diseases'.

4.4 Question 4

What is the optimum balance between (a) geographically focused use of funding and (b) focus of funding on existing research and innovation



excellence and capability, bearing in mind the Cabinet Secretary for Economy and Infrastructure's new regional approach to economic development?

4.4.1 HEI sector responses and closely related organisations including HEFCW

HEFCW was clear in this point stating 'Our view is that the bulk of funding for research should be directed towards supporting research excellence, based on outcomes of the UK-wide (REF) and volume of activity'. However, 'it is possible ... to operate formula-based funding "strategically"'.

The universities were more equivocal. Bangor stated that 'There is a strong case that there should not be a trade-off between (a) and (b). Instead an appropriately 'smart' strategy would maximise the synergy between geographical focus and focus on excellence, to produce the best outcome with maximum net benefit'. Similarly, Cardiff's response was 'We welcomed the UK Government's commitment to the place-based approach within the Industrial Strategy Green Paper, whilst stressing the importance of any investments being based on research and innovation excellence'.

In addition, 'Cardiff Metropolitan supports geographical investments in initiatives such as the Cardiff Capital Region and in the development of clusters; however funding based on capacity-building and capability linked to Welsh priority areas rather than the status quo or geography is likely to drive R&I competitiveness'. Cardiff Metropolitan went on to say 'Niche pockets of excellence within challenger universities could support the new regional approach' of the Welsh Government and that 'Fostering emerging excellence in areas that will be strategically important in the future could be an innovative use of replacement structural funds'. Further, Cardiff Metropolitan suggests that Welsh strengths could be aligned collectively with components of the Industrial Strategy and that the Welsh Government could 'facilitate discussion with UK Government on' this collective

contribution to the Industrial Strategy.

Swansea recognised that 'Wales has benefitted hugely from geographical research and innovation funding as a result of investments' from a range of EU structural funds programmes which themselves are differentiated on a geographical basis in Wales.

Perhaps a good solution could be as South Wales suggested: 'By maintaining the dual funding system we believe a healthy balance can be achieved between regional funding and funding excellence wherever it is found'.

4.4.2 Business, industrial and local authority

Philip Wallace of TWI suggests that, as 'Wales is a relatively small country', there should be 'No need to duplicate existing facilities' and that Wales should 'Support what is already available', implying the R&I infrastructure which is supported by QR and that 'ensure existing resources work for all of Wales'. He goes one to say that 'Where there is a need for new facilities, then location can be key, but selection should be based on technical concerns primarily and economic concerns secondly', i.e. by placing facilities where they will be best supported and used rather than on a geographic distribution. This is developed in more detail by Byron Tucker of Tata Steel who stated 'Tata Steel has found that geographical proximity to manufacturing is important, particularly for the realisation of innovation in manufacturing processes and to realise process developments demonstrated at laboratory scale'. For other R&I activities, he states 'The case for concentrating funding on existing and successful R&I assets.... is that of critical mass. Spreading resources too thinly can be counter-productive'. Hence, it depends on the nature of the R&I activity, whether it is of lower TRL levels R&I or whether it is close to market (higher TRLs), which should determine where investments in R&I are made. Business Development Wales suggested a similar theme by stating 'the investment should go where the returns



are high', i.e. concentrated on 'growth orientated enterprises'.

4.4 3 Informed body sector (charities, academics and societies).

The Learned Society of Wales stated 'there is a need to fight for a specific and significant part of the funding released by the UK Government for research and innovation to be allocated directly to Wales'. The distribution of this in Wales could be based on 'the City Deals and the north Wales links with the Northern Powerhouse. The development of nuclear engineering research at Bangor and the links with Horizon are examples of exciting possibilities which could benefit a large geographical region'.

Cancer Research UK thought that maintenance of a dual funding mechanism in Wales 'will help ensure that important research areas are protected at the same time as investing in emerging areas and developing talent'. This was echoed by the Royal Academy of Engineering who stated 'The Academy believes that while excellent research should be funded where it is found, geographically focused funding has a significant role to play in supporting innovation excellence and capability'. The Academy introduced the concept of 'Innovation Assets' i.e. the use and exploitation of existing infrastructure to support new innovation in defined geographical areas.

Thus, it seems, the general opinion is that Wales having a dual funding system is the means by which both excellence and geographical focus can be accommodated, as proposed by the dual funding model in the PCET White Paper, i.e. Quality-related Research (and innovation) funding (QR and HEIF) and Strategy-related Research and Innovation funding (SRI) are the means to address both options in the question.

Paul Hildreth, a PhD student from UCL, discussed the types of company that are found in a particular region of Wales, that

of Deeside and the surrounding area. He identified that 'of the three characteristics of the firm economy; clusters, urban agglomeration and a diversity of investments' that the most appropriate for the Mersey Dee is 'diversity of investments' which is characterised as 'differentiated patterns of new and evolved MNE' (Multi-National Enterprises) 'and privately owned companies'. He argues that 'An appropriate response is to be sensitive to firm and place-based differences', that thinking should go beyond sectors and that 'local, regional and national institutions should design an integrated approach towards industry appropriate to addressing the diversity character of firm investments ... across North Wales' and elsewhere.



5. Oral Evidence Hearing Summary

5.1 Universities, Colleges & Independents – 3 May 2017

- Dr Louise Bright, University of South Wales
- Professor Richard Day, Glyndŵr University
- Iestyn Davies, Colegau Cymru Colleges Wales
- Dr David Owen, Life Sciences Bridging Fund

There was a plea for certainty over R&I funding, especially on year-to-year certainty and also for the reintroduction of innovation funding so as to be on a par with England (Bright). Further, there was a call for the available funding to be focussed on areas of strength and not to be spread too thinly, especially so for innovation funding which offers the biggest opportunity for the future (Owen). Wales needs not to be too introverted and needs to look more widely in order to attract more companies to Wales (Davies) and that much R&I activity in Wales is far from being 'Catapult-like'.

There is a need for a clear, long-term strategy and leadership by the Welsh Government which focuses activities and funding on areas that are of national importance. The funding needs to have clear outcomes and expectation attached to it and funding should not be focussed on specific HEIs (Davies). Further, funding should not be available to sustain the research institutions – it should be used to exploit research and innovation (Davies).

The levels of 'joining' between research and innovation, i.e. between Government, institutes and researchers levels is poor and there are large areas of potential improvement at universities (Owen). Further, it was reported that there is a mismatch or 'disjoint' between economic policy and university policy. The rhetoric is correct about the value of research and innovation and its impact but the (Government's) policies are not aligned to what is being undertaken (Bright).

The Panel offered the suggestion that 'anyone who needs a Government steer is not worth steering' because steering creates a dependency society (Holford). The response to this suggestion was that the drive needs to come from the universities and not from government and that the universities should be more collective on this issue (Day). Further, there needs to be a wider collective involving FE colleges, thus joining up various courses, research (PhDs), apprenticeships and, by implication, other teaching and skills development activities (Bright). Funding is a 'useful tool' for achieving this (Bright). Thus, Government should take a lead on mechanisms which promote a more collegiate approach but not dictate specific areas of endeavour.

There is a need for a strategy which joins up research and innovation, post compulsory education and government and that the (Welsh) Government needs to show leadership in bringing this about (Davies). However, the Welsh Government should not get in the way but develop long-term funding mechanisms which promote and encourage this collective approach (Davies).

On the issue of Innovation funding (meaning HEIF type), it was acknowledged that some of it worked and that some of it did not (Bright). It was suggested part of innovation is about helping companies understand existing knowledge and not just about gaining new knowledge. Thus, innovation needs a fresh approach without being driven by too many KPIs (key performance indicators) which distort behaviour (Bright). One area which could help in the future, as it has in the past, would be for Government to provide small sums of funding which allow people within SMEs or companies to spend time in universities and colleges for a short period and vice versa, thus allowing each to understand the cultures and ways of working of the other. The example of the Strategic Insight Programme was given as a very successful way of achieving this two-way



flow of people (Davies, Bright, Day).

On the issue of collective working between HE and FE in delivery of the R&I agenda, the Panel suggested that there was little evidence of a common approach. However, the University of South Wales illustrated its engagement with FE with the example of its strategic alliances with five FE colleges in the South Wales area and that the present one 'shop front' to businesses in the area (Bright). This single point of entry is important to companies and SMEs from experience (Owen).

The issue of innovation 'Hubs' (as identified by Diamond) was discussed. It was thought that Hubs could be useful for innovation and knowledge transfer (KT) activities if they develop along the lines of the Catapults Centres but there was not much agreement on how they should be constituted or operate. The Hubs idea was compared to the HEIF (Higher Education Innovation Funding) type funding provided in the past to universities. It was thought that, in the past, discrete innovation and KT funding provided to institutions quickly become core funding and was lost within the institutions and that this funding might be deployed more effectively in Hubs (Davies). However, Wales does not have a sufficient critical mass of industry in order to justify specific innovation hubs, thus they need to be more general in nature (Davies).

The Panel explored the issue of QR funding (Quality-related Research funding). The uncertainty between Research Excellence Frameworks (REFs) and 'in-year' uncertainty is a problem (Bright, Day) because it discourages long term planning. Some QR funding needs to be response mode funding, i.e. some of it kept back by institutions to allow exploitation of opportunities which arise within the REF periods (Bright, Day). The example of criminology research at USW was given (Bright) and that a small amount of QR can make a big difference in developing R&I, especially with industry (Day). However, the

question of how to get the best out of QR funding was raised, how do we get better outcomes for learners, R&I and others? (Davies). In order to make the most effective use of QR, there needs to be the research strength coupled with strong teaching (of undergraduates, enriched by the research (Day)) and effective knowledge transfer and engagement mechanisms so that a full service offering is provided to industry and business; thus, excellent (QR funded) research is turned into 'impact' in REF (Bright). USW has done well on 'impact' because it is an 'institution of their region' and impact is what they do (Bright).

5.2 Universities Wales – 3 May 2017

- Professor Colin Riordan, VC Cardiff University
- Professor Hilary Lappin-Scott PVCR Swansea University
- Amanda Wilkinson, Director, Universities Wales
- Lisa Newbury, Deputy Director, Universities Wales
- Olivia Jones, Universities Wales

The potential or probable loss of Structural Funds from WEFO is an issue, especially with BrExit. Although the level of WEFO funding of approximately £50m per year to the HE sector is not large compared to the recent HEFCW funding of approximately £150m yearly, nevertheless it is a very important source of funding, especially so with the recent loss of HEIF-type funding (Lappin-Scott). To overcome this loss, some form of UK Government funded replacement is required and that the First Minister has said that he is seeking a replacement regional fund (Riordan). The basis for this should be success of application and the return on investment and the example of the Compound Semiconductor Catapult was given which has leveraged several different sources of funding (Riordan).

It was recognised that QR funding has been maintained, even at the expense of other funding from HEFCW and that this is a good thing. However, Barnett consequentials are not always visible when they traverse the Welsh Treasury and it seems that in very recent times this is lost within Welsh Government (Wilkinson). Universities Wales recognises that the funding is under pressure within Welsh Government, especially with the move of funding to Health and Social Care so it is vital that the Diamond Recommendations on QR are implemented (Wilkinson). Further, QR is fundamental to the structure of universities' research capacity and also it is symbolically critical for attracting researchers to Wales (Riordan).

On the issue of Innovation Hubs (as in Diamond), these could be useful although there was little clarity on how they would operate. It was suggested that they could be the 'go to place' for industry to engage universities a sort of 'clearing house' (Riordan). They could include FE Colleges so as to offer skills and training and could be coordinated across the universities by the PVCRC Group (Riordan). When asked what budget should be provided, there was little clarity with a suggestion of £30m yearly but that the case needs to be made (to fund the Hubs) and then see how much money is available (Riordan). What is clear, though, is that the funding should not be at the expense of QR funding (Riordan).

5.3 Industry – 7 June 2017

- Philip Wallace, General Manager, TWI Technology Centre (Wales)
- Rob Rolley, Technology Director, General Dynamics
- Byron Tucker, Technology Centre Manager, RD&T Programme Manager, Tata Steel
- Dr Penny Owen, GE Healthcare
- Dan Mines, Admiral Insurance
- Justin John, Business Innovation Manager, Cardiff Medicentre.

Regarding the WBFG Act, the respondents thought that it was good in some ways, for instance creating the right environment and providing support but that it was too slow for fast-moving industry. Further, it takes too much effort for SMEs to access funding routes. However, it could be used to drive 17 and 18 year olds into employment, so long as there was a strategy plan to do this (Rolley).

There was considerable comment on the maturity of the environment in Wales to foster university and industry collaboration. It was thought that the environment was not mature (Wallace) and that there was too much focus on universities' fundamental research rather than on the needs of industry which is much nearer to market (Wallace). Academia needs to structure its research to meet industry's long term goals (Rolley). There is a wide gap in available funding for bridging the gap between academic research and the needs of industry and this is fuelled by Wales research being 'siloed' (Owen). In the Finance and Services Sector especially, support is very bureaucratic and universities are hard to engage generally, even for large companies. There needs to be greater unity between the universities in Wales and they need to 'stop fighting as big fish in a small pond' (Mines). There is little coordination between universities and no national coordinating strategy in Wales – this coordinating strategy needs to be developed (John).

On the relationship between Wales and the UK, there was agreement that there should not be a split, that Wales should align itself with aspects of the Industrial Strategy where there is the research and innovation strength and alignment with industrial need. For example, there is a major revolution required in steel product development, metallurgy and manufacturing processes over the next ten years and that focus by Welsh R&I will help secure steel's future in Wales (Tucker). However, this has to be seen in the context of the UK and even the world and that these



global 'grand challenges' are what should drive the R&I agenda in Wales (Wallace). Further, significant amounts of funding could come from world sources and that R&I players should gear themselves up to win this (Wallace).

The issue of market pull on research and innovation was explored; it was thought that the market will move to areas where the research and innovation environment is most attractive (Owen, Mines) and that Wales has only niche expertise, i.e. the research capability that exists is not aligned significantly to market needs, either in Wales or the UK (John). Hence, specialist support is required from elsewhere in the UK, e.g. Strathclyde University (Wallace). The implication was that, if Wales is to benefit from its research and innovation capability, this capability has to be aligned more closely with market needs and, where necessary, be prepared to collaborate with anyone else who offers capabilities in the 'gaps' (Owen, Wallace).

BrExit was thought to be a risk to the availability of R&I funds in Wales. Although there has been lots of interaction between governments, this has not yet generated a meaningful strategy (Rolley). Consequently, there are risks to the talent pipeline and also to parity on regulatory frameworks which guide research, innovation and adoption of technologies into the market place (Owen, Wallace). However, it was thought also that there are more important things to industry than BrExit (Rolley) such as making the most of what we have got already. In the case of steel, this industry faces global challenges which are bigger than the BrExit issues but the loss of EU funding will hasten these challenges. Wales needs to obtain from the UK Government or generate more R&I funding itself to support such industries facing these global challenges, for instance by the creation of the UK National Steel Innovation Centre (Tucker).

On the issue of the creation of UKRI, it was thought to be too early to tell what the impact would be on the R&I landscape. However, there needs to be a consideration of the balance between Capital funding to Revenue funding, i.e. there is no point in providing funding for Capital infrastructure without the on-going Revenue funding to support it (Wallace). This applies equally to the balance between funding for academic research compared to funding for knowledge transfer, innovation and exploitation of research (Wallace). Supporting innovation and exploitation, narrowing the 'valley of death', driving 'cross-sector' collaboration and mitigating risks while transferring knowledge to production are all areas that require funding (John, Rolley, Tucker). It was clear that industry's view is that research and innovation is seen and funded equally well in industry as it is in academia and that, traditionally, industry R&I endeavours have not been given the same funding or prominence as academic research activities.

5.4 Public Bodies – 7 June 2017

- Kellie Beirne, Deputy Chief Executive, Monmouthshire County Council and Co-Chair of the Welsh Government's Innovation Advisory Council for Wales
- Professor Jon Bisson, Health and Care Research Wales. Welsh Government
- Gareth Clancy, ONS (Office of National Statistics)

The concept of 'innovation' as applied to public bodies is much wider than in the more narrow sense of technology and that Wales needs to recognise this and develop a support strategy to help drive innovation in this area (Beirne). Further, there is a need for national strategy which consolidates funding, strategies and priorities (Clancy) and which brings closer coordination between the proposed PCET body and health and care research (Bisson). In developing a national innovation strategy, this needs to be 'at arm's length' (to government) and offer

coherence for all funding opportunities and strategies (Beirne). There are too many bodies funding R&I in Wales and HEFCW spreads its resources too thinly to be effective (Clancy).

On the issue of FE and HE collaboration, it was felt that they did not work closely enough on certain issues. The provision of new skills was an issue which is not being served by FE, for example in data analytics (Clancy) and in aspects of the NHS despite the NHS having strong links with FE (Bisson). It was suggested that FE and HE should work more closely together on the delivery of these higher end skills, especially where advanced apprenticeships are concerned. However, currently, there is little incentive for HE to undertake apprenticeship training and that this needs to be addressed.

To explore what works in driving innovation, there is a need for 'test beds' to try out new ideas of working (Beirne), for example the current example of Compound Semiconductors and IQE. One key quality of these 'test beds' is the acceptance of greater risks, especially for the public services and private sectors. Traditionally in the public sector, there has been too much aversion to risk – you are damned if you do but not damned if you don't, i.e. it is too easy to do nothing (Beirne). Regional 'test bed' facilities, hubs or structures that allow for higher risk endeavours are required, probably on a regional basis (Beirne). Further, there is a need to identify clearly what R&I solutions are required and this requires R&I expert people to be embedded within organisations, especially local authorities and other public sector bodies (Bisson).

On the issues of BrExit and the creation of UKRI, it was thought that it is too early to tell what the impact would be on the R&I landscape (Clancy). However, there is a clear need to have Wales better promoted at UK Government level and with UKRI and that this will require a concerted effort to engage both more effectively (Bisson, Beirne). To aid this, Wales needs to identify

and adopt 'leader status' in priority areas (Clancy), develop and promote these as 'USPs', for example, the case of compound semiconductors (Beirne) or 'big data' (Bisson, Clancy).

5.5 University innovation and enterprise offices – 7 June 2017

- Dr Dave Bembo, Director, Research and Innovation Services, Cardiff University
- Dr Garry Reed, Director of Research & Enterprise Office, Bangor University
- Dr Ceri Jones, Director of Research, Engagement and Innovation, Swansea University
- Kathryn David, Director of Commercial Services, UWTStD and WILO group

It was thought that structural funds have been too complex and bureaucratic and therefore a large burden which influences universities' abilities to engage industry. Restoring HEIF would overcome this (Garry Reid). Although WEFO funding has been good at driving some academia and industry collaborations, generally the funding periods have been too short to enable long-lasting trust and understanding being built up between the two (Bembo). Further, the large numbers of different programmes of support have not helped in the alignment and achievement of objectives and that closer cooperation or even a single strategy would help (Jones).

Although this group thought that universities worked well with industry, there were mixed views on what they thought industry's view would be of academia's collaboration with industry. On this question, the answer was 'yes and no' (Bembo). 'Yes', universities work well with industry in relation to knowledge transfer, for example the establishment of the Compound Semiconductor Catapult and 'No' in relation to issues related to state aid rules and IP Ownership (Bembo, Jones). (NB: this contrasted with industry's actual view that academia was hard to engage generally, see above). Further, the loss of dedicated

HEIF funding has hampered engagement with industry, especially SMEs (David). It was agreed that science had captured the term 'Innovation' (Reid), that university innovation is predominantly 'technology transfer' and that the HE sector is poor at 'service innovation', i.e. meaning public sector or services sector innovation (Reed). To help address these issues, the group was agreed on the need for HEIF type funding to be reinstated at least to the level of the original HEFCW funding and to be on a par with the rest of the UK (Reed, David, Bembo, Jones). It was suggested that HEIF funding should be distributed by a formula based on perhaps on HEBCIS data (Jones) and amount to £10m yearly over the HE sector (Reed).

On the question of providing innovation funding to FE, there was caution. It was thought that this would be of benefit in the development of complementary skills and training provision (for example in relation to the skills required for compound semiconductor processes and manufacturing) but that it should not be pushed too hard or too quickly, i.e. it should be managed carefully (Jones, David, Reed, Bembo). However, in developing a 'one-stop shop' for industry to engage, there has been little collaboration between HE and FE hitherto but that degree apprenticeships are being considered as a means to achieve greater collaboration (Reed).

To address engagement with industry, the group thought that Hubs could help but the question of how they were to be set up and managed was an issue (David). One way would be to set the Hubs up in alignment with supply chains around particular sectors, groups of SMEs or large businesses (Jones). The Hubs need critical mass, need to reflect regional economies and not overlap with existing support provision (Bembo, Reed).

The group thought that the creation of UKRI and the additional £4.7bn UK Government funding presented challenges and opportunities. The lack of HEIF-type funding

in Wales would hamper their universities' abilities to win this new funding, especially the Industrial Strategy Challenge Funding and Global Challenges Research Funding. They thought there remained the question of how this extra funding would be allocated, i.e. whether some of it would find its way to Wales through the Barnett formula and whether additional funds might be sought to replace the to-be-lost WEFO funding as a result of BrExit.

5.6 Research Councils, Charities & UK Research & Innovation – 15 June 2017

- Professor Sir John Savill CEO MRC
- Professor Duncan Wingham, CE of NERC
- Dr Paul Burrows, Executive Director of Corporate Policy and Strategy, BBSRC

The Research Councils said that none of the Welsh universities are in the top 30 UK universities for competitive awards of funding. They have below the national average success rate of winning bids overall (i.e. percentage of submitted bids won) (Burrows).

On MRC awards, only Cardiff makes any significant impact. For example, recent awards for CUBRIC and for the Dementia Research Institute although Swansea has had minor success with the Farr Institute (Savill). There is a lack of critical mass in Wales and a lack of push for translational schemes (Savill).

Wales' success at winning NERC funding shows a similar pattern to the BBSRC in that there is little that is internationally renowned and what there is lacks critical mass (Wingham).

It was thought that the Sêr Cymru programme was very commendable but that it is too early to tell whether it will make any difference in the long term. The reason why Sêr Cymru holds out hope is that it (a) specialises on priority areas, (b) fosters coordination nationally and internationally and (c) aims to recruit and retain the best (Burrows). All three of these things are what

are required for improving Wales' success (Savill). Further, there is a need to 'play into' UK national activities in a way that is not done currently. This requires Welsh affiliated researchers becoming much more involved in governing councils and other decision making bodies as well as engaging in national initiatives such as the Alan Turing Institute (Savill).

What is clear is that the funding landscape is changing rapidly with the creation of UKRI and the establishment of the competitively-awarded ISCF and GCRF funds. Further, these new funds are more 'innovation' related rather than pure research which will require a shift in approach and delivery by institutions. Wales needs to recognise this change in landscape and adapt accordingly otherwise it will be left further behind (Wingham). To complicate matters, the RCs themselves are not quite sure how to respond to the changing landscape because it is obvious that most of the new funding will not be routed through the RCs but be routed either directly from Government or through Innovate UK (Wingham and implicit in the responses from all three).

On the issue of place based R&I, there is an argument for not always using 'excellence' criteria for award of funding but it is hoped that the same funding pot is not used for both (funding excellent research and funding regional or geographical R&I) (Wingham). However, if seeking 'regional' funding, Wales needs to collaborate with others in the UK because, ultimately, any benefit of the R&I activity has to be UK-wide benefit. As such, the collaboration between NIHCW and HCRW (Health and Care Research Wales) is a good example, which is working to the benefit of Wales (Savill).

For future success, Wales needs to concentrate on key areas and build these into national renowned capabilities by recruiting people (Savill, Wingham). Further, Welsh institutions need to improve their applications for funding (i.e. too many are

of poor quality) and one way to do this is to engage more closely with the Research Council on individual calls (Burrows). Where real UK-wide expertise exists in Wales, for example CUBRIC, it should be made a priority for funding and be exploited further (Savill). Other appropriate areas for exploitation in agriculture are oats and upland farming (at IBERS) (Burrows). However, although these research strengths have scored highly on 'impact' (in REF) it should be recognised that much of this research is not likely to lead to many publications in Nature and other highly valued publications, therefore implying a balance needs to be sought between excellent research and more applied R&I (Savill, Burrows).

5.7 Charities – 15 June 2017

- Dr Anne-Marie Coriat, Head of Research Careers, Wellcome
- Katherine Mathieson, CE, British Science Association
- Ms Emma Greenwood, Director of Policy and Public Affairs, CRUK
- Mr Simon Gillespie, CE British Heart Foundation or BHF

Wales has significant strengths in niche areas such as patient electronic systems, cancer registration data, biomarkers and blood cancer but, overall, there are too few researchers in the fields of interest to CRUK and BHF (Greenwood, Gillespie). Wales needs a more strategic approach which coordinates closely with common UK challenges. Wales gets about 1 per cent of BHF's £100m annual spend in the UK because of a lack of researchers (Gillespie).

To address this lack of Charity research income, Wales needs to focus available resources on (a) people, (b) facilities and (c) complementary funding (Welsh Government, Research Councils, etc.), thus fostering the right environment and infrastructure for the Charities to invest. If this was achieved in, for example, cancer and genomics, then they would be likely to invest for the long

term (Gillespie, Greenwood). For this to happen, there has to be a long-term strategic approach (Greenwood).

The nature of Charities work involves engaging the general public. This is an area in which more work could be done and not just in Wales, as this helps develop the talent pipeline and recruitment of people into health and medical research. The recent British Science Festival at Swansea was a major success and this points the way forward on public engagement (Mathieson). In many areas of medical research, science research is key to finding treatments but this is not always recognised by the public; hence proper public engagement is essential (Greenwood).

With regard to what research is undertaken, this needs to be informed by 'research journeys', i.e. research maps so that subsequent lines of applied research can be identified, for example clinical application research, thus a route to patient can be identified (Gillespie). Wales has some advantages in this respect in that it has a clearly defined and not too divergent population. This offers an opportunity for more targeted research (Greenwood).

All of the Group agreed that excellent research should be funded wherever it is found and this could include existing or new Centres should these be of high enough quality. However, any Centre would have to be in line with the funder's needs; for example brain cancer research is poorly provisioned in the UK so there is an opportunity here which CRUK is pursuing actively (Greenwood).

5.8 UK Research and Innovation (UKRI) – 15 June 2017


- Kevin Baughan, Deputy Chief Executive, Innovate UK
- David Sweeney, Executive Chair (Designate), Research England
- Professor Philip Nelson, Chief Executive EPSRC

- Phil Sooben, ESRC Director for Policy and Resources and Deputy Chief Executive

Wales (and Northern Ireland) has not performed well in competition for Innovate UK funding, partly because Welsh Institutions have sought funding from WEFO instead (Baughan). However, the Compound Semiconductor Catapult is a good example of Innovate UK success. There is a need to improve communications to businesses of the benefits of Innovate UK funding and the Welsh Government has a role to play in this (Baughan).

The Research Councils fund excellence wherever it is found and will continue to do this. Where they can fund research on a regional basis is where there are strengths aligned to UK strengths, for example Compound Semiconductors. However, to grow regional strengths, there has to be a long strategic plan which pulls together QR funding, aligns student teaching with relevant UK industry and encompasses other funding support (Nelson). Wales has several 'pockets of excellence' which have the potential to be developed in this way but there has to be the concerted effort by all involved to concentrate resources on these pockets (Sweeney). Wales, being small, has the potential to do this through its Government funding mechanisms.

Regarding the participation of Welsh affiliated researchers in the Research Councils' councils and decision making bodies, candidates are selected on their merit and scientific expertise with no favouring or 'fair sharing' for the Devolved Nations. While they encourage people to apply from all over the UK, they do recognise that Wales is under-represented overall. There are opportunities opening up with the creation of UKRI for people to apply and they welcome applicants from anywhere within the UK (Baughan, Sooben). Devolved Nation involvement is essential to ensure that the UKRI works collectively in the interests of the whole of the UK (Sweeney).



The new Industrial Strategy Challenge Fund is being run differently from other calls. A 'Challenge Director' will be recruited to run the challenge calls and these represent opportunities for people to get involved (Baughan, Sooben). Being 'Industrial', having involvement with, or engagement from industry will be essential (Nelson).

The balanced funding principle, as defined in the Higher Education and Research Act 2017 was explored. It was thought that this balance will apply only to the budgets of Research England (i.e. un-hypothecated QR) and the Research Councils (hypothecated research) and will not include Innovate UK. It would include ISCF or GCRF funding that was managed by Research Councils (Sweeney). The Research Councils will have to work closely with Innovate UK which may complicate this balance (Nelson). Further, while some of the new funding may be managed by Innovate UK and Research Councils, it may not be a formal part of Innovate UK or Research Council funding. Since some of it may be routed through the Research Councils, QR would need to increase to maintain the overall balance. There may then be a Barnett consequential (Baughan). There was no indication of the UK Government trying disadvantage the Devolved Nations. UK Government is trying to do what it considers is best for the UK as a whole (Nelson).

On regional issues, Innovate UK starts with the needs of the market and how the UK can exploit these markets. Then it seeks companies and research strengths which can deliver solutions and commercial offerings into these markets. It then considers which funding mechanism is best suited to foster the activities between industry and research and puts out calls accordingly, for example, the Catapults, the Innovation and Knowledge Centres (IKCs) or Small Business Research Initiatives (SBRIs) (Baughan). Key to all of this and to the joint activities with the Research Councils is that there have to be benefits

across the UK (Sooben) and this may mean that the research capability is not necessarily co-located with the industrial strength (Baughan). Thus, regional opportunities are explored only when there is a clear rationale for doing so.

The future funding of research and innovation is open to new ideas. The Innovate UK is really passionate about new ideas which drive new initiatives, drive new investors and which are potentially disruptive (Baughan). Research in the UK is really productive in academic terms but this is against a low national spend; thus there is a need to foster new sources of funding, for example venture capital. HEIF-type funding for universities is critical for knowledge exchange and industrial engagement and to help this process of attracting new sources of funding (Sweeney, Nelson). Wales, being a small nation, has the opportunity and agility to make this happen quickly, i.e. but only by being bold! (Baughan, Sooben).



Annexes



Credit: PCI Pharmaceuticals

Annex 1 – Proposed R&I Budgets

The table below includes proposals for resources that would implement the recommendations in my review. I make no recommendation on the timing of this resource allocation. In practice, the timing of any funding changes would be influenced by:

- Opportunities and pressures on overall levels of research and innovation in Wales arising from increases in the budget for UKRI announced by HM Treasury Autumn Budget 2016 and being introduced progressively over a period until 2020/21. By that time, the UKRI budget will have increased by £2bn yearly.
- Pressures on research and innovation in Wales from the impact of Brexit on EU structural funding. These in turn will depend on the process and timing of the UK's withdrawal from the EU. During this review, I have assumed that EU structural funding will fall to zero by 2023-24 or thereabouts.
- Opportunities for research and innovation in Wales from the introduction of the UK Shared Prosperity Fund to replace EU structural funds. These in turn will depend on the scale, timing and other arrangements for the Shared Prosperity Fund. During this review, I have assumed that EU structural funds will be replaced in full but that the timing is unclear and the terms of that replacement will be the subject of negotiation.
- The priority given to research and innovation within the wider context of Welsh Government budgets, taking those factors into account.

Some funding proposals, such as QR funding, PGR Scholarships and Sêr Cymru and Innovation competitions could be introduced in full at short notice. They support existing work that would return benefits to Wales from an early uplift in resources. Other proposals, including the Future of Wales fund; innovation hubs; LSW funding and

Innovation and Engagement Funding would be better introduced progressively, to allow time for the preparation and evaluation of business cases and development of capacity within the business, higher education and further education sectors.

The future trajectory for WEFO funding and its replacement is subject to external influences and I have handled it distinctly within the table. Once the scale and terms of future funding are defined, I propose that the distinction can fade and it can be integrated fully into the St David's Investment Fund.

Diamond recommended that funding be made available to support funding premia for expensive subjects and I support fully that recommendation. I have made no provision for it in this table because I have focussed only on research and innovation. Funding remains in the £50m unhypothecated budget, after my recommendations on innovation have been supported.

Funding stream		Current funding	Proposed additional funding	Proposed total funding
		£m p.a.	£m p.a.	£m p.a.
Diamond implementation	QR	71.00 ^(a)	0.00	71.00
	PGR	5.00	3.75 ^(b)	8.75
	Innovation and Engagement	0.00	25.00 ^(c)	25.00
	LSW	0.00	1.00 ^(d)	1.00
Sêr Cymru		6.00 ^(e)	0.00	6.00
Future of Wales fund		0.00	30.00 ^(f)	30.00
<i>Sub-total</i>		82.00	59.75	141.75
St David's Investment Fund	WG Innovation	10.00 ^(g)	0.00	10.00
	WEFO [+ replacement] ^(h)	65.00	0.00	[65.00] ^(h)
	Innovation Hubs	0.00	10.00 ⁽ⁱ⁾	10.00
	Innovation competitions	0.00	15.00 ^(j)	15.00
<i>Sub-total if WEFO funding not replaced</i>		75.00	25.00	35.00
<i>Sub-total if WEFO funding replaced</i>		75.00	25.00	[100.00] ^(h)
Total for research & innovation	If WEFO funding not replaced	157.00	84.75	176.75
	If WEFO funding replaced @ £65m	157.00	84.75	[241.75]^(h)

Notes:

(a) QR – Diamond recommended that QR should at least be maintained at £71m in real terms. The HEFCW Funding Circular for 2017/18 states that a funding reduction of £28.5m has been applied to HEFCW's total funding. That reduction is not reflected in this table.

(b) PGR – Diamond recommended £3.75m yearly for PGR scholarships in addition to existing funds.

(c) Innovation and Engagement – Diamond recommended reinstatement of HEFCW's Innovation and Engagement funding at £25m yearly

(d) LSW – Diamond recommended £1m yearly for the Learned Society of Wales.

(e) Sêr Cymru – Welsh Government has advised that it has £6m in its budget on an ongoing basis, for a successor to Sêr Cymru.

(f) Future of Wales Fund – No source of funding has yet been identified for this recommendation.

(g) Welsh Government Innovation – Welsh Government officials have advised me that the Welsh Government budget for Innovation has been £5m yearly, with a historic outturn of £10m yearly.

(h) WEFO replacement funding – I understand that WEFO replacement funding remains under discussion with HM Treasury. The Welsh Government's Securing Wales' Future states that it is crucial that EU funding is replaced by a revision to the Block Grant (p. 5). I assume that the source of replacement funding would be the UK Shared Prosperity Fund. Meanwhile, WEFO replacement funding is shown in [£] alongside budgets that exclude WEFO replacement funding.

(i) Innovation Hubs – these could be funded using £10m yearly of the £50m yearly unhypothecated funding, which Diamond recommended should be provided to HEFCW, from the funding released elsewhere by his recommendations.

(j) Innovation Competitions – these could be funded using £15m yearly of the £50m yearly unhypothecated funding, which Diamond recommended should be provided, to HEFCW from the funding released elsewhere by his recommendations.

Annex 2 – Companies working in collaboration with universities and research institutes in Wales

1. Horizon Nuclear Power Ltd.

A wholly owned subsidiary of Hitachi, Horizon Nuclear Power Ltd. is currently planning to invest of the order of £10bn in a new nuclear power station, Wylfa Newydd, on Anglesey. Bangor University and Horizon have signed a Memorandum of Understanding for joint working on student work and study placements; collaboration for research and use of facilities and educational engagement with local young people, to raise awareness of STEM subjects.

Sasha Davies, Head of Strategic Development Wales, Horizon Nuclear Power Ltd. said:

“We look forward to working with the University as the Wylfa Newydd project moves forward, utilising the first-class research and development facilities and expertise it has developed over many years.”³⁵

2. IQE

The world’s leading manufacturer of advanced semiconductor wafers, IQE plc is headquartered in Cardiff. They are working in partnership with Cardiff University. The aim, backed by the UK and Welsh Governments, is to make Wales the home of the world’s first compound semiconductor cluster, generating over 5,000 high-value jobs.

Dr Drew Nelson OBE, Chief Executive, IQE plc said:

“This JV with Cardiff University is a key step in creating the World’s first Compound Semiconductor Cluster, spanning the complete Technology Readiness Level (TRL) scale from basic research to full scale production.”³⁶

3. Renishaw

Renishaw plc and Cardiff University have worked together on a number of programmes from investment in joint research projects and studentships to larger joint initiatives such as the Renishaw Advanced Metrology Laboratory. More recently, Renishaw, the University Hospital of Wales and Cardiff University celebrated the first robotic-assisted neurosurgery procedure for epilepsy in Wales and a further collaborative project which looks to conduct a stem cell transplantation procedure that could benefit people affected by Huntington’s disease in Wales.

Gareth Hankins, Renishaw’s Manufacturing Director said,

“As a company at the cutting edge of engineering technology we were delighted to be invited to participate in this modern facility which offers the best possible learning opportunities for students in the fields of manufacturing, engineering and physics. The Renishaw Room is already in constant use and will help expose our name and technologies to the next generation of high-class graduate engineers and physicists.”³⁷

Paul Skinner, General Manager of Neurological Products at Renishaw, added:

“We are pleased that Renishaw’s expertise in engineering is continuing to support pioneering research at the University Hospital of Wales. It is exciting to be part of a collaboration that sees precision engineering and innovative surgical practice working in synergy to improve patient outcomes.”³⁸

4. Tata Steel

Swansea University’s relationship with Tata underpins SPECIFIC³⁹ Innovation &

³⁵ https://www.hefcw.ac.uk/documents/publications/hefcw_reports_and_statistics/HEFCW%20Innovation%20Nation%20English.pdf (p.32)

³⁶ <http://www.openiqe.com/news/2015/07/09/iqe-and-cardiff-university-establish-a-joint-venture/#.WczqiFtSyUk>

³⁷ <http://www.renishaw.com/en/renishaw-supports-new-engineering-and-physics-library-at-cardiff-university--10819>

³⁸ <http://www.cardiff.ac.uk/news/view/751954-stem-cell-transplantation>

³⁹ Sustainable Product Engineering Centre for Innovation in Functional Coatings

Knowledge Centre, which works with local authorities to implement the Buildings as Power Stations project and the establishment of the Steel Science Centre which will address the current and future challenges of sustaining primary steel-making capacity in the region and the UK.

The partnership has created impact by leveraging additional UK and EU funding; spin-outs; community outreach programmes; new research buildings and student placements.

Paul Jones, Technology and Innovation Manager at Tata said:

“We have been working with the College of Engineering at Swansea University through the Steel Training Research and Innovation Partnership (STRIP) and Sustainable Product Engineering Centre for Innovation in Functional Coatings (SPECIFIC). It is a great way for us to tap into the knowledge and enthusiasm that exists in abundance within the university.”⁴⁰

Dr Martin Brunnock, Director, Tata Steel Strip Products UK said:

“The graduates that come from our Swansea EngD partnership are the life blood of our technical and management sections. Their research outputs directly affect our business competitiveness and the large number that work in our supply chain continues to add value after they have left the University.”⁴¹

5. Airbus Newport

Airbus Group’s Endeavr initiative with Cardiff University and Welsh Government aims to boost innovation across Wales. The partnership brought together companies, academia and government to bridge the gap from early stage research to the development of commercial value. This relationship has

led to numerous benefits such as the new Airbus Centre of Excellence in Cyber Security Analytics, within the School of Computer Science.

Dr Kevin Jones, Head of Cyber Security Innovation at Airbus, said:

“Collaborating with leading Universities, such as Cardiff, to research and develop sophisticated machine learning and data analytics for attack detection is a key approach in the future protection of critical systems. The launch of the Centre of Excellence in Cyber Security Analytics is an enabler for the rapid transfer of research into operational activities and ensures that researchers are able to access the latest techniques and data, and in addition are supported by Airbus experts.”⁴²

6. Haydale Graphene Industries

Haydale Graphene Industries is focused on the commercialisation of graphene and other nano materials. They have strong links with Swansea University’s Welsh Centre for Printing and Coating (WCPC) – one of the world’s leading centres for research and development of printing and coating processes. In 2016, the company exercised its rights, under its existing pipeline agreement with the university and Swansea Innovation, to acquire a new invention.

Ray Gibbs, CEO at Haydale said:

“I am pleased to announce this second invention acquired from Swansea under the Pipeline Agreement. As previously stated, our strategy is to work with experts in our chosen market sectors to rapidly develop commercial products using our HDPlas™ functionalisation process. This announcement demonstrates that this strategy is working and we are optimistic that the

⁴⁰ <http://www.telegraph.co.uk/sponsored/business/business-reporter/11469739/swansea-science-and-innovation-bay-campus.html>

⁴¹ <http://www.swansea.ac.uk/business-and-industry/businesspartnerships/tatasteel/>

⁴² <https://www.cardiff.ac.uk/news/view/733311-cyber-security-centre-of-excellence-to-open-at-cardiff-university>

new invention will further enhance Haydale's commercial opportunities in the application of graphene and carbon nano-materials."

7. Cogent Power

Cardiff University's alliance with Cogent Power – a business within Tata Steel – spans several decades. Together, the partners are working on exciting new research, including the reduction of transformer noise and the manufacture of high-efficiency motor-generators for electric and hybrid vehicles in collaboration with innovative customers.

Mark Cichuta, Director of Product and Process Development at Cogent Power, said:

"The collaboration has enabled Cogent to extend its technical and research capability by utilising the expertise of the Cardiff University team. It has also been able to develop relationships via the pan European Horizon 2020 scheme and other collaboration instruments."⁴³

8. Pfizer

Pfizer will collaborate with Swansea University and other relevant partners on initiatives aimed at improving health across Wales. Plans include the establishment of a Pfizer Innovation Hub at the University.

Erik Nordkamp, Managing Director of Pfizer UK said:

"We are pleased to announce our intention to collaborate with Swansea University. Partnership working between the pharmaceutical industry, academia and the NHS is essential for tackling today's demands on the health system. Through sharing our different skills and expertise we really can make a difference to improving health outcomes for patients, developing new ways of supporting the provision of healthcare."⁴⁴

9. BEACON Biorefining Centre of Excellence

Led by Aberystwyth University and in collaboration with partners at Bangor and Swansea Universities, it was established in 2011 with £10.6m of EU funding support through the Welsh Government. BEACON uses biorefining expertise at the universities to support research and development at small and medium size companies.

Dr Ahmed Ali, Research Director, Compton Group, said:

"The results obtained from this [BEACON] separation project will play a vital role in helping Compton Group and our US partner companies progress the development towards commercialisation."

Craig Bartlett, Director, MDF Recovery Ltd said:

"BEACON has assisted MDF Recovery to test and optimise our novel technologies in such a short time frame, something no other organization could offer."⁴⁵

⁴³ <http://www.cardiff.ac.uk/news/view/765911-engineering-alliance-picks-up-partnership-award>

⁴⁴ <http://www.arch.wales/latest-news.htm?id=65>

⁴⁵ https://www.hefcw.ac.uk/documents/publications/hefcw_reports_and_statistics/HEFCW%20Innovation%20Nation%20English.pdf

Annex 3 – Literature and expertise in research and innovation policy

There is a large volume of high quality literature on science and innovation policy and the economics of R&D. I summarised the literature in an earlier publication⁴⁶. The Campaign for Science and Engineering is currently building a library of evidence⁴⁷.

The literature includes theoretical and empirical evidence on public spending research and innovation, including analysis of relationships and interdependencies between public, private and charitable investments. Universities, including Cambridge; Cardiff; Imperial College; Kings College, London; Manchester; Sheffield; Sussex and UCL have institutes or research groups focused on science and research policy. National Academies, notably the Learned Society of Wales, are building strong reputations for their economic and policy analysis. Several consultancy firms including Rand Europe; Technopolis; Oxford Economics and Biggar Economics specialise in the evaluation and analysis of the impact of research programmes and research disciplines. Much of their work is in the public domain.

Broadly speaking, the literature on the economics and policy of R&D investment supports public spending for research – particularly at the frontiers of knowledge – and has done so consistently over several decades. The case for public spending on R&D is, in essence, that the benefits of research investment are difficult for individual investors to capture, particularly if the research findings are in the public domain and the timing of the ultimate benefit is unpredictable. Government therefore intervenes on behalf of the population of taxpayers, takes risk on their behalf and harvests benefits for the whole community. For example, a strong research

base attracts foreign direct investment and indigenous business investment (the Cardiff semiconductor cluster being one example). Businesses hopefully make a good return on these investments but there is a wider picture – by way of career opportunities for local people, new customers for local firms and a more prosperous environment for the wider population – that is difficult for individual investors to capture.

Some analyses try to define a generic optimum level of national R&D investment and arrive at figures of around 2.3 – 2.6 per cent of GDP (roughly the level of the US and Germany). These levels equate to 2017 Manifesto commitments from several political parties but they are well above existing levels of investment in the four countries of the UK.

Productivity, wage growth and public spending on science and research

Numerous analyses by the OECD and highly cited work by Hughes & Haskel⁴⁸ support the case for public spending on research and development to raise levels of productivity. A summary of the arguments was recently published by Professor Richard Jones at Sheffield University⁴⁹.

After several years of stagnation in earnings and productivity across most parts of the UK, these analyses have underpinned wider attention on R&D investment levels. Manifestos from Conservative, Labour and Liberal Democrat parties, ahead of the 2017 general election, each called for major increases in R&D from both the public and private sectors. A recent analysis from Bank of England staff pointed to the importance to the productivity agenda of attracting foreign firms with histories of higher R&D investment, higher productivity and as a fresh source of innovative practices⁵⁰. The Centre for Social Justice called for an acceleration of

46 http://www.ncub.co.uk/index.php?option=com_docman&task=doc_download&gid=180&Itemid

47 <http://www.sciencecampaign.org.uk/engaging-with-policy/evidence-base.html>

48 <http://www.sciencecampaign.org.uk/asset/4567DD2A-0604-42E5-AF8EEA248D3DCE1B/>

49 <https://www.sheffield.ac.uk/news/nr/innovation-research-and-the-uks-productivity-crisis-1.506369>

50 <https://bankunderground.co.uk/2017/08/17/foreign-owned-firms-and-productivity/>

public spending increases on R&D to address stagnation in productivity and, consequently, earnings⁵¹.

There are dissenting voices, with Terrence Kealey (The Economic Laws of Scientific Research, 1996) one of the more prominent, arguing against almost all public spending on university research. But the balance of evidence and argument and the choices made by cash-strapped governments around the world weighs heavily in favour of public spending on R&D as a significant contribution to productivity and a source of other economic and social impacts.

University-business relations

Twenty years ago, the relationship between universities and businesses was rightly criticised. University – business relationships across the UK are now widely admired around the world. Indeed, businesses and policy-makers from other countries visit the UK frequently to observe our approach and to meet organisations that lubricate, analyse and professionalise the relationship. These include the National Centre for Universities and Business (NCUB); NESTA; PraxisUNICO; and, in Scotland, Interface.

Funding streams that incentivise and reward university-business collaboration have been refined over the last 20 years or so, progressing from somewhat burdensome and over-specified competitions (such as University Challenge and Science Enterprise Challenge, around the millennium) into more sophisticated formulaic allocations designed to incentivise and reward strong relationships. These funding models – the Higher Education Innovation Fund being the largest in the UK – are often admired internationally. In England and Scotland, funding for university-business collaboration has been increased substantially and has been accompanied by persistent growth in university earnings from sources

outside the public sector research and higher education system.

That said, many challenges remain, particularly in discovering how best to support smaller firms and firms with no history of collaborating with universities. In evidence to this review, Professor Kevin Morgan has submitted a helpful explanatory note which is reproduced as Annex 4 of this report, comparing the preferences of ‘innovation aware’ firms with a wider population of businesses. Professor Morgan’s analysis gives some sense of the scale of the challenge in engaging more businesses in university collaboration.

Measuring the success of university-business collaboration is not trivial. The total level of external income is the accepted measure and good quality data is already collected UK-wide by the Higher Education Statistics Agency⁵².

I would recommend caution before departing from that measure, at least until new plans for a Knowledge Exchange Framework have had time to develop further⁵³ but the limitations of existing metrics should also be recognised. In particular, the overall income metric gives no recognition to relationships that generate little revenue for the university but are of significant value to the business. I suspect that relationships with smaller firms and businesses with no experience of collaboration would benefit if a wider range of measures could win the confidence of the business and academic communities.

In this review, I recommend the introduction of a funding incentive in Wales to encourage university-business collaboration. That approach has been a great success in Scotland and England. I have seen nothing to persuade me that Wales is different in that regard.

51 https://www.centreforsocialjustice.org.uk/core/wp-content/uploads/2017/09/CSJJ5710_Productivity_report_WEB-170918.pdf

52 <http://www.hefce.ac.uk/ke/hebci/>

53 <http://www.hefce.ac.uk/ke/KEportal/>

Evaluations of Innovation and Research Commercialisation

Countless evaluations of research and innovation initiatives have been published around the world while the relationship between businesses and universities has been subject to many studies. Dame Anne Dowling, herself the author of such a review, in which she catalogued and analysed earlier work⁵⁴, observed:

“..business-university collaboration has been an exceptionally popular target for reviews and studies in recent years.”

Such a large volume of recommendations – almost 300 between 2010 and 2015 – appeared from these reviews that the National Centre for Universities and Business produced an online tool for those wishing to search and analyse review recommendations. Frequent messages from these UK-wide reviews included:

- The need for simplification of government support for innovation and knowledge exchange.
- The need for stable, predictable support from Government rather than a continual flow of new policies and initiatives.
- Continued incentives and rewards through the English Higher Education Innovation Fund.
- The challenge of encouraging smaller firms to experiment with university collaboration for the first time (thereafter SMEs can make informed decisions about collaboration).

While there is a degree of uniformity internationally about environment in which top quality research thrives, often in universities, there is a diverse and somewhat opaque set of conditions for optimum harvesting of research impact.

- Germany is rightly admired for its [Fraunhofer Institutes](#);

- USA for [DARPA](#);
- Finland for [TEKES](#);
- Singapore for [A-Star](#);
- Scotland for its [Innovation Centres](#); and
- Innovate UK for its [Catapult Centres](#)

Each of these models has distinct characteristics, reflecting the economic disposition of Government; the sentiments of private investors; the health and scale of the research base; and the structure of the business community. We can and should learn from the experiences of these organisations but **attempts to mimic the success of other nations by replicating their research commercialisation models should be approached with caution**, since their design and management of individual initiatives are likely to reflect the wider environment in which they operate and even the most successful models cannot be ‘cut and pasted’ into other countries.

One theme, however, is visible throughout these models: a strong identity for the innovation agenda, even if beneath that identity lies a variety of operational models each of which is tailored to a specific geographic area, business sector or economic challenge. The single, clear identity simplifies the outward appearance of the work, makes it easier to promote to new audiences in the business community and fosters a sense of common purpose among the participants.

The UK has an unfortunate history of changing the names and specifications of business support initiatives, often re-inventing similar services under different titles and management teams. This leaves businesses confused and frustrated. Dame Ann Dowling illustrated vividly the complexity of business support and innovation schemes in her report.

The impact of science and research

The 2014 Research Excellence Framework

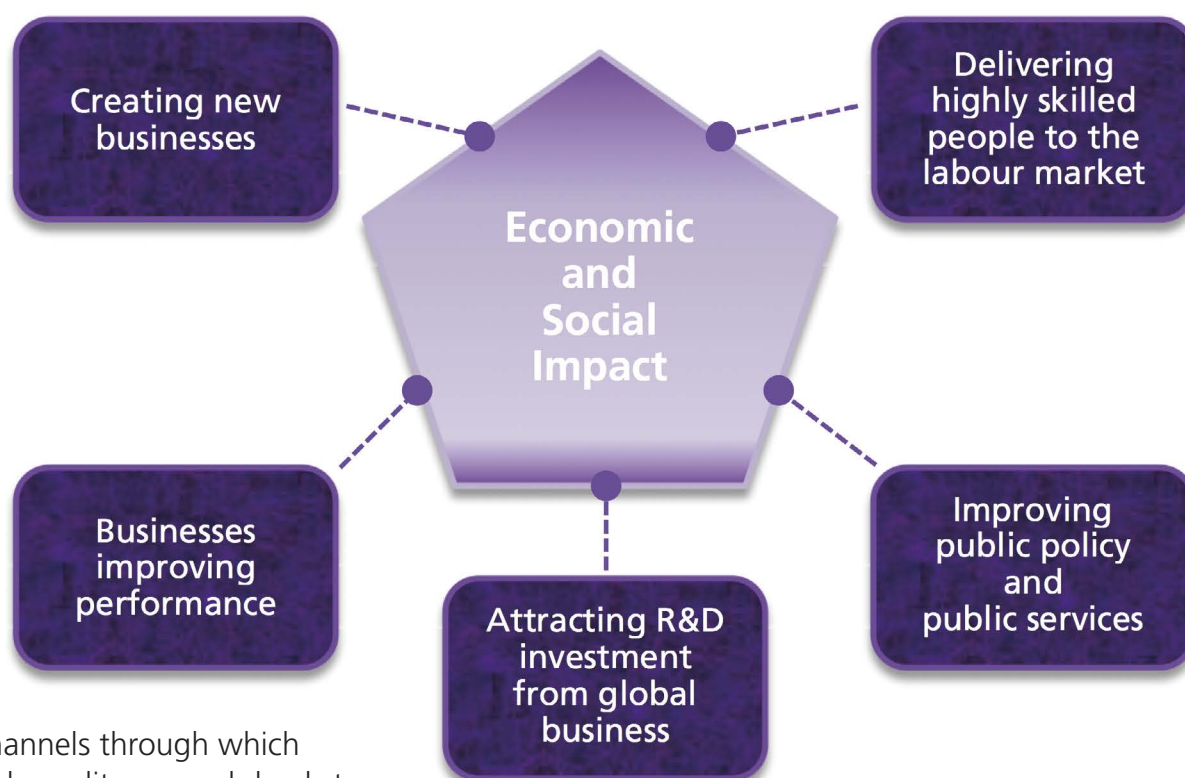
⁵⁴ <http://www.raeng.org.uk/publications/reports/the-dowling-review-of-business-university-research>

– and the QR funding that depended on it
– raised the profile of research impact in the academic community and provided a stimulus for better understanding and assessment of the impact of academic research on the economic and society. A 2017 report commissioned by the Learned Society of Wales⁵⁵ describes both the range of academic disciplines from which impacts arise and the breadth of geographic locations and types of beneficiary in Wales.

I have explored the impact of science and research more widely elsewhere and I refer readers to that document for a fuller treatment of the evidence⁵⁶.

One key point is worth bringing out here because it bears directly on the rationale for R&D investment by the Welsh Government. It is tempting to imagine that the dominant impacts of research arise in the form of patents or spin-out companies. The evidence paints a rather wider picture, illustrated in the diagram below.

Successful new businesses are indeed created by spinning out enterprises from universities. Some of these businesses are subsequently acquired by larger corporations. There is a separate debate on whether such acquisitions prevent the growth of large new indigenous firms or whether they provide fresh new injections of capital that can be reinvested in further enterprises. However that debate is resolved, major business successes from spinout companies make up a small and unpredictable part of the impact landscape. They make wonderful success stories when they occur but they are not the primary pathway to research impact. Data from the Higher Education Statistics Agency – and shown elsewhere in this review – shows that some 3-4 per cent of external income to universities comes from patents and licensing, less than one tenth of the amounts coming from consultancy and contract research.



Channels through which
high quality research leads to
economic and social impact

55 <https://www.learnedsociety.wales/wp-content/uploads/2017/06/The-impacts-of-academic-research-from-Welsh-universities.pdf>

56 http://www.ncub.co.uk/index.php?option=com_docman&task=doc_download&gid=180&Itemid

Larger, more consistent impacts come from two sources: the supply of highly skilled people to the labour market and the attraction of foreign direct investment (or investment from other parts so the UK to Wales) in R&D carried out by businesses. A 2010 study by the Royal Society⁵⁷ demonstrated that around half of PhD graduates leave universities directly after graduation and a further proportion at later career stages – taking highly valued research skills into a wide range of careers. The availability of highly skilled people, along with access to university research expertise, are major determinants of R&D locations for business investors, as shown both by the clustering of business research around research universities and by the number of business-university collaborations that now operate at a strategic level rather than through a series of smaller transactions (sponsoring a PhD student or sponsoring a single project).

To some degree, businesses in Wales will acquire scientific and research capability from academic research performed elsewhere, at the expense of Governments and other funders outside Wales. At one rather simplistic extreme, a company or product could be developed in Wales based on research in a university located elsewhere. For this to succeed, however, the business would first need to acquire the capacity to absorb research findings. This is challenging, risky and expensive – particularly at the frontiers of knowledge. A report to the Prime Minister's Council for Science and Technology (CST)⁵⁸ explored this challenge in a population of high technology SMEs and revealed the complexity of acquiring knowledge from remote sources.

Of course businesses and universities in Wales will collaborate and share knowledge across many UK-wide and international networks.

That is a healthy part of research and innovation. But it complements – rather than replaces – the attractions of collaboration and joint ventures in close proximity, such as IQE in Cardiff, the SPECIFIC initiative in Swansea, IBERS in Aberystwyth and the major emerging opportunities in nuclear engineering in the Bangor area.

The adoption of evidence into public policy

The plethora of R&D policy analyses inform public policy through direct consumption by officials and ministers; contributions to Parliamentary inquiries and contributions to policy reviews.

Policy papers, strategies and government consultations build on these analyses. The Foundation for Science and Technology conducted a recent survey of science and innovation strategies published or commissioned by the UK Government since 1945. They reveal a growing frequency of reviews and evaluations – from one in the 1940s, three in the 1960s, eleven in the decade after the millennium and six so far in the current decade. These numbers exclude reviews specific to individual business sectors and academic disciplines⁵⁹.


The main themes in these reviews are:

- a. Funding: a constant theme has been the difficulty in meeting the stated aspirations of consecutive governments to raise government spending as a percentage of GDP and to encourage UK businesses to follow suit.
- b. Commercialisation: from 1946 onwards there has been at best a mixed picture and at worst a continual struggle to take the world-class ideas created by UK scientists and innovators and convert these into patents and commercial opportunities – compared to traditional competitors and

57 https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2010/4294970126.pdf

58 https://www.cbr.cam.ac.uk/fileadmin/user_upload/centre-for-business-research/downloads/research-projects-output/barriers-to-growth.pdf

59 http://www.foundation.org.uk/Events/pdf/20171018_Summary.pdf



competition from a rising number of new countries.

- c. Skills and Higher Education: although significant effort has been expended over many decades, these issues will require constant funding, resource and commitment to remain at the current levels in an ever more technically advanced and globalized world, let alone surge ahead as a number of strategies have forecast.'

These themes persist over time. It appears that they are more difficult to address than they are to describe in policy reviews.

Annex 4 – Explanatory note from Professor Kevin Morgan

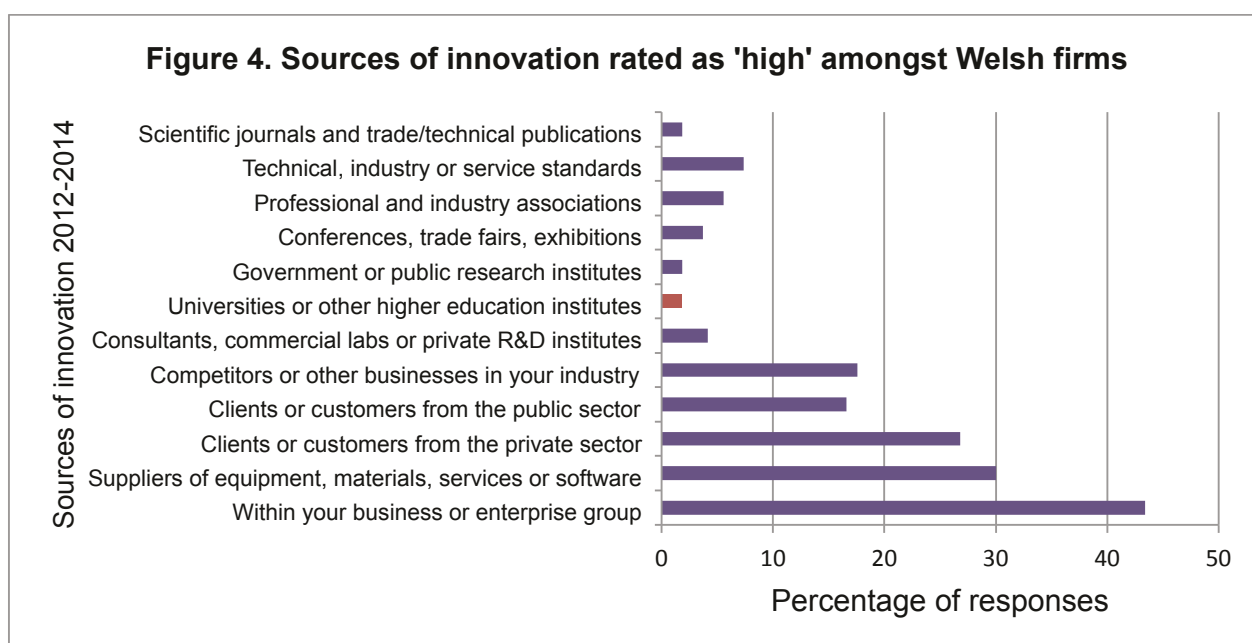
Universities as Sources of Innovation: An Explanatory Note

The NCUB report – *Growing the Value of University-Business Interactions in Wales* – was published in June 2017 and submitted as evidence to the Reid Review of Research and Innovation in Wales (Morgan et al, 2017). As the lead author I would like to take the opportunity afforded by the Reid Review to clarify a figure that appeared in the main report because it has caused a good deal of confusion in both academic and business circles. The figure (4) in question is reproduced below and it was drawn from the UK Innovation Survey, a source we explicitly acknowledged in our report.

Some people seem to have interpreted Figure 4 to mean that Welsh firms have a particularly low opinion of universities as a source of innovation. Although this may of course be true in some cases, the main point I wish to establish here is that, in surveys of this kind, universities are invariably ranked much lower than the principal sources of innovation – namely intra-firm sources, suppliers, clients or customers.

The ranking of information sources has been very consistent throughout the life of the UK Innovation Survey, with *internal* sources being the most important followed by *market* sources (such as suppliers, customers and clients etc) and *institutional* sources (such as universities and public research institutes etc) lagging way behind the commercial sources – as Table 3 from the latest UK Innovation Survey (below) illustrates.

This ranking of sources of information is an established feature of the innovation studies literature and it is widely accepted by both scholars and policy-makers in and beyond the UK. Professor Alan Hughes, one of the UK's foremost authorities on the subject, succinctly summarised the position when he said: "This is not to deny that there are some businesses or sectors for which interactions with the university sector may be relatively more important or be ranked more highly than these averages suggest. Moreover, the evidence is not to be taken to suggest that the role of universities is unimportant. Rather it is to emphasise that universities are only one part of the innovation eco-system and that many other actors have extremely important parts to play" (Hughes, 2014).



Source: UK Innovation Survey

Two important points flow from this observation. First, universities are ranked higher with firms that are *innovation aware*, as the following table from the 2016 CBI Innovation Survey demonstrates:

Table 3: Sources of information (% of all firms with some innovation activity rating “high”)*.

Per cent			
Information sources	Size of Enterprise		
	10 – 250 employees	250+ employees	All (10+ employees)
Internal			
Within the enterprise itself or within the enterprise group	46	60	47
Market			
Suppliers of equipment	23	25	23
Clients or customers from private sector	20	26	20
Clients or customers from the public sector	9	12	9
Competitors or other enterprises in your industry	13	16	13
Consultants, commercial labs or private R&D institutes	4	7	4
Institutional			
Universities or other higher education institutes	2	3	2
Government or public research institutes	2	3	2
Other sources			
Technical, industry or service standards	6	10	6
Conferences, trade fairs, exhibitions	6	5	6
Scientific journals and trade/technical publications	1	2	1
Professional and industry associations	6	7	6
* = Unweighted base = 8,735			

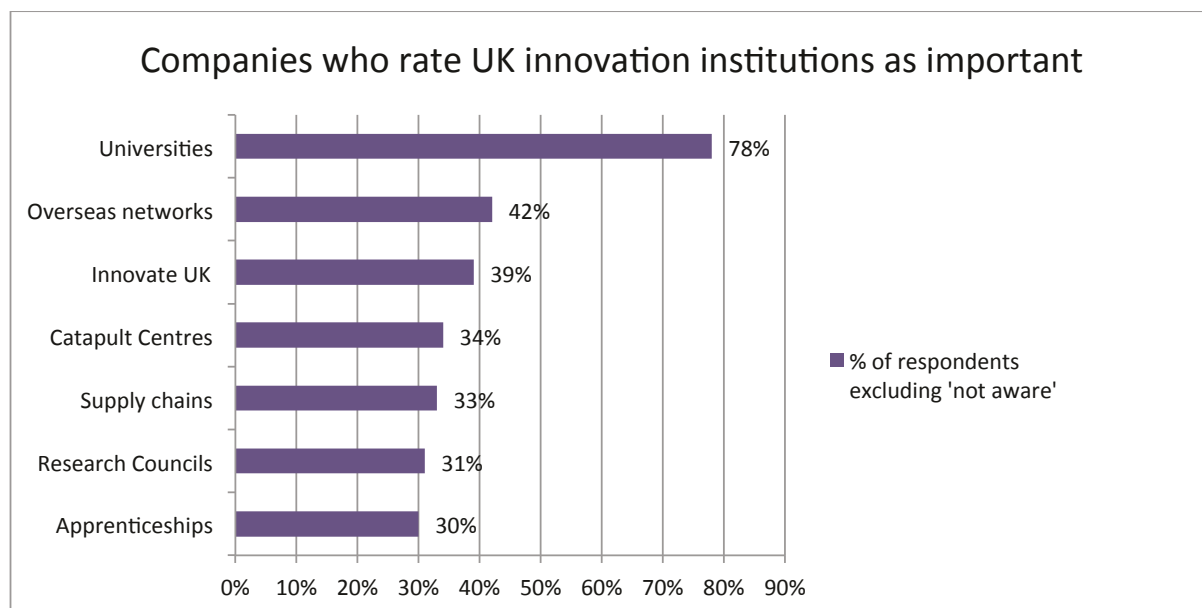


Exhibit E: Companies who rate UK innovation institutions as important (% of respondents, excluding not aware).

The second point concerns the importance of the *innovation eco-system* – one of the key themes of our NCUB report – which highlights the need for the supply-side of knowledge generation to be better aligned with the demand-side of knowledge exploitation. We argued that this will require a more strategic partnership between government, universities and business in Wales if a stronger sense of collective purpose is to be forged. We also argued that university leaders in Wales need to demonstrate a stronger commitment to knowledge exchange to ensure that businesses have a clearer appreciation of and easier access to relevant university partners. These changes would do much to elevate the status of universities as sources of innovation for the private, public and third sectors of Wales.

Hughes, A. (2014) Keeping a sense of perspective, *State of the Relationship Report 2014*, National Centre for Universities and Business, London

Morgan, K, Healy, A, Huggins, R, and Thomas, M (2017) *Growing the Value of University-Business Interactions in Wales*, National Centre for Universities and Business, London

Professor Kevin Morgan
Dean of Engagement
Cardiff University
2 October 2017



Annex 5 – Reid Review Advisory Panel Membership

Dr Wendy Ewart

Chair of Welsh Government's Sêr Cymru Independent Evaluation Panel and former Deputy Chief Executive and Chief of Strategy of the Medical Research Council

Professor Peter Halligan

Chief Executive Officer, Learned Society of Wales

Professor Karen Holford

Deputy Vice-Chancellor, Cardiff University

Dr Sarah Main

Executive Director, Campaign for Science and Engineering

Ms Alexandra Vincent

Research Councils UK and, recently, Arts and Humanities Research Council

Professor Robin Williams

former Vice-Chancellor, Swansea University and Chair of the Science Advisory Council for Wales

Mr Andrew Evans

SPTS Technologies Ltd.

Mr Colin Sirett

AMRI and formerly Airbus

The Review secretariat function was provided by Dr Robert Hoyle, Chief Scientific Adviser's Division (CSAD), Welsh Government. Further administrative support was provided by Mr Adam Wadding of the CSAD.

Annex 6 – Letter inviting submission of oral evidence

Adran yr Economi, Gwyddoniaeth a Thrafnidiaeth
Department for Economy, Science and Transport



Llywodraeth Cymru
Welsh Government

[x] April 2017

Dear ,

Re: Invitation to attend Reid Review Oral Evidence Hearing on Research and Innovation in Wales at the Temple of Peace, King Edward VII Ave., Cardiff, CF10 3AP from 00:00 – 00:00 on [x] June 2017.

I write to bring to your attention the review of research and innovation in Wales which I am undertaking on behalf of the Welsh Government. As part of this review, I am seeking oral and written evidence in response to a number of questions; I should be very grateful if you would be prepared to attend an oral evidence hearing on the date given above. Should you accept, please be prepared to answer questions similar to those given in Appendix 1 of this letter. I am asking others to appear at the hearings so you should expect to be present with three or four others. Please note that your contribution may be cited in the report and an audio recording of your session will be made available publically on publication of my report.

This Review has been commissioned for the Welsh Government by the Cabinet Secretary for Education, Kirsty Williams AM, the Cabinet Secretary for Economy and Infrastructure, Ken Skates AM, and the Minister for Skills and Science, Julie James AM. The Review was announced in the Senedd by the Cabinet Secretary for Education on 31 January 2017, building on the work undertaken as part of the Hazelkorn Review.

The findings of the review will be mine alone but I plan to draw heavily on advice and guidance from a series of oral evidence hearings conducted by my Advisory Panel, the results of which will be cited in the final report. In addition, a call for written evidence will be published separately.

This review has been commissioned to identify current research and innovation strengths in Wales and to outline how these strengths can be developed to enable them to continue to support business, communities and Government effectively in the future, not least in the context of Brexit and the potential loss of significant research and innovation funding. The Welsh Government's aim is to position Wales as a small smart nation which can achieve the scale and quality of research and innovation which compare favourably with other OECD members within 10 years.

Please could you contact Dr Robert Hoyle (robert.hoyle@wales.gsi.gov.uk) to confirm whether you are able to attend.

Yours sincerely,

Graeme Reid



BUDDSODDWR | INVESTORS
MEWN POBL | IN PEOPLE

Parc Cathays • Cathays Park
Caerdydd • Cardiff
CF10 3NQ

Ffôn • Tel 02920 826609

[Appendix 1 to the letter is reproduced as Annex 7 below.]

Annex 7 – Text of ‘Appendix 1’, referenced in the Annex 6 invitation letter

Appendix 1. Example questions used to start Oral evidence hearing discussions –a selection adapted to suit witnesses organisation or background.

1. How would you describe the strengths and weaknesses of the research base in Wales?
2. Is the number and quality of applicants from Wales for seats on Governing Councils and Advisory Committees in Research Councils at the level you would expect from a country the size of Wales?
3. There is a growing emphasis on larger collaborations, whether through the new Challenge Funds or the creation of new research institutes. What advice would you offer to Welsh Government and Welsh Universities, on how researchers in Wales could improve their competitive strengths in this new environment?
4. UK Government puts growing emphasis on ‘place’. According to its Industrial strategy green paper (page 111), Research Council investment per person in Wales is around half that in the UK as a whole. Is that pattern of concern to Research Councils?
5. If there was a single change the Welsh Government or Welsh Universities could make, to raise the level of Research Council income in Wales, what would it be?
6. What is your assessment of the impact of the research base in Wales from Research Council funding? Do research excellence and high impact come from the same research groups?
7. How does your organisation plan to take advantage of the opportunities set out in the white paper – is it going to be proactive? If so, what do they have in mind?
8. What are the implications of the White Paper for the relationship between Welsh HE funding and similar funding in other countries of the UK?
9. Whether there are new strategic goals for research and KT (knowledge transfer) within the new organisation – the new Commission?
10. If a ‘Diamond Dividend’ or a replacement from UK Government for lost WEFO funding become available, how should this be proportioned between un-hypothecated QR and what the White Paper describes as Strategy-related Research and Innovation hypothecated funding?
11. How should industry in Wales and that elsewhere in the UK relevant to Wales be encouraged to drive R&I collaborations with the HE/FE sectors?
12. What advantages and opportunities does the integrated nature of the proposed Commission (HE, FE, Apprenticeships, skills and training and industry engagement) offer, for the benefit for Wales? How should these be organised within the Commission?
13. How can future support for Government-led investment and support for research and innovation in Wales be aligned with the requirements of the Well-being of the Future Generations (Wales) Act (2015)? What link should there be between the WBFG Act requirements and the economic and industrial strategy of the Welsh and UK Governments?
14. What can be done by the Welsh Government, Welsh universities and the private sector to increase the competitiveness of the research and innovation landscape in Wales, thereby increasing the attractiveness of Wales as a place to undertake research and innovation and attract inward investment and investors from outside Wales, both

in academia and in industry?

15. What can be done by the Welsh Government, business and universities to increase research and innovation income in Wales in the light of the implications of BrExit and the increased funding announced in the 2016 Autumn Statement and UK Government's 2017 Budget, the Global Challenge Fund and other, opportunistic Government funding opportunities?
16. What is the optimum balance between (a) geographically focused use of funding and (b) focus of funding on existing research and innovation excellence and capability, bearing in mind the Cabinet Secretary for Economy and Infrastructure's new regional approach to economic development?

Appendix 1. Questions for written evidence

- a. How can future support for Government-led investment and support for research and innovation in Wales be aligned with the requirements of the Well-being of the Future Generations Act (2015)? What link should there be between the WBFG Act requirements and the economic and industrial strategy of the Welsh and UK Governments?
- b. What can be done by the Welsh Government, Welsh universities and the private sector to increase the competitiveness of the research and innovation landscape in Wales, thereby increasing the attractiveness of Wales as a place to undertake research and innovation and attract inward investment and investors from outside Wales, both in academia and in industry?
- c. What can be done by the Welsh Government, business and universities to increase research and innovation income in Wales in the light of the implications of BrExit and the increased funding announced in the 2016 Autumn

Statement and UK Government's 2017 Budget, the Global Challenge Fund and other, opportunistic Government funding opportunities?

- d. What is the optimum balance between (a) geographically focused use of funding and (b) focus of funding on existing research and innovation excellence and capability, bearing in mind the Cabinet Secretary for Economy and Infrastructure's new regional approach to economic development?


Please answer questions using no more than 500 words per question. You are welcome to provide additional prior published evidence should you feel it relevant and appropriate.

Additional Information:

Professor Graeme Reid's Review of Government funded Research and Innovation in Wales

Professor Graeme Reid (University College London and former head of research funding at the Department of Business Innovation and Skills) has been asked by the Cabinet Secretary for Economy and Infrastructure (Ken Skates AM), Cabinet Secretary for Education (Kirsty Williams AM) and Minister for Science and Skills (Julie James AM) to undertake a review of strengths, gaps and future potential to sustain and grow strong research and innovation activity in Wales. This review builds on work undertaken in recent reviews of student finance and funding by Professor Sir Ian Diamond and the review of the oversight of post-compulsory education by Professor Ellen Hazelkorn. The last of these reviews recommended a review of research and innovation strategy and policy.

Professor Graeme Reid's review will identify research and innovation strengths in Wales and outline how these assets can be used more effectively by business, communities and Government. The Welsh Government's aim is to position Wales as a small smart nation which can achieve the scale and quality of research and innovation which



compare favourably with OECD member states within 10 years.

Professor Reid's review will:-

1. Collate the results of recent analyses of research and innovation activity in Wales. This collation will be used to generate a map of research excellence and innovation strengths in Wales. Recent analyses include the results of the Research Excellence Framework in 2014, the analysis of innovation and business support arrangements in Wales completed by the REAP panel in 2016, the Science and Innovation Audits of South West England and South East Wales submitted by the GW4 network of universities in 2016, the Science and Innovation Audit for the rest of Wales led by Swansea University in 2017, the Innovation Advisory Council's recent review of innovation activity and the analysis of research impact in Wales completed by staff from Kings College London in 2017, as well as the report on research in Wales by Halligan and Bright and the Elsevier Report on Science in Wales (Halligan and Bright, 2015; Elsevier, 2016).
2. Seek to identify patterns and themes in the development of business and public services in Wales which draw on research and innovation strengths in Wales and further afield. This analysis to be undertaken with staff in the Welsh Government's economy and infrastructure department drawing on expertise and support from the office of the Chief Scientific Adviser for Wales, Innovation Division and representatives of the academic, business and public services communities at national and regional levels. This national and regional analysis will draw on work undertaken as part of the Cardiff City Deal, Swansea City Deal and North Wales local growth deal bid processes, as well as reports from the Regional Employment and Skills

Partnerships, Innovation Advisory Council for Wales, Science Advisory Council for Wales and other groups. These analyses will consider how firms, public services and research groups in universities connect locally and globally to support the needs of Welsh communities, business and the economy. It will also consider how the connections and interactions between these groups can be improved to enable Wales to become a more entrepreneurial state (Mazzucato, 2013).

3. To consider how future Government-led investment and support for research and innovation in Wales can be aligned with the requirements of the Well-Being of the Future Generations (Wales) Act (2015). The seven well-being goals are as follows:
 - a prosperous Wales;
 - a resilient Wales;
 - a healthier Wales;
 - a more equal Wales;
 - a Wales of cohesive communities;
 - a Wales of vibrant culture and thriving Welsh language; and
 - a globally responsible Wales.

To also consider the implications of BrExit for Government-funded research and innovation in Wales.

4. Work with people from the business, higher education, public service and research communities in Wales, the U.K. and further afield to consider how current activities and future plans can be aligned with the five principles of the Well-Being of Future Generations Act 2015. The five principles are as follows:
 - look to the long term;
 - focus on prevention;
 - deliver an integrated approach to achieving the 7 well-being goals;

- work in collaboration with others to find shared sustainable solutions; and
 - involve diverse populations in decisions that affect them.
5. Make recommendations for the development of a research and innovation strategy for Wales and guiding principles to inform future investment and funding decisions by the Welsh Government. These recommendations to be informed by analyses of what works in other parts of the UK and further afield as revealed by systematic studies and evaluations of science and innovation policy of the sort completed by the Manchester Institute of Innovation Research (MIOIR), National Centre for Universities and Business (NCUB), National Endowment for Science Technology and the Arts (NESTA), Organisation for Economic Cooperation and Development (OECD), Science Policy Research Unit (SPRU) and the ESRC What Works Centre for Local Economic Growth (e.g. Elder et al, 2013 and Martin, 2015) and by Professor Reid himself (Reid 2014). To also consider these proposals in the light of related recommendations for innovation, knowledge exchange and research contained in the Diamond Review Report 2016.

Professor Reid will be supported in his work by staff from the Welsh Government and by a small panel of advisors with experience in the following fields:

- research and innovation in business
- research and innovation in health and social care
- research and innovation policy and funding in an international context and
- research and innovation in universities
- research and innovation in Wales

Professor Reid's advisory panel will receive written and oral evidence over the spring and summer months to help inform the development of the report and recommendations. The panel will balance science and innovation expertise.

References:

Elder, J.; Cunningham, P.; Gok, A. and Shapira, P. (2013). Impacts of Innovation Policy: Synthesis and Conclusions, Manchester Institute of Innovation Research, University of Manchester. Available at: http://www.innovation-policy.org.uk/share/20_Impacts%20of%20Innovation%20Policy%20Synthesis%20and%20Conclusion_linked.pdf. Last accessed 17th January 2017.

Elsevier (2016). *International Comparative Performance of the Welsh Research Base 2010-2014*, 2016 update. Available at: https://www.elsevier.com/_data/assets/pdf_file/0010/221410/HEFCW-Report-final-adjustment-02112016.pdf. Last accessed 5th February 2017.

Halligan, P. and Bright, L. (2015). *The Case for Growing STEMM Research Capacity in Wales*, Stimulus Paper, Leadership Foundation for Higher Education.

Martin, B. (2015). 'Twenty Challenges for Innovation Studies,' Science Policy Research Unit, University of Sussex and Judge Business School, University of Cambridge. Available at: <https://m.sussex.ac.uk/webteam/gateway/file.php?name=2015-30-martin.pdf&site=25> Last accessed 19th January 2017.

Mazzucato, M. (2013). *The Entrepreneurial State: De-bunking Public vs Private Sector Myths*, Anthem, London.

Mazzucato, M. (2013). *The Entrepreneurial State: De-bunking Public vs Private Sector Myths*, Anthem, London.

Reid G (2014) Why should the taxpayer fund science and research?, National Centre for Universities and Business <http://www.ncub.co.uk/reports/why-science.html>

Annex 8 – Written evidence providers

- 1 PraxisUnico/AURIL Association for University Research and Industry Links, Tamsin Mann
- 2 Bangor University
- 3 Swansea University
- 4 Cardiff University
- 5 Cardiff Metropolitan University
- 6 Aberystwyth University
- 7 Compound Semiconductor Cluster Chris Young for Welsh Government
- 8 University of Wales Trinity Saint David
- 9 University of South Wales
- 10 Universities Wales
- 11 Cancer Research UK
- 12 Business Development Wales
- 13 British Academy
- 14 Royal Academy of Engineering
- 15 Tata Steel in Europe, Byron Tucker, R&D Manager, Port Talbot
- 16 AMRC, University of Sheffield, Colin Sirett, Chief Executive Officer
- 17 TWI Technology Centre Wales, Philip Wallace, Associate Director
- 18 Kellie Beirne, Deputy Chief Executive, Monmouthshire County Council & Chair of Welsh Government's Innovation Advisory Council for Wales
- 19 Andrew Middleton, Tyf Group and member of the Welsh Government's Innovation Advisory Council for Wales
- 20 South East Wales Academic Health Board
- 21 World's First Compound Semiconductor Cluster, Chris Young, Welsh Government
- 22 Dr David Owen, Life Sciences Bridging Fund
- 23 Andrew Evans, Director – Commercial Services, SPTS Technologies
- 24 Kirsten Bound, NESTA
- 25 Sir David Grant, NPL
- 26 Wrexham Glyndŵr University, Professor Richard Day
- 27 CBI Wales
- 28 The Wellcome Trust
- 29 Glyndŵr University, Prof Richard Day PVCr, DR Aulay Mackenzie, PVC Partnerships
- 30 Andy Wood, VP Technology – Optical Systems, Qioptiq Ltd
- 31 The Royal Society

Reports

- 1 Professor Kevin Morgan, GVW Report.
- 2 Learned Society of Wales, Impacts of academic research from Welsh universities: A comprehensive review of the REF 2014 impact case studies
- 3 Paul Hildreth, University College London, Bartlett School of Planning; Understanding the Mersey Dee Economy, unpublished PhD work

Annex 9 – Formal and informal oral evidence hearings

Formal hearings

Person providing evidence	Post/Position at Institution/Organisation
Wednesday 5 April 2017	
Professor Julie Williams	Chief Scientific Adviser for Wales
Dr Alastair Davies	Head of Innovation, Welsh Government
Professor Robin Williams	HEFCW Council Member & Chair of the HEFCW Research, Innovation & Engagement Committee
Alyson Thomas	Head, Research, Innovation & Engagement, HEFCW
Professor Dylan Jones-Evans	Assistant Pro Vice-Chancellor (Enterprise) & Professor of Entrepreneurship, University of South Wales
Duncan Hamer	Deputy Director, Entrepreneurship & Delivery, Welsh Government
Professor Peter Halligan	CEO, Learned Society of Wales
Wednesday 3 May 2017	
Dr Louise Bright	Director of Research & Business Engagement, University of South Wales
Professor Richard Day	Professor of Composites Engineering & Academic Leader, Mechanical, Aeronautical & Electrical Engineering, Wrexham Glyndŵr University
Iestyn Davies	CEO, ColegauCymru
Dr David Owen	Chair, Advisory Board to the Life Sciences Bridging Fund
Professor Colin Riordan	Vice-Chancellor & President, Cardiff University & Chair of Universities Wales
Professor Hilary Lappin-Scott	Senior Pro Vice-Chancellor, Swansea University
Amanda Wilkinson	Director, Universities Wales
Lisa Newbury	Deputy Director, Universities Wales
Olivia Jones	Political & Public Affairs Policy Adviser, Universities Wales
Wednesday 7 June 2017	
Philip Wallace	General Manager, TWI Technology Centre (Wales)
Rob Rolley	Technology Director, General Dynamics
Byron Tucker	Technology Centre Manager, RD&T Programme Manager Tata Steel
Dr Penny Owen	Then GE Healthcare & Interim Chair of the Life Science Hub Wales
Dan Mines	Executive at Admiral Insurance
Justin John	Business Innovation Manager, Cardiff Medicentre
Kellie Beirne	Deputy Chief Executive, Monmouthshire County Council & Chair, Innovation Advisory Council for Wales

Person providing evidence	Post/Position at Institution/Organisation
Professor Jon Bisson	Head of Health & Care Research Wales (HCRW), Welsh Government
Gareth Clancy	Assistant Deputy Director – Head of Analytical Capability ONS (Office for National Statistics)
Dr Dave Bembo	Research & Innovation Services Director, Cardiff University
Dr Garry Reed	Director of Research & Enterprise Office, Bangor University
Dr Ceri Jones	Director of Research, Engagement & Innovation, Swansea University
Kathryn David	Director of Commercial Services & WILO Group, University of Wales Trinity St David
Thursday 15 June 2017	
Paul Hildreth	The Bartlett School of Planning, University College London
Professor Sir John Savill	CEO, Medical Research Council (MRC)
Professor Duncan Wingham	CEO, Natural Environment Research Council (NERC)
Dr Paul Burrows	Executive Director of Corporate Policy & Strategy, Biology & Biological Sciences Research Council (BBSRC)
Katherine Mathieson	Chief Executive, British Science Association
Emma Greenwood	Director of Policy & Public Affairs, Cancer Research UK
Mr Simon Gillespie	Chief Executive, British Heart Foundation
Kevin Baughan	Deputy Chief Executive, Innovate UK
David Sweeney	Executive Chair (Designate), Research England
Professor Philip Nelson	CEO, Engineering & Physical Sciences Research Council (EPSRC)
Phil Sooben	Director for Policy & Resources & Deputy Chief Executive, Economic & Social Research Council (ESRC)
Wednesday 28 June 2017	
Dr David Blaney	Chief Executive, HEFCW
Bethan Owen	Director of Institutional Engagement, HEFCW
Linda Tiller	Senior Research Manager, HEFCW
Mr David Allen	Council Member, HEFCW
Professor Robin Williams	Council Member, HEFCW
Dr Colin Wyatt	Council Member, HEFCW
Professor Mark Smith	Council Member, HEFCW/Lancaster University (phone)
Wednesday 5 July 2017	
Professor Sandra Esteves	Director of Wales Centre of Excellence in AD (Anaerobic Digestion), University of South Wales
Mark Chicuta	Director of Product & Process Development, Tata Steel
Chris Morris	Technical Director, Fre-Energy Ltd.

Person providing evidence	Post/Position at Institution/Organisation
Dr Richard Matthews	Asset Engineer, Welsh Water (for Victoria Wilson, Asset Scientist)
Philip Allen	Head of Knowledge Transfer & Commercialisation, Innovation, Welsh Government
Tony Guile	SMART Cymru Senior Operation Manager, Welsh Government
Professor Helen Langton	Deputy Vice-Chancellor, University of South Wales
Professor Jenny Ames	A/Pro Vice-Chancellor–Research, University of South Wales
Thursday 16 November 2017	
Kellie Bierne	Deputy Chief Executive, Monmouthshire County Council & Chair, Innovation Advisory Council for Wales
Josh Miles	Policy Manager, Federation of Small Businesses
Duncan Hamer	Deputy Director, Entrepreneurship & Delivery, Welsh Government
Paul Matthews	Chief Executive, Monmouthshire County Council
David Wilkes	Deputy Director for Connect Portfolio, Development Group, Innovate UK
Leighton Jenkins	Assistant Director, CBI Wales
Chris Meadows	Head of Open Innovation, IQE plc
Dr Alastair Davies	Head of Innovation, Welsh Government
Michael Bacigalupo	Innovation Development, Senior Manager, Welsh Government
Tony Guile	SMART Cymru Senior Operation Manager, Welsh Government
Geraint Green	Head of Business & Innovation, Welsh European Funding Office (WEFO)
Tom Smithson	Head of Strategy, Welsh European Funding Office (WEFO)
Phil Catherwood	Senior Strategy Manager, Advanced Material & Manufacturing Sector Team, Welsh Government
Tom James	Head of Innovation & Industry Engagement, Welsh Government with NHS Wales
Ifan Evans	Deputy Director Technology & Innovation, Welsh Government with NHS Wales
Mick McGuire	Director, Business & Regions, Welsh Government

Informal hearings

Person providing evidence		Day and date
Rebecca Endean	UK Government, BEIS	Thursday 15.6.2017
Sharon Ellis	UK Government, BEIS	Thursday 15.6.2017
Dr David Blaney	HEFCW, Chief Exec.	Thursday 15.6.2017
Meeting with the Innovation Advisory Council for Wales (IACW), Kellie Beirne, Deputy Chief Executive Monmouthshire County Council & co-Chair of IACW & Mr Ian Menzies, Lead Executive & Managing Director of Northrop Grumman UK Ltd. & co-Chair of IACW.		Wednesday 9.8.2017
Meeting between SACW members who attended: Dr Wendy Ewart, Prof Chris Gaskell, Prof Hywel Thomas (for Prof Colin Riordan), Dr David Owen, Prof Tim Jones SACW member Professor Peter Halligan & SACW Chair Professor Robin Williams also attended. Discussion with HEFCW.		
Meeting with Welsh Treasury officials: Andrew Jeffreys, Jonathan Price, Dyfed Alsop	Director Chief Economist Director of the WRA Implementation Programme	Tuesday 5.9.2017
Meeting with HEFCW Officials: Dr David Blaney, Bethan Owen, Alyson Thomas, Linda Tiller	See above for positions with in HEFCW	Tuesday 5.9.2017
Meeting with Professor Kevin Morgan	Cardiff University	Tuesday 5.9.2017
Meeting with Welsh University Vice-Chancellors at UUK Conference in London		Wednesday 6.9.2017
Meeting with the Wales Pro Vice-Chancellors for Research group in London: Professor Michael Philips, Professor Hilary Lappin-Scott, Olivia Jones, Lisa Newberry, Alyson Thomas, Rick Delbridge, Professor Richard Day	University of Wales Trinity Saint David Swansea University Universities Wales Universities Wales HEFCW Cardiff University Wrexham Glyndŵr University	Tuesday 19.9.2017
Meeting with: Sir David Grant	Chair, NPL Management Ltd. Board & former Vice-Chancellor, Cardiff University, IQE & Renishaw (non-exec director of each)	Thursday 28.9.2017

Annex 10 – Schedule of visits made and other meetings

Wednesday 28.6.2017	<p>TWI, Port Talbot: Philip Wallace & Peter Oakley</p> <p>University of Wales Trinity St David, Port Talbot: Professor Mike Phillips, Pro Vice-Chancellor for Research and Innovation Professor Peter Charleton, NDT Chair Andrew Collins, Neath Port Talbot County Borough Council</p>
Tuesday 18.7.2017	<p>Swansea University: Professor Richard Davies Vice-Chancellor Professor Hilary Lappin-Scott, Senior Pro Vice-Chancellor Professor Steve Wilks, Pro Vice-Chancellor Ceri D. Jones, Director Research, Engagement & Innovation Services Team</p>
Wednesday 19.7.2017	<p>Swansea University Tour of Active Classroom & SPECIFIC: Professor Richard B. Davies Professor Hilary Lappin-Scott Professor Steve Wilks Ceri D. Jones Sharon Lusher, Pembrokeshire College Mark Jones, Gower College Professor Keith Lloyd, Swansea University Medical School Professor Ceri Phillips, College of Human & Health Science Professor Elwen Evans QC, College of Law, Professor J. Spurr, College of Arts & Humanities School of Management, Professor Marc Clement Professor Bernd Kulesa, College of Science Professor Steve Brown, College of Engineering Tour of Bay Campus facilities: led by Professor J. Sienz Professor Martin Bache, Institute of Structural Materials (Rolls Royce collaboration) Dr Charlie Dunnill, Energy Safety Research Institute</p>
Wednesday 13.9.2017	<p>Bangor University: Ashley Rogers, North Wales Business Council Sasha Davies, Horizon, Wylfa Newydd & Chair, Regional Skills Partnership. Mark Salisbury, Horizon, Wylfa Newydd, Head of Training, Operations Maggie Griffiths, Assistant Principal, Coleg Llandrillo Menai Professor John Hughes, Vice-Chancellor Professor David Shepherd, Deputy Vice-Chancellor Professor Jo Rycroft-Malone, Pro Vice-Chancellor, Research and Impact Professor Paul Spencer, Dean of College of Physical and Applied Sciences Dr Rob Elias, Director of Bio-composites Centre Dr Garry Reed, Director of Research and Enterprise Office (REO) Bryn Jones, Head of Enterprise and Innovation (REO) Frank Fitzmaurice, Executive Director of Marketing & Communications</p>

Thursday 14.9.2017	<p>Bangor University: Professor John Hughes, Vice-Chancellor Professor David Shepherd, Deputy Vice-Chancellor Professor Jo Rycroft-Malone, Pro-VC Research and Impact Professor Paul Spencer, Dean of College of Physical and Applied Sciences Professor Colin Jago, Dean of College of Natural Sciences Professor John Healey, Director of Research, College of Natural Sciences & senior staff from SEACAMS/SOS at Bangor University</p> <p>Menai Science Park, Anglesey (M-SParc): Ieuan Wyn Jones, Director, M-SParc Pryderi Ap Rhisiart, Project Manager, M-SParc Emily Roberts, Project Administrator, M-SParc</p>
Wednesday 11.10.2017	<p>Aberystwyth University: Professor Elizabeth Treasure, Vice-Chancellor Professor Chris Thomas, Pro Vice-Chancellor Professor Mike Gooding, Institute Director IBERS Professor Neil Glasser, Institute Director IGHPP Professor Qiang Shen, Institute Director IMPACS Dr Jenny Deaville, Deputy Director RB & I Dr Rhian Hayward, Chef Executive AICE</p>
Thursday 12.10.2017	<p>Professor Elizabeth Treasure, Vice-Chancellor Professor Chris Thomas, Pro Vice-Chancellor Professor Mike Gooding Institute Director IBERS Professor Neil Glasser, Institute Director IGHPP Professor Qiang Shen, Institute Director IMPACS Dr Jenny Deaville, Deputy Director RB & I Mike Shaw – Group Manager Community Regeneration and European, Ceredigion County Council Invited Eifion Evans – Chief Exec Ceredigion County Council Professor Tim Woods, Institute Director IAH Professor Reyer Zwiggelaar, Head of Graduate School Visit to Gogerddan Innovation & Enterprise Centre, Aberystwyth University</p>

Thursday 6.11.2017	<p>Cardiff University:</p> <p>Cardiff University Executive Board members:</p> <p>Professor Ruedi Allemann, Pro VC, Physical Sciences & Engineering College</p> <p>Professor Gary Baxter, Pro VC, Biomedical & Life Sciences College</p> <p>Professor George Boyne, Pro VC, Arts, Humanities & Social Sciences College</p> <p>Professor Amanda Coffey, Pro VC, Student Experience & Academic Standards</p> <p>Ms TJ Rawlinson, Director, Development & Alumni Relations</p> <p>Ms Clare Sanders, Director, Communications & Marketing</p> <p>Mr Rob Williams, Chief Finance Officer</p> <p>Deans of Research, Directors – University Research Institutes (URI), senior staff:</p> <p>Dr Dave Bembo, Director, Research & Innovation Services</p> <p>Professor Phil Bowen, Director, Energy URI</p> <p>Professor Gill Bristow, Dean of Research, Arts, Humanities & Social Sciences</p> <p>Dr Isabelle Durance, Director, Water URI</p> <p>Professor Stephen Fairhurst, Director, Data Innovation URI</p> <p>Professor Martin Innes, Director, Crime & Security URI</p> <p>Professor Derek Jones, Director, Cardiff Univ. Brain Research Imaging Centre</p> <p>Professor Kevin Morgan, University Dean for Engagement</p> <p>Professor Jim Murray, Director, European Cancer Stem Cell URI</p> <p>Professor Richard Wyn Jones, Dean for Public Affairs</p>
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Annex 11 – List of Acronyms

AHRC	The Arts and Humanities Research Council
AMRC	Advanced Manufacturing Research Centre
BA	The British Academy
BBSRC	Biology and Biological Sciences Research Council
CBI	Confederation of British Industry
CE/CEO	Chief Executive/Chief Executive Officer
CSAD	The Chief Scientific Adviser's Division, in the Welsh Government
CST	The Council for Science and Technology (The Prime Minister's)
CUBRIC	Cardiff University Brain Imaging Research Centre
EngD	Engineering Doctorate – a PhD-level Research & Taught Degree
EPSRC	Engineering and Physical Sciences Research Council
ESRC	Economic and Social Research Council
FCO	The UK Government's Foreign & Commonwealth Office
FE	Further Education
FSB	The Federation of Small Businesses
GDP	Gross Domestic Product
GW4	'Great Western Four' – alliance of Bath, Bristol, Cardiff & Exeter Universities
HCRW	Health and Care Research Wales
HEBCIS	Higher Education Business and Community Interaction Survey
HEIs	Higher Education Institutions
HEIF	Higher Education Innovation Funding (operated in England by HEFCE)
HEFCE	Higher Education Funding Council for England
HEFCW	Higher Education Funding Council for Wales
HESA	Higher Education Statistics Agency
HVM	high value manufacturing
IACW	The Innovation Advisory Council for Wales
IBERS	Aberystwyth University's Institute of Biological, Environmental & Rural Sciences
IKC	Innovation and Knowledge Centre
JV	Joint Venture
KE	knowledge exchange
KPIs	key performance indicators
LSW	Learned Society of Wales
MNE	multi-national enterprise
MRC	The Medical Research Council



NCUB	The National Centre for Universities and Business (HQ in London)
NDT	non-destructive testing
NERC	Natural Environment Research Council
NIHCR	National Institute for Health Care Reform
OECD	Organisation for Economic Cooperation and Development
ONS	Office for National Statistics
PCET	post-compulsory education and training
QR	'Quality research'
R&I	Research and innovation
REF	Research Excellence Framework (2014)
RAEng	The Royal Academy of Engineering
SACW	The Science Advisory Council for Wales
SBRI	Small Business Research Initiatives
SEWAHSP	South East Wales Academic Health Science Partnership
SFC	Scottish Funding Council (HE & FE)
SME	small and medium-sized enterprises
STFC	Science and Technology Facilities Council
TERCW	The proposed Tertiary Education and Research Commission Wales
TRL(s)	Technology Readiness Level(s)
UCL	University College London
UKRI	United Kingdom Research and Innovation
USP	unique selling point(s)
UW	Universities Wales
WBFG Act	The Wellbeing of Future Generations (Wales) Act 2015
WCPC	The Welsh Centre for Printing and Coating, at Swansea University
WEFO	Wales European Funding Office
WG	Welsh Government
WRILO	The proposed Welsh Research and Innovation Office, London

